WORKING LANDS

Managing Forests for Trees and Birds in Connecticut

A Guide to Habitat Assessments and Silvicultural Practices

Audubon | CONNECTICUT

Contents

Introduction and Purpose

Connecticut has more than 1.8 million acres of forested land (Butler, 2016), and about 73% of that land is privately owned (Tyrell, 2015). Private landowners are positioned to be significant contributors to creating and maintaining habitat for forest birds and other wildlife.

In the face of ongoing development and suburbanization in Connecticut, our existing forest resources are increasingly valuable. Thoughtfully managed, they can benefit landowners, sustain birds and other wildlife that are at risk of decline, help buffer our state against the effects of climate change, and provide additional critical ecosystem services.

This manual presents basic principles to evaluate forests with bird habitat in mind and ways to use silviculture to manage for bird habitat. Here, silviculture is considered as a way to produce birds as well as timber.

Healthier forests and more abundant birds are not the only results of doing silviculture with birds in mind. Birds can also be indicators of overall ecosystem health (Niemi and McDonald 2004), diversity, and productivity, so managing for birds can have far broader benefits.

FOREST STRUCTURE AND BIRD DIVERSITY

As the composition and structure of a forest change over time, there are corresponding changes in the wildlife that it supports. Connecticut's forests are skewed toward older trees; only a small percentage of our forests is less than 30 years old. This is why young forest specialists, such as Chestnut-sided Warbler and Ruffed Grouse, have declined in range and abundance.

Because of this trend, one approach to increasing the diversity and abundance of some forest birds in CT is to re-create young forest habitat. However, it isn't the only option. A landowner's management goals, the property size, and the conditions and uses of surrounding properties may point toward other beneficial ways to steward a mature forest. Simply increasing understory and midstory structure can benefit mature-forest species that are declining, such as Wood Thrush and Veery. Rather than dictating one approach, this manual helps you to make informed choices by showing which bird species are likely to benefit from various silvicultural measures.

CONNECTICUT FOREST BIRDS

Over 175 species of birds breed in Connecticut every year. Identifying all of them by sight and sound is a daunting task, even for expert birders. A simpler starting point for those interested in managing forests with birds in mind is Audubon Connecticut's *Pocket Guide to Connecticut's Forest Birds*: a selection of the 40 forest songbirds that Audubon Connecticut identifies as high priorities for protection. These species were selected because they:

- Are relatively simple to identify by sight and/or sound.
- Collectively use a wide range of forest types and conditions for feeding and breeding.
- Are likely to respond positively to some common silvicultural practices.
- Are likely to occur with other bird and wildlife species that use similar habitat. Managing for Focal Birds can provide broader benefits.

The *Pocket Guide to Connecticut's Forest Birds*
A Pocket Guide with Identification tips and ecological information for focal species of Connecticut's forests is available. It is a quick-reference, full-color look at each of the Focal Birds. It is an essential companion document to this guide.
https://ct.audubon.org/forest-for-birds

Evaluating a Project

Creating a stewardship plan with birds in mind is similar to a typical forest management plan, but there is additional emphasis and intent given to maintaining or enhancing habitat features that support species needing conservation. It considers habitat at two scales, going from the largest to the smallest:

1. The landscape surrounding the parcel
2. The stand level characteristics

After evaluating the current habitat conditions, work with the landowner to prioritize management activities based on timber and bird habitat objectives, and incorporate Bird-friendly Best Management Practices (BBMPs) during implementation (see page 20 for more details).

1. EVALUATE LANDSCAPE CONDITION FOR BIRDS

A full explanation of landscape effects on habitat quality is beyond the scope of this document, but general concepts are presented here.

On the landscape scale, a wide variety of CT priority birds will be supported by a diversity of forest ages and tree species, with some young forest, some forest maturing to old forest, large blocks of interior forest, and wetland complexes, riparian areas and other water features. The surrounding landscape you actually encounter may differ considerably from this ideal.

In the area where you are working, consider landscape *composition* (the proportion of different land uses, forest ages, and species composition) as well as *configuration* (size, shape, arrangement, and relative positions of the land uses, forest ages, and species compositions). These factors can influence habitat quality within the stand or property, so they deserve attention even though they may be hard to address through stand-level management. As just one example, an open area adjacent to a stand may expose nesting forest birds to intrusion and nest parasitism by Brown-headed Cowbirds.

One helpful way to think about landscape from a bird perspective is to consider an area of approximately 2,500 acres. This is about the area of a circle with an approximately 1.1 mile radius.

REPRESENTATION OF FOREST AGE CLASSES

As noted earlier, much of Connecticut's forest lacks early successional habitat. There are potential benefits to creating early successional habitat in both small (<2.5-5 ac) and large (>5 ac) patches, depending on the target bird species being managed and the landscape context. Maintaining up to 10% of the forested landscape in early successional stages has been suggested for maximizing wildlife diversity (Litvaitis, 2006). However, since wildlife diversity is only one objective for forest management (though a valuable one), that percentage is not necessarily an appropriate goal for all management plans.

AMOUNT OF FOREST COVER AND LARGE BLOCKS

Large (>1,000 acres) blocks of contiguous (i.e., unfragmented) forest provide the highest quality habitat for interior-nesting birds. These birds (for example, the Cerulean Warbler) reproduce more successfully away from edges and development. Some of these species even avoid forests where all the available habitat is within 330 feet of the edge (Rosenberg et al. 2003).

Generally speaking, the bigger the forest block the better. However, the minimum size forest block needed to provide high-quality habitat depends on the species and the total amount of forest cover in the landscape. For example, if the larger landscape is heavily forested (>70% cover), Wood Thrush can thrive in medium-sized blocks (~200 acres). In landscapes with little forest (40% cover), Wood Thrush need forest blocks of more than 350 acres for good nesting success. Other Focal Birds sensitive to forest block size include Black-throated Blue Warbler and Black-throated Green Warbler.

PROXIMITY OF BLOCKS AND SURROUNDING LAND USE

The distance between blocks matters too, especially in a fragmented landscape. A forest bird's reproductive success is often higher in a block located close to other forest blocks. Dispersal of birds (including young ones) among closely spaced blocks may be easier, so that

individuals from a growing population in one block are able to move to a nearby block. Birds in smaller, more isolated blocks have less opportunity for their populations to mix and augment each other over time, and their populations can be at higher risk of decline or disappearance.

Note that the definition of "close" block varies by species. The rather sedentary Ruffed Grouse may only move a maximum of 3 miles to appropriate habitat (Small and Rusch 1989), whereas adults of highly mobile migratory species can disperse tens of miles between habitat patches (Tittler et al. 2009).

Finally, land uses between blocks may affect the movements of birds in the landscape. A bird may readily move through a residential area with scattered trees, while a large treeless expanse may offer little cover and deter the bird from moving across it.

2. ANALYZE STAND LEVEL CONDITIONS

Moving inward from the surrounding landscape, the next thing to consider is the structural complexity and habitat conditions within a stand. A bird's ability to survive and reproduce successfully depends on specific features such as nest sites, food and foraging substrates, singing perches, and cover from predators.

The presence of a particular species does not necessarily indicate high-quality habitat. It may be possible to improve its habitat quality, and therefore the probability that it will survive and raise a brood, by managing the stand to encourage desirable structural features.

Of course, not all bird species require the same habitat conditions, and it is impossible to manage for all species in the same space. The Focal Birds list is intended to help in that regard. Making management decisions based on a Focal Bird species and its habitat type is also likely to benefit other species that have similar, though not identical, requirements.

For birds that use mature forest habitat, the following attributes are important to keep in mind. (Special considerations for young forest habitats are discussed on page 11.)

FOREST EDGE

Forest "edge" occurs when there is an abrupt change from forest to non-forest. Edge effects, such as predation from raccoons, cats, and skunks and nest parasitism from Brown-headed Cowbirds, threaten the survival and reproductive success of forest interior breeding birds and are more pronounced in landscapes where forest fragmentation is high and where remaining forest patches are relatively small and adjacent to agricultural operations or developed areas (Robinson et al. 1995, Donovan et al. 1997, Hartley and Hunter 1998, Driscoll and Donovan 2004).

Within more fragmented landscapes, edge effects have been observed more than 300 feet from the forest edge (Brittingham and Temple 1983, Rosenberg et al. 1999, Austen et al. 2001, Dunford and Freemark 2004, Driscoll et al. 2005, Nol et al. 2005, Environment Canada 2013).

Choosing an appropriate silvicultural treatment to create young forest conditions will depend on the size of the forest block. Even-aged management within smaller forest blocks may temporarily increase edge effects and limit the amount of quality interior forest habitat. Softening or feathering "hard" forest edges to reduce an abrupt transition from forest to another cover type can also help reduce negative impacts to forest interior birds (Rosenberg et al. 1999, Rosenberg et al. 2003, DeGraaf et al. 2006).

CANOPY COMPOSITION

For the purposes of forest bird habitat, a "mature forest" is composed of trees that are over 30 ft. tall, and has a generally closed canopy (>80%) with relatively small gap openings throughout. This favors mature forest species such as Scarlet Tanager, and Black-throated Green Warbler; also tree species composition will affect which birds are likely to be present.

When creating gaps with a low-intensity harvest, the diameter of the gap should not be more than twice the canopy height. For reference, a circle with a diameter of 120 feet — twice a 60-foot canopy-– has an area of ¼ acre. These openings mimic small natural disturbances and create opportunities for regenerating intermediate- and shade-tolerant tree species. Canopy gaps can be larger – from ¼ to ¾ of an acre – when conducting a moderate-intensity harvest.

Regeneration in these openings provides nesting and foraging habitat for birds such as Black-throated Blue Warbler, Wood Thrush, and Veery. The distribution of these openings may vary, but mature forest conditions (i.e., generally closed canopy and height over 30 feet) should predominate, if the primary bird management objective is the species that nest in mature forest.

Midstory Vegetation

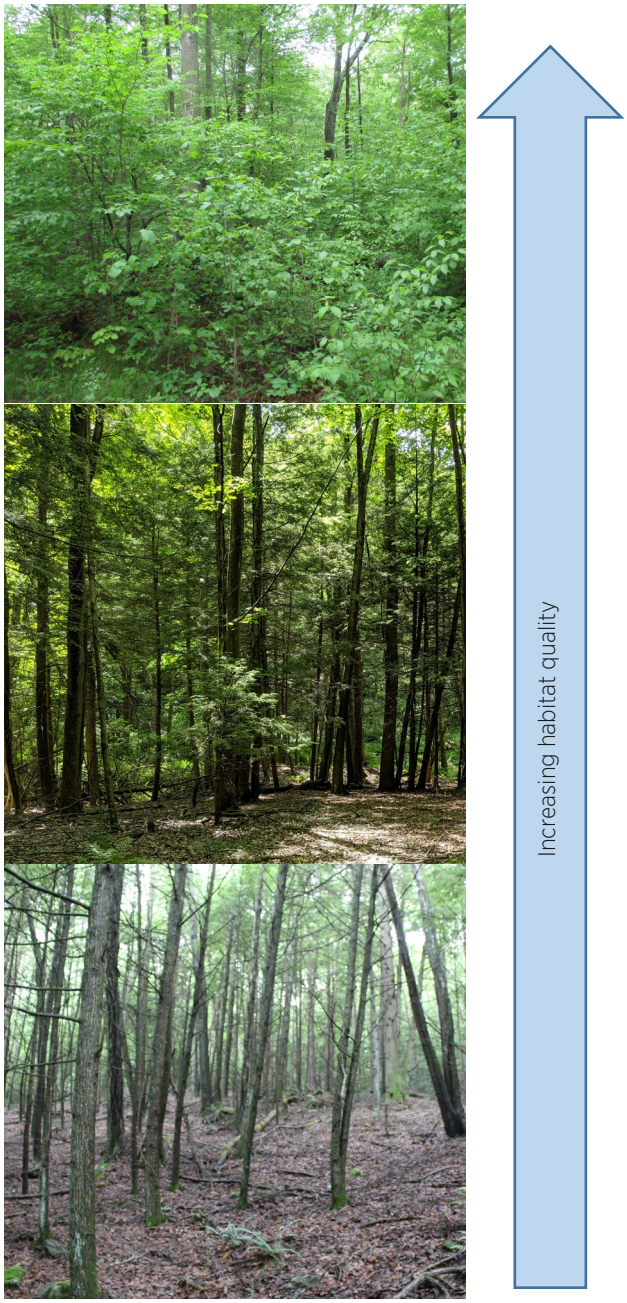
Defined as woody vegetation with live foliage 5-30 feet high, this layer includes understory trees such as striped maple and hophornbeam, young or suppressed canopy tree species, and taller shrubs such as witch hazel and mountain laurel.

FUNCTION FOR FOREST BIRDS

High stem and foliage densities of woody plants in this forest layer provide potential nest sites, foraging substrates, and protective cover. Stand-wide coverage is desirable but not necessary; well distributed patches are sufficient. The majority of Focal Bird species nest and/or forage within the 1-30 ft. layer of the forest. Nests of Wood Thrush, American Redstart, Black-throated Green Warbler, and Red-eyed Vireo are most commonly found in the midstory level.

INVENTORY INTEGRATION TIPS

When evaluating regeneration at a plot, simultaneously evaluate density of all vegetation in the midstory layer – whether shrubs, commercial species, or non-commercial species.
Note whether distribution is even or patchy at and between plots.
When inventorying during leaf-off, evaluate foliar density by trying to visualize what it would look like during leaf-on when nesting occurs.
Many bird species benefit from denser vegetation in this layer, but others prefer an open midstory.



References: DeGraaf and Yamasaki 2001, Hoover and Brittingham 1998, James 1998, Morse and Poole 2005, Sallabanks 1998

Understory Vegetation

DEFINITION

For bird habitat purposes, understory is defined as live vegetation 0-5 feet high, including tree seedlings and saplings, shrubs, and herbaceous vegetation.

FUNCTION FOR FOREST BIRDS

High stem and foliage densities of woody plants in this forest layer provide potential nest sites, foraging substrates, and protective cover. Standwide coverage is desirable but not necessary; well distributed patches are sufficient. Herbaceous plants may also be used by songbirds for foraging and nesting, but generally less so than woody plants. Species in this layer frequently used by birds include tree seedlings and saplings, mountain laurel, Rubus spp., blueberry, huckleberry, sweet pepperbush, and spicebush. Some of these understory plants can provide additional benefits of nectar and soft mast production which are critical sources of food (directly or indirectly) for birds.

Black-throated Blue Warbler and Wood Thrush place nests in this layer, and Ovenbird and Veery tend to nest on or near the ground, concealed by dense understory growth. The best breeding habitats for American Woodcock, Chestnut-sided Warbler, and Blue-winged Warbler are patches of dense, low growth with <30% overstory cover in patches >1 acre in size (early-successional habitat conditions).

In many forests across the state, understory is thin or lacking, and enhancing this cover is often beneficial. Well-distributed patches of understory vegetation covering 50%-80% of the stand is desirable. Care should be taken to not disturb existing areas of dense understory, especially near wetlands including small wooded swamps or streams.

INVENTORY INTEGRATION TIPS

When evaluating commercial regeneration at a plot, also look at the density of all vegetation in the understory layer – whether shrubs, commercial tree species, or non-commercial species.
Note whether distribution is even or patchy at and between plots.
When inventorying during leaf-off, evaluate foliar density by trying to visualize what it would look like during leaf-on when nesting occurs.

Coarse and Fine Woody Material

DEFINITION

Coarse woody material (CWM) is defined as downed logs and branches ≥5 inches diameter at the tip, and >5 feet long. Fine woody material (FWM) is composed of limbs, twigs, and branches <4 inches diameter. Blowdowns and slash are the most common sources of CWM and FWM.

FUNCTION FOR FOREST BIRDS

CWM provides cover and perch sites for singing (e.g. by Ovenbird) and other male courtship displays, and provides habitat for the insects and other arthropods that are a significant part of the breeding season diet of many birds. Ruffed Grouse tend to use CWM >8 in. diameter as drumming perches.

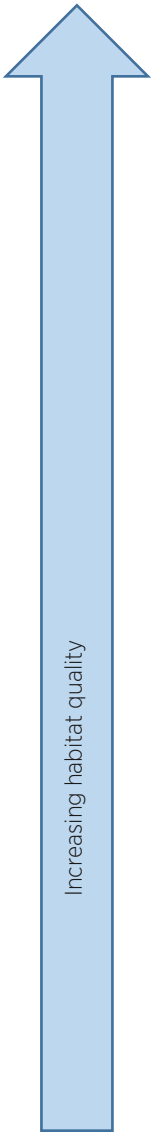
Maintain a minimum of at least 2 cords CWM per acre, and up to 10-12 cord/acre. This value has been estimated as a minimum 4-5 trees > 14" DBH per acre, and up to 20-25 trees > 14" DBH per acre. When possible, leave large cull logs that will remain for long periods of time. Individual pieces of FWM have limited value, but when FWM is aggregated into piles (e.g., slash piles), it can offer perches, nesting substrate, and protective cover for birds like Ovenbird, Winter Wren, and Veery.

Soft CWM is used as a feeding site by many forest birds, amphibians, and reptiles, as it creates a moist microclimate for amphibians, insects and other small invertebrates.

INVENTORY INTEGRATION TIPS

Note relative amounts, locations, and decay stage of CWM. Less decayed pieces provide better nesting habitat function than soft material.

Note if fine woody material is scattered or aggregated.



Snags and Cavity Trees

DEFINITION

Snags are standing dead or partially dead trees that are relatively stable. Cavity trees may be alive or dead.

Pileated Woodpecker
Roger Williams/Audubon Photography Awards

FUNCTION FOR FOREST BIRDS

Snags provide opportunities for nest cavity excavation by birds such as Yellow-bellied Sapsucker and Northern Flicker, which may be re-used in subsequent years by Eastern Screech-Owl and other birds and wildlife. As with CWM, the dead wood creates abundant forage for bole-feeding birds such as woodpeckers and nuthatches. Branches on snags may be used as foraging perches and nest sites.

Retain all snags when possible, but do not leave standing snags where they are a hazard along trails or other places where people walk. Strive for a minimum of 5 per acre greater than 10 inches diameter. Consider creating snags by girdling if there are particularly few. This should only be done in areas where doing so is unlikely to create safety risks for people walking or working.

Cavity trees may be alive or dead. Suggested targets for cavity trees are 1 tree >18 inches DBH per acre, and 3 trees >12 inch DBH. Managers should strive for a relatively even distribution of snags and cavity trees, as most cavity users are territorial, and clustering snags will result in fewer individuals using the nest holes. Aspen, paper birch, and red maple make particularly good live cavity trees, as they are frequently chosen for cavity excavation, possibly due to their soft wood and vulnerability to various heart-decay fungi.

INVENTORY INTEGRATION TIPS

Include snags and cavity trees in tally at plot. Indicate whether trees are dead or alive and whether cavities are present.

Qualitatively assess snag and cavity tree abundance between plots: low (overall low abundance of any snags or cavity trees), moderate (snags and cavity trees present, but of small diameter(s) or minimal abundance of snags and cavity trees of target diameters), and high (abundance of target diameter snags and cavity trees). Make special note of aspen and birch snags and cavity trees.

DECIDUOUS LEAF LITTER

An abundant layer of moist leaf litter is home to an array of insects, mites, and spiders. These arthropods make up a significant component of Ovenbird, Veery, and Wood Thrush diets during the breeding season. Ovenbirds also rely upon a deep layer of deciduous litter for constructing their ground nests, and nest site selection is strongly associated with this habitat variable. For these reasons, the period from early May-late July is the best time to assess litter conditions.

Ovenbird Nest
Ken Elkins

LARGE DIAMETER TREES

Large-diameter cavity trees are critical for larger cavity nesting species including Barred Owls and Pileated Woodpeckers. Some large-diameter (24+" DBH) trees should be present in the forest. Some of these may be financially mature acceptable growing stock (AGS), and others may be senescent or declining unacceptable growing stock (UGS) that may be retained as legacy and wildlife trees. Structurally-sound, large-diameter trees are important stick nest sites for woodland raptors, such as Broad-winged Hawk and Northern Goshawk. Some Focal Bird species, including Cerulean Warbler also prefer larger diameter trees for nesting.

NATIVE SPECIES DIVERSITY

Plant species composition should reflect the range of species that are part of the natural community type. Native species diversity is important for regeneration, overall forest health and resiliency, and for forest birds that tend to select specific vegetation types for foraging or nesting. For example, yellow birch provides preferential foraging substrates for many insect-eating bird species including Blackburnian Warbler, Black-throated Green Warbler, and Scarlet Tanager (Holmes and Robinson 1981).

SOFTWOOD INCLUSIONS

Retain softwood inclusions in hardwood stands to provide increased structural complexity and species diversity, as well as varied foraging and nesting opportunities. Such components are particularly beneficial for species such as the Black-throated Green Warbler, Blackburnian Warbler, and Pine Warbler.

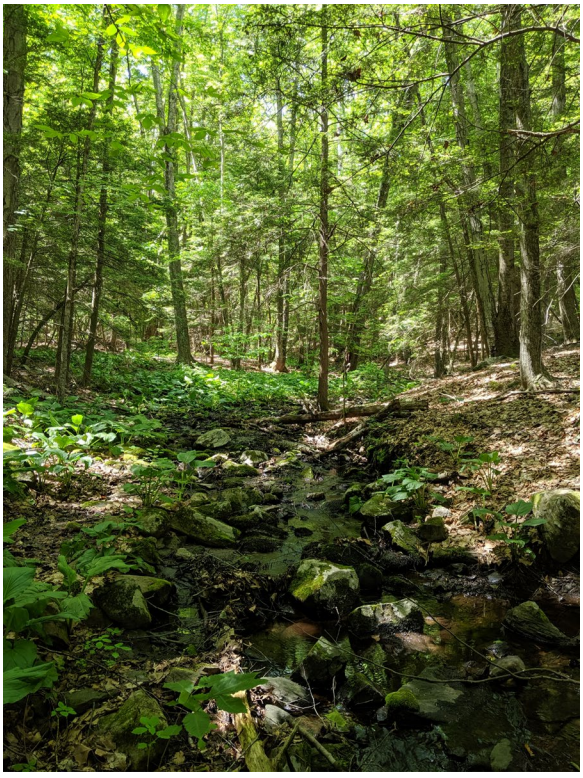
WATER AND WETLAND FEATURES

Streams, ponds, and wetlands add to the diversity of habitats available for forest birds. For example:

- Rock- or gravel-bottomed streams within a forest matrix may support Louisiana Waterthrush, a warbler that nests in cavities under steep streamside banks or in upturned roots of a fallen tree over or near water.

- Forested wetland communities such as red maple, Atlantic white-cedar, and hemlock- hardwood swamps provide breeding habitat important to Canada Warbler. These forests tend to have a low canopy height and an abundance of ground cover — primarily herbaceous species and shrubs. They also have structurally complex and uneven forest floors with hummocks, rootballs, and downed woody material that provide concealment for nests and young.

- Shrub-dominated wetlands provide habitat for American Woodcock and Willow Flycatcher.



SPECIAL CONSIDERATIONS

YOUNG FOREST OBLIGATE SPECIES

Creating a young forest patch on the landscape is one of the most beneficial actions a forester or a landowner can accomplish for wildlife. Young, regenerating forests are critical for a suite of birds that exclusively use early successional habitat for breeding and foraging. Many of these species have experienced severe population declines, largely due to loss of habitat (*Schlossberg and King 2007).* Additionally, some species that breed in mature forest, such as Black-and-white Warbler and Wood Thrush, move into these areas after the breeding period, but before migrating south (*Anders et al. 1998, Marshall et al. 2003, Vitz and Rodewald 2006).* Finally, early successional habitat is used by many other types of wildlife, including some mammals, reptiles, and pollinator species.

A reasonable goal in managing for wildlife diversity in the Northeast is to have about 10% of the forest in a landscape in an early successional stage at any point of time (DeGraaf et al. 1992). If early successional habitat is lacking in the surrounding landscape, and you would not be disrupting highly valuable or rare habitat of another type, you might consider creating young forest. It does not need to be a clearcut; many of the benefits just noted can follow from a low-density shelterwood cut that meets the definition of young forest below.

For the purposes of bird habitat, a young forest is an area of at least 2.5 acres with dense, low growing (less than 30 feet tall) regenerating forest, and an open canopy (<30% cover). These young forest habitats are ephemeral, benefiting some bird species for a small window of time as forest succession proceeds for about 15-20 years (Table 1).

YOUNG FOREST PATCHES OF ALL SIZES are likely to benefit birds in Connecticut, from small 2.5 acre openings distributed throughout a forested matrix, to large openings in excess of 25 acres (Litvaitis 2006, Askins et al. 2007, Schlossberg and King 2008, Shake et al. 2012).
Staggering the creation of adjacent patches of young forest over time prolongs the existence of this habitat type. Alternatively, where feasible, young forest conditions can be maintained by repeated cutting of the same stand.

PATCH SHAPE. Birds that use young forest for their habitat needs are often sensitive to edge. Create square or circular patches of young forest rather than rectangular or irregularly shaped patches to reduce the amount of edge. Both early successional and mature forest birds (during the post-breeding period) have been found to prefer interior young forest habitat (≥ 164 feet from the edge) compared to edge habitat (Rodewald and Vitz 2005, Vitz and Rodewald 2006, Schlossberg and King 2008, Shake et al. 2011*).*

The previously mentioned concepts of soft mast, coarse and fine woody material, snags and cavity trees, and invasive plant species apply to both mature and young forest habitats.

SOFT EDGES between mature and young forest openings are also better than abrupt hard edges. Soft edges provide a buffer against predators and Brown-headed Cowbirds entering deeply into the forest, and obscure their view of nesting birds (Hagenbuch et al. 2012*).*

CATERPILLARS are a vitally important food source for forest birds—a fact that can be overlooked in choosing tree species composition. As sources of caterpillars, oaks rank highest. When possible, removing oaks for timber should be tempered by considering their food value to birds. Cherry, willow, and birch species also rank high as caterpillar sources and should be favored. Other good caterpillar sources include blueberry, maple, pine, and hickory. (Tallamy, 2007)

OAK REGENERATION Another factor to consider is oak regeneration. Because oaks are relatively shade intolerant, successful regeneration requires a lot of sunlight. As an additional benefit, this kind of treatment frequently creates good young forest habitat conditions for birds and other wildlife.

Table 1. Number of years after clearcutting an eastern deciduous forest that breeding, early successional birds first appear, become common, and then decline.

SPECIES	FIRST APPEAR	BECOME COMMON	DECLINE
Ruffed Grouse	10	15	20
Veery	3	10	20
Northern Flicker	1	1	7-10
Chestnut-sided Warbler	2	4	10
Black-and-white Warbler	3	10	*
Canada Warbler	5	15	*
Willow Flycatcher	1	2	5-7
Rose-breasted Grosbeak	3	15	*
Common Yellowthroat	2	6	10

It is assumed that some residual stems (snags and live trees) remain
*Present until next cutting cycle
Excerpt of table from DeGraaf and Yamasaki 2003

ADVERSE IMPACTS OF DEER

Many regions in Connecticut have high deer populations, which can have significant adverse ecological impacts. Large numbers of deer can overbrowse a forest interior, affecting the abundance, species composition, and density of understory vegetation and regenerating canopy trees. This is especially true where dense understories are made up of exotic invasives and/or some native species such as ferns, sweet pepperbush, and sometimes mountain laurel that limit desirable regeneration. In turn, this can negatively affect the abundance and diversity of birds that nest and forage below the canopy (McShea and Rappole 2000, DeCalestra 1994).

While deer density is particularly high in southern Connecticut, it can be a problem throughout the state. Writing a management plan with a bird habitat component provides an opportunity to speak with landowners about the importance of managing deer populations on their forestland, in order to benefit forest birds. Mitigation of deer browse can be achieved through installation of deer fencing or leaving an abundance of coarse woody material and slash to protect seedlings from deer browse.

MOVING FORWARD

Once you have evaluated a property, ask yourself the following questions before making your management decisions:

- What are the bird habitat strengths and deficiencies across the landscape and property?
- What birds are presently benefiting? What birds could or should be here?
- Is there unique habitat on the property? In the landscape? A stark lack of certain habitat, such as young, early successional forest, old forest or a softwood component?
- Are there opportunities to leverage existing quality habitat to improve nearby deficiencies?
- Are there timber management priorities that can be used to leverage habitat creation, or that can be adjusted to maintain habitat elements?

These and other questions can help identify areas of important habitat, prioritize stands for treatment, or help justify a complex management decision. Decisions often involve balancing habitat goals with timber and/or other objectives.

MAKING MANAGEMENT DECISIONS

Every silvicultural application will have its pros and cons for a given bird or suite of birds. For practical purposes, the effects of management can be generalized into the following four categories of harvest intensity. Each one typically creates forest conditions that can benefit different groups of birds. You may use these categories to select a harvest intensity to create specific habitat, or use them to identify habitat attributes likely to result from a proposed harvest.

MANAGEMENT OPTION 1

Let It Grow

"Let It Grow" can sometimes be the best option to promote bird habitat, when supported by current stand conditions, appropriate landscape context, and a landowner's objectives. Closed-canopy stands with well-developed midstory and understory layers may already be providing quality forest bird habitat. These conditions can be found in old forests or may be the result of past management practices. In these cases, suitable habitat conditions may continue without a harvest. Letting it grow shouldn't, however, mean "do nothing." In the absence of timber harvests, there are many less intensive management activities that can serve to maintain or enhance the habitat quality currently provided by the stand, such as:

- Controlling invasive plant populations
- Regular monitoring of habitat quality
- Creating snags and future cavity trees throughout stands by girdling
- Increasing coarse and fine woody material on the forest floor
- Supplemental planting of mast-producing shrubs and/or softwood trees where appropriate
- Identifying and retaining legacy or wolf trees (e.g., trees with especially large size, cavities, shaggy bark, etc.)

Snags are especially valuable to birds as foraging sites and potential nest cavity sites.

MANAGEMENT OPTION 2

Low-Intensity Harvest

A low-intensity harvest maintains a closed-canopied forest (>80%) while enhancing timber quality of existing stems. Understory and midstory layers may also be enhanced, favoring shade-tolerant tree species and understory plants. These types of harvests are meant to mimic small natural disturbances, like wind-throw or ice storm damage, which create small scattered gaps in the canopy and increase growing space for residual crowns. Natural events would create snags and downed woody material, so these may be appropriate considerations during harvest as well.

The decision to conduct a low-intensity harvest may represent a balance between managing for timber and mature forest habitat. Periodic harvests may occur while maintaining and gradually enhancing habitat. These types of treatments favor birds that need mature, closed-canopied forests for breeding, such as Black-throated Green Warbler Eastern Wood-Pewee and Wood Thrush. Other important elements to consider are understory and midstory layers, snags, woody material, and the softwood component.

ENSURING FUTURE FOOD FOR BIRDS

Oaks support a huge number and variety of caterpillars, and provide essential high-quality food for nestling and fledgling birds. Oak forests tend to support more abundant and diverse bird populations than forests dominated by other trees. Low-intensity harvest should avoid removing too many of the bigger old oaks to make room for smaller trees that are not oaks. This can degrade bird habitat over the long term.

ATTRIBUTE ENHANCEMENT

- Locate gaps to release advance regeneration, remove clusters of high-risk, low-vigor, or low-value trees, and avoid sensitive sites
- Expand "crop tree" to include:
    - Tree species with special bird value (e.g., yellow birch and soft mast-producing trees such as black cherry)
    - Trees with novel features (e.g., cavities, exfoliating bark, or large crowns for perching)
    - Trees such as oaks, cherry, and birch that are key host plants for caterpillars
    - Underrepresented species (e.g., soft mast producers, softwood inclusions)
    - Maintain or enhance an understory tree and/or shrub component for forage and cover (e.g, hophornbeam, mountain laurel, huckleberry, blueberry)
    - Retain cavity and den trees

COMPATIBLE SILVICULTURAL TREATMENTS

- Small Group (<0.3 ac) and Single Tree Selection
- Variable Retention Thinning

Red-eyed Vireo
Photo: Greg Pasek/APA 2018

MANAGEMENT OPTION 3

Moderate Intensity Harvest

When managing for birds, the moderate-intensity harvest category encompasses a broad range of silvicultural practices, all of which generally involve a regeneration component combined with a deliberate canopy retention somewhere between 30%-80%. Specific retention and regeneration systems will vary based on timber quality, markets, overstory species, regeneration target species, and many other factors. In terms of bird habitat, what these treatments all share is a resulting marked increase in understory vegetation and widespread creation of gaps and openings of various sizes. This type of harvest may mimic a range of natural events to which birds have adapted, including widespread tree mortality due to pests, pathogens, or storms, which would create a significant number of snags and downed woody material over time.

Depending on canopy retention and opening sizes, these types of treatments will benefit different birds. At the higher end of canopy retention, benefits may be kept intact for birds requiring closed-canopy forests for breeding, such as Black-Throated Green Warbler and Wood Thrush, and may create optimal habitat for gap feeders like Cerulean Warbler, Eastern Wood-Pewee and Scarlet Tanager. At the lower end of canopy retention, or with removals focused in larger groups or patches, young forest-obligates like Chestnut-sided Warbler may start to appear.

ATTRIBUTE ENHANCEMENT

- Locate gaps and patches to release advance regeneration, remove clusters of high-risk, low-vigor, or low-value trees, and avoid sensitive sites
- Expand "crop tree" to include:
  - Tree species with special bird value (e.g., yellow birch and soft mast-producing trees)
  - Trees with novel features (e.g., cavities, exfoliating bark, or large crowns for perching)
  - Trees such as oaks, cherry, and birch that are key host plants for caterpillars
  - Underrepresented species (e.g., soft mast producers, softwood inclusions)
- Maintain an understory tree and/or shrub component for forage and cover (e.g., hophornbeam, mountain laurel, huckleberry, blueberry)
- Retain cavity and den trees
- If oak regeneration is lacking, ideally implement management during acorn crops if it is an oak site.
- Factor in the effects on forest structure likely to result from irruptions of insects and pathogens (e.g., oaks killed by gypsy moth or ash killed by emerald ash borer). In some parts of the state, the attributes listed above can emerge as a result of local die-offs, reducing the need to create gaps through silviculture.

COMPATIBLE SILVICULTURAL TREATMENTS

- Small Group (0.25-2 ac) Selection
- Shelterwood with Reserves
- Expanding Gap Shelterwood
- Patch Selection

Eastern Wood-Pewees flit out into canopy gaps when hunting for flying insects

Table 2. Modified Attributes and Bird Species that May Benefit from a Low-to Moderate-Intensity Harvest

CONDITION	DURATION POST-TREATMENT	BENEFITTING BIRD SPECIES
Improved foraging gaps in open mid-story	1-30 years	Cerulean Warbler Eastern Wood-Pewee Scarlet Tanager
Increased understory density	3-15 years	Black-throated Blue Warbler Hooded Warbler Veery Wood Thrush Worm-eating Warbler
Enhanced softwood component	5+ years	Black-throated Green Warbler Blackburnian Warbler Canada Warbler Pine Warbler
Increased growth and vigor in canopy trees	5+ years	Scarlet Tanager Wood Thrush Cerulean Warbler
Increased midstory density	15+ years	Wood Thrush Red-eyed Vireo Ovenbird
Retained or created snags/cavity trees	5+ years	Northern Flicker Yellow-bellied Sapsucker Pileated Woodpecker Barred Owl

Table modified from similar table in “Managing Forests for Trees and Birds in Massachusetts”

MANAGEMENT OPTION 4

High Intensity Harvest

Either a lack of young forest habitat on the landscape, or the lack of an alternative management option for a degraded stand, may lead to the decision to conduct a high-intensity harvest. This treatment is designed to create a large area of young forest, reducing the canopy cover to 0%-30%. This option approximates stand-replacing natural events like tornadoes and forest fires, and it also replicates a historically widespread cutting practice that benefited a suite of birds that are now all in decline.

SIZE AND SHAPE

- An area of 2.5 acres is a minimum to be of high value for early successional birds
- Larger areas are even better, upwards of 25 acres or more
- Minimize the amount of edge relative to area. Circles are best; squares are better than long, thin strips

DEGREE OF STRUCTURAL COMPLEXITY

- Include parts of vertical structure like snags and larger perch trees, evenly distributed. Larger openings may retain groups of legacy trees
- Retain soft mast as this will contribute to structure as well as add to the diversity and temporal availability of forage
- Minimize non-native, invasive species
- Allow for advanced regeneration of timber species, shrubs, and herbaceous growth
- Enchance levels of coarse woody material, and retain piles of fine woody material

SUGGESTIONS FOR A STRATEGIC LOCATION

- Avoid creating young forest in or near areas with dense infestations of invasive plants
- Create young forest near an open wetland
- Build off existing early successional habitat, such as powerline corridors or abandoned beaver ponds; again, only if the danger of introducing non-native invasive plants can be avoided
- Consider a gradient of age classes by creating new young forest adjacent to sapling/pole stands
- Consider clearing a stand of degraded timber quality due to high grading, ice damage, disease, etc
- Consider creating young forest on poor growing sites, which will extend its longevity. Regenerating old fields also last longer as young forest than a recently cut forest
- Cut aspen (quaking and bigtooth) in winter months to create dense thickets of root-sprouts that are particularly beneficial to Ruffed Grouse

COMPATIBLE SILVICULTURAL TREATMENTS

- Clearcut/Clearcut with Reserves
- Seed Tree
- Overstory Removal in 2-Cut Shelterwood

Clearcut with reserves- 1 year post cut. What initially appears extreme will become great habitat for early successional bird species as the understory regenerates.

Focal Species Disturbance Associations

Table 3. Focal Species Disturbance Associations *

NATURAL DISTURBANCE REGIME	MANAGEMENT OBJECTIVE	CANOPY COVER	DECIDUOUS TO MIXED FOREST	CONIFEROUS TO MIXED FOREST
Stand-replacing disturbances >2.5 acres in size	Maintain patches of young forest, 5-15 years old, >2.5 acres in size	Open (0%-30%)	Eastern Towhee Chestnut-sided Warbler Ruffed Grouse American Woodcock^ Brown Thrasher Northern Flicker Indigo Bunting Blue-winged Warbler Prairie Warbler Rose-breasted Grosbeak Black-billed Cuckoo Baltimore Oriole	Winter Wren Whip-poor-will
Canopy gaps and pockets of regeneration 0.24-0.75 acres in size	Create canopy gaps to encourage dense regeneration in pockets 0.25-0.75 acres in size	Intermediate (30%-80%)	Black-and-white Warbler Black-throated Blue Warbler Canada Warbler Eastern Wood-pewee Ruffed Grouse Veery Wood Thrush Northern Flicker Hooded Warbler Worm-eating Warbler Red-eyed Vireo Yellow-throated Vireo	Canada Warbler Red-eyed Vireo Blackburnian Warbler Brown Creeper
Small and infrequent disturbances that maintain an average of >80% canopy cover	Minimize gap size and frequency. Favor large, old trees and snags. Maintain >80% canopy cover in the stand.	Closed (80%-100%)	Black-and-white Warbler Black-throated Blue Warbler Eastern Wood-pewee Wood Thrush Yellow-bellied Sapsucker Pileated Woodpecker Ovenbird Louisiana Waterthrush	Black-throated Green Warbler Pine Warbler Brown Creeper

*Focal Birds are grouped according to habitat features they strongly associate with. They may be found in a wider variety of conditions than shown here.

^ These species require other nearby habitat types in addition to early successional forest.

Table modified from similar table in "Managing Forests for Trees and Birds in Massachusetts"

Bird-friendly Best Management Practices

With or without bird-conscious practices spelled out in a forest management plan, there are Bird-friendly Best Management Practices (BBMPs) that may be implemented during timber harvesting that can benefit forest-breeding birds:

- *Time of Year* – If possible, operate outside of the breeding season (mid-April to late August in Connecticut), as to not disrupt mating behavior, destroy nests, or alter quality habitat after birds have chosen their territories.

- *Roads and Trails* – Keep woods roads and skid trails <20 feet wide, and incorporate bends and twists on long straightaways. Wider roads have been shown to have a fragmentation effect for strictly interior forest species, such as the Wood Thrush and Ovenbird, and long stretches of straight roads are favorable corridors for Brown-headed Cowbird to travel into forest interiors.

- *Leave it messy* – Avoid a park-like condition; leave some tops, slash, and coarse woody material that can be used as cover, singing perches, and foraging substrates.

- *Follow BMPs* for water quality– A number of bird species rely on forested swamps, stream banks, and other water-related habitats for breeding. Avoid disturbing existing tip-ups, stumps, downed logs, and snags during harvesting operations. The Connecticut BMP Field Guide can be found online at: https://portal.ct.gov/-/media/DEEP/forestry/best_management_practices/BestPracticesManualpdf.pdf

COMPANION DOCUMENTS AND ADDITIONAL RESOURCES

This and other Foresters for the Birds information, as well as any updates, will be available on the website at

https://ct.audubon.org/forest-for-birds

The following resources are also of importance:

- *Birds with Silviculture in Mind: A Pocket Guide to Focal Birds for Connecticut Foresters* – A quick-reference, full-color look at each of the Focal Birds.

- *Connecticut Bird Atlas* – www.ctbirdatlas.org Read all about each bird species, including our priority birds, and the science behind what is causing population declines. A summary of the findings of the Breeding Bird Atlas, including case studies on a representative species of different habitat types.

Credits

The Connecticut Foresters for the Birds program, including this document, was adapted from the original program created in Vermont. This was done in consultation with Audubon Vermont, Audubon New York, and Massachussetts Audubon Society.

Contact Audubon Sharon with questions about how to become involved in the Foresters for the Birds program, or for further assistance, search online for "CT Forester for the Birds" or visit https://ct.audubon.org/forest-for-birds.

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Matt Tillett: Brown Headed Cowbird; Dawn Beattie/ Flickr Creative Commons: Cowbird chick with Song Sparrow; Greg Pasek/APA 2018: Red-eyed Vireo with nesting material; Brian E Small/Vireo: Eastern Wood-pewee on branch; Ken Elkins: Ovenbird nest

Recreated by Audubon Connecticut from *Silviculture with Birds in Mind: Options for Integrating Timber and Songbird Habitat Management in Northern Hardwood Stands in Massachusetts* and *Forest Bird Habitat Assessment: A Guide to Integrating Bird Habitat Data into a Massachusetts Forest Inventory* ©2014.

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The project on which this publication is based is supported by the U.S. Forest Service and The William P. Wharton Trust.

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Priority Birds

We share our northern forests with as much as 90% of the global breeding populations of dozens of species of migratory birds, including the Scarlet Tanager, Wood Thrush, Black-throated Blue Warbler, and Worm-eating Warbler (Partners in Flight). We have a responsibility to look out for the future of these birds because our forests are the core of their breeding range. Audubon Connecticut refers to these birds as Priority Species. Fortunately, because these birds are still common in our region, we have the opportunity to protect and enhance their breeding habitat now before they become threatened or endangered. Knowing which species are or may be nesting on a property is a great way to ensure that you're making a positive difference.

Mature Hardwoods/Mixed Forest

American Redstart
Black-and-white Warbler
Blackburnian Warbler
Black-throated Blue Warbler
Blue-gray Gnatcatcher
Blue-headed Vireo
Broad-winged Hawk
Brown Creeper
Cerulean Warbler
Eastern Wood-pewee
Hairy Woodpecker
Hermit Thrush
Hooded Warbler
Northern Goshawk
Ovenbird
Pileated Woodpecker
Purple Finch
Red-eyed Vireo
Red-shouldered Hawk
Ruby-throated Hummingbird
Scarlet Tanager
Sharp-shinned Hawk
Veery
Winter Wren
Wood Thrush
Worm-eating Warbler
Yellow-throated Vireo

Young Hardwoods/Mixed Forest

American Woodcock
Canada Warbler
Chestnut-sided Warbler
Eastern Whip-poor-will
Northern Flicker
Ruffed Grouse

Forest Edges/Dense Shrubs

Baltimore Oriole
Black-billed Cuckoo
Blue-winged Warbler
Brown Thrasher
Eastern Towhee
Gray Catbird
Indigo Bunting
Orchard Oriole
Prairie Warbler
Rose-breasted Grosbeak
Yellow-billed Cuckoo

Riparian Corridors or Wetlands

Barred Owl
Eastern Kingbird
Eastern Screech-Owl
Great-crested Flycatcher
Least Flycatcher
Louisiana Waterthrush
Willow Flycatcher

Mature Softwood Forest

Pine Warbler
Black-throated Green Warbler