Audubon VERMONT

Forest Bird Habitat Assessment

Richmond Town Forest / Andrews Forestland
Richmond, VT

428 GIS acres




Assessment Date:
July 7, 2017

Report Date:
November 2017

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Bird photos courtesy of the Powdermill Avian Research Center, All About Birds.com, and Charley Eisman (left to right): black-throated blue warbler, chestnut-sided warbler, scarlet tanager, mourning warbler.

Introduction

The purpose of this report is to 1) describe the current habitat types and conditions for forest nesting songbirds on the Richmond Town Forest / Andrews Forestland, and 2) provide management recommendations for integrating habitat management with other ownership objectives in order to enhance the forest's value for songbirds. This assessment is focused on the breeding habitat conditions for "responsibility species" of Bird Conservation Region (BCR) 14, the Atlantic Northern Forest, as identified by Audubon Vermont's Forest Bird Initiative.

Background

Breeding bird surveys have shown that the forests of Vermont and Northern New England are globally important for birds throughout the hemisphere. Our forests are home to the highest concentration of bird species breeding in the continental United States; they are a "veritable breeding factory" for hundreds of neo-tropical migratory birds.

Unfortunately – even though they are still common in our area - many of these birds are experiencing long-term population declines throughout their breeding range. Audubon Vermont's Forest Bird Initiative focuses its conservation efforts on 40 of these forest bird species, known as *responsibility species*. These birds have a high proportion of their global populations breeding in our region, so we have the responsibility – and opportunity - to keep them common before they become threatened or endangered.

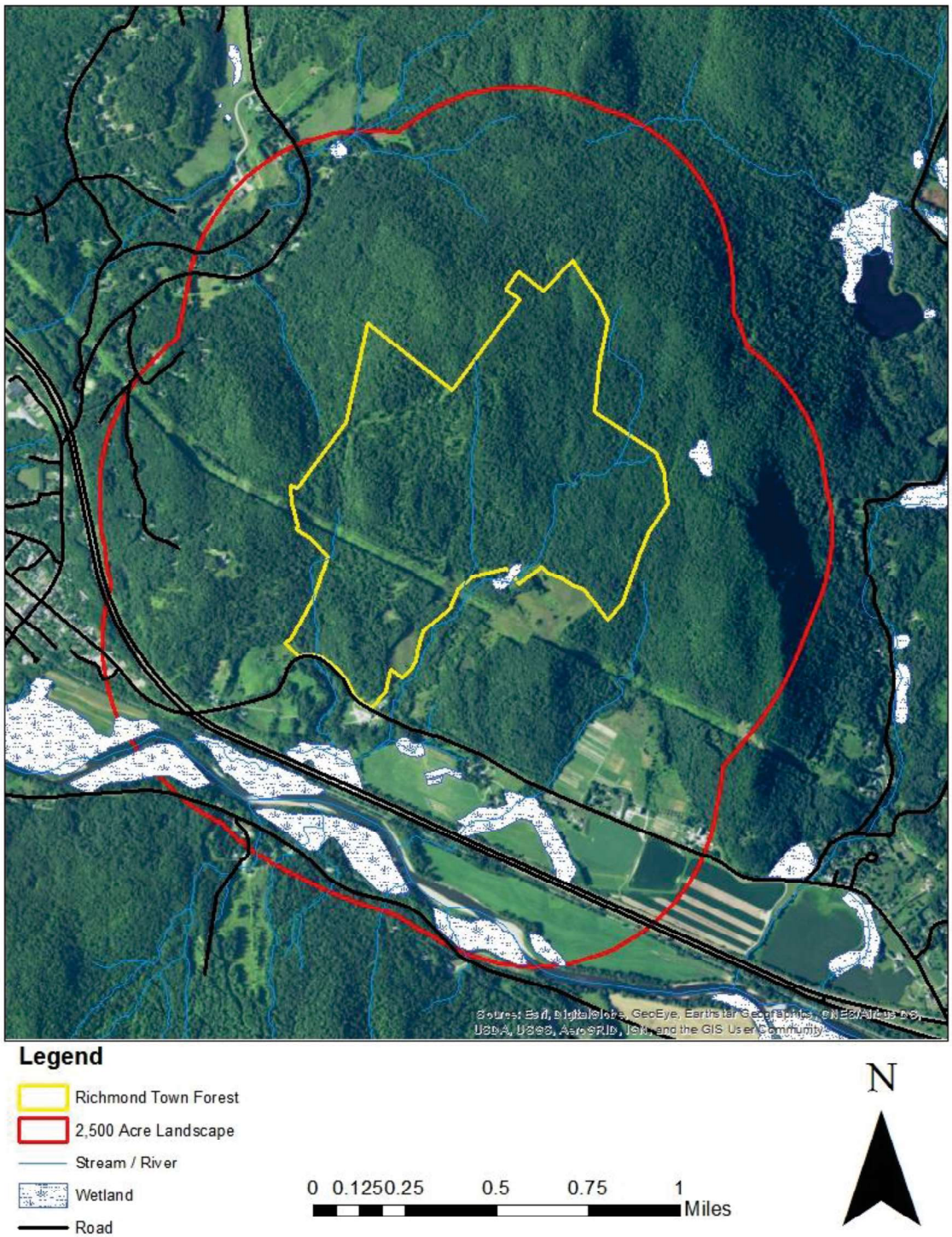
Assessment Methods and Reporting

The inventory and assessment of habitat conditions is based on fixed plot sampling from 20 plot centers, or approximately 1 data point for every 21 acres, supplemented by casual observations.

This report is designed to help inform the creation of an overall management plan for the property. Habitat types have been delineated based on current conditions. Each habitat type includes: a general description; a table of important habitat attributes along with an assessment of their current condition and a short list of bird species associated with each attribute; and list of bird species observed during the assessment as well as others likely to find suitable nesting conditions there. Management recommendations and considerations for maintaining and/or enhancing each habitat type are provided in the context of other stated management objectives for the property. A glossary of terms used in this report can be found as an Appendix.

Landscape-Level Considerations

The composition and configuration of the 2,500 landscape that immediately includes and surrounds the Richmond Town Forest affects how birds and other wildlife will use the property and the quality of the habitat they find there. Understanding the landscape context can also help inform management decisions at the stand-level on the property.



The following table summarizes the condition of the landscape and its value for the suite of forest responsibility birds:

	Current Condition	Value for Forest Birds
% Forest Cover	>70%	**High -** Heavily forested landscapes (70+% forest cover) provide the greatest quantity, diversity, and quality of habitat for responsibility birds compared to fragmented and/or developed landscapes.
% Young Forest	Approx. 2%	**Low –** 2+ acre patches of young forest are important breeding habitat for several responsibility birds including chestnut-sided warbler as well as post-breeding habitat for additional species. Audubon Vermont recommends that < 10% (preferably 3-5%) of a landscape be in this condition at any point in time. Given the composition of this particular landscape a target of 3-5% is deemed appropriate.
Forest patch size	>2,500 acres	**High –** Large (>2500 acres) patches of contiguous forest provide higher quality habitat for interior-nesting birds like wood thrush that reproduce more successfully away from edges and development. These large forest patches also provide habitat for source populations of birds that may recolonize smaller forest patches if/when they lose their original populations. The Richmond Town Forest is located in the 290,389 acre "Mansfield/Worcester Priority Block" as identified by the National Audubon Society, and a 6,288 acre "Highest Priority Interior Forest Block" as identified by the State of Vermont.

Recommendations based on landscape context

- **Protect interior forest conditions.** Utilize multi-aged silvicultural treatments over the majority of the property. Avoid creating new permanent openings or wide (> 20 feet wide), linear roads and trails.

- **Consider creating 5-10 acres of young forest/early-successional habitat.** Although there is currently sufficient young forest habitat on the Richmond Town Forest, the function of this habitat is likely to diminish around the year 2025 due to maturation of the forest. In order to maintain this valuable habitat condition it is recommended to create a new area(s) sometime after 2025.

Forest Bird Habitat Types and Assessment

Habitat Type 1: Mature Hardwood/Mixedwood Forest

Acres: 394
% of Property: 92%

Forest with an overstory greater than 20 feet tall and >30-50% canopy closure. Canopy tree species are represented by both hardwoods and softwoods. Red maple, eastern hemlock, white pine, and red oak tree species are well represented on the parcel. Less abundant tree species yet valuable habitat elements are yellow birch, black cherry, white birch, and aspen. The combination of hardwoods and softwoods provides habitat for a greater diversity of bird species than hardwoods or softwoods along would (Figure 1). Yellow birch and red oak are particularly valuable as foraging sites for birds due to the high diversity of native insects that utilize these tree species (Figure 2). White birch and aspen hold high value for cavity nesting bird species. Black cherry offers a minor fruit resource, important to birds during the post-breeding / pre-migration time frame.

Many responsibility birds breed in mature forest habitats where they find nest sites, cover, and food (predominately insects). Typically, the quality of mature forest habitat increases for forest birds as a forest ages and structure diversifies. Pole stands are the youngest type of mature forest habitat and are typically structurally simple and attract a relatively small suite of forest birds including ruffed grouse and American redstart. Older stands with partially to well-developed understory and midstory layers, canopy gaps, big trees, snags, and logs on the ground, attract a much greater diversity of birds including black-throated blue warbler, wood thrush, and black-throated green warbler. The rocky-bottom stream which flows through the eastern half of the property likely serves as nesting habitat for Louisiana waterthrush.

Figure 1. Hardwood dominated mature forest habitat

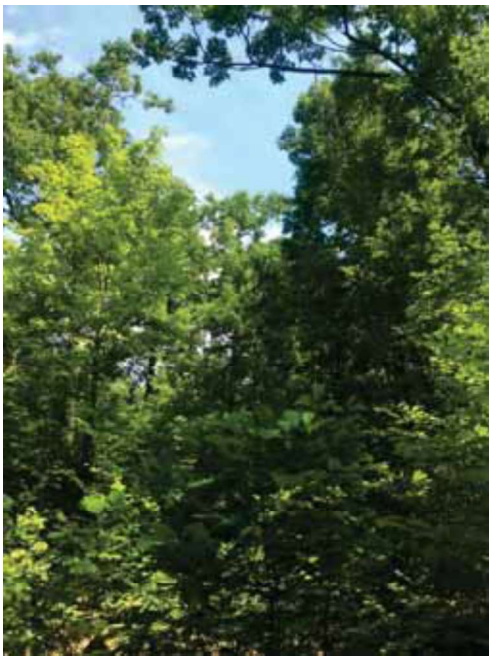


Figure 2. Red oak is of high habitat value

Habitat Structure

The following table describes desirable mature forest habitat conditions for supporting a diversity of bird species and promoting nesting success, an assessment of their current condition on the Richmond Town Forest, and example bird species that may benefit from the condition.

Desired Habitat Condition	Current Condition	Satisfactory	Needs work	Birds that may benefit	Notes
Generally closed canopy (>70% cover on average)	72% cover	X		Black-throated green warbler, Blue-headed vireo, Ovenbird	
Canopy gaps (≤ 1 acre each)		X		American redstart, Eastern wood-pewee	
Moderate to high density of midstory (6-30') vegetation	50-75% cover	X		Blue-headed vireo, Wood thrush	
Moderate to high density of understory (0-6') vegetation	25-50% cover	X		Black-throated blue warbler, Veery	Higher density preferable
Abundant current and future snags and cavity trees (6 >10" diameter per acre)	<6 snags >10" diameter per acre		X	Northern flicker, Yellow-bellied sapsucker	Figure 3
Abundant coarse woody material on the ground (large logs)	28 pieces/acre	X		Ruffed grouse	Figure 4
Abundant fine woody material on the ground (tops, brush piles)	8 piles/acre		X	White-throated sparrow, Ovenbird	
Vigorous canopy trees		X		Scarlet tanager	
Diversity of native plants; lack of invasive, non-native plants		X	X	All	Minor amounts of Japanese barberry observed wind damaged area (2010) of Forest Stand #1 (FMP 2012)

Figure 3. Small diameter snags are common

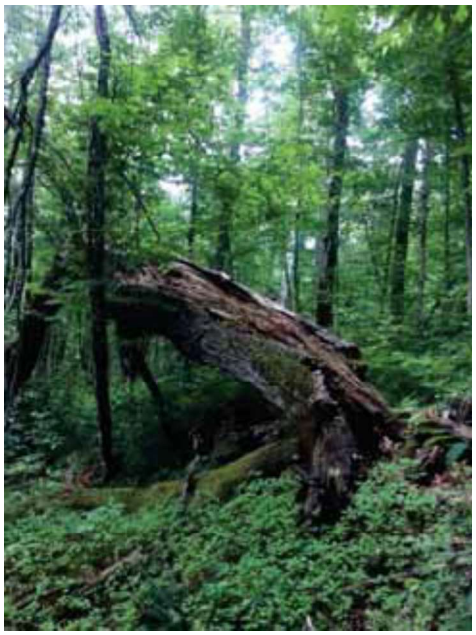


Figure 4. Coarse woody material on forest floor

Bird Species

Responsibility bird species observed during the field assessment are noted as "observed". Those that were not observed but likely to utilize the Habitat Type during the breeding season are noted as "potential".

Mature Hardwood/Mixed Forest	Confirmed	Potential
American Redstart		x
Blackburnian Warbler		x
Black-throated Blue Warbler	x	
Black-throated Green Warbler	x	
Blue-headed Vireo	x	
Chimney Swift		
Eastern Wood-pewee	x	
Northern Parula		x
Ovenbird	x	
Purple Finch		x
Scarlet Tanager	x	
Veery	x	
Wood Thrush	x	
Yellow-bellied Sapsucker	x	
Additional Species Observed Red-eyed Vireo, Tufted Titmouse, Northern Flicker, Hermit Thrush, Blue Jay, American Robin, Dark-eyed Junco		

Management Recommendations and Considerations

In an effort to integrate forest bird habitat considerations with a multiple use approach to management, the following recommendations are provided:

- Continue to manage the majority of mature forest habitat as mature forest habitat with a focus on enhancing overall forest structure and maintaining plant diversity. Multi-aged silvicultural treatments are preferable although even-aged treatments may have applicability in certain stands or portions of stands. *Silviculture with Birds in Mind: Options for Integrating Timber and Songbird Habitat Management in Northern Hardwood Stands in Vermont* provides a number of options. Those most suitable for the Richmond Town Forest property are:

  1B – Variable Retention (Density) Thinning
  2A – Expanding Gap Group Shelterwood (groups <1/2 acre preferable to larger openings)
  2B – Single Tree and Small Group Selection (groups <1/2 acre preferable to larger openings)

  These silvicultural options can help maintain/enhance desirable forest bird habitat conditions for mature forest nesting bird species. They will also assist in developing a higher-quality timber resource for the future.

  The most appropriate option and timing of implementation is dependent upon pre-existing stand conditions primarily as they relate to developmental stage/size class and acceptable and unacceptable growing stock levels. This information should come from the detailed forest inventory under the direction of a consulting forester.

- Retain existing large-diameter snags during harvest and consider marking additional trees to be girdled or retained to grow into large-diameter cavity trees that eventually will naturally become snags. Aspen and white birch are good candidates for recruitment.

- Mark some low-value trees 10+ DBH to be cut and left on site for recruitment of additional coarse woody material in the area (e.g. mark 1 cut-and-leave tree per acre). Leave all tops in the woods and do not lop slash.

- When possible minimize harvesting during the breeding season (May – mid-July). Winter (frozen ground) harvesting is preferable as it will not result in direct impacts to nesting birds.

- Develop a plan for managing non-native and invasive plants. Ongoing monitoring and eradication efforts can go a long way toward preventing more significant future infestations. The Vermont program of The Nature Conservancy (http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/vermont/volunteer/wise-on-weeds.xml) is among the many sources of useful information related to management on non-native, invasive plant species.

Habitat Type 2: Young Forest

Acres: 27
% of Property: 6%

Forest with an overstory <30% canopy closure. This condition is found in three distinct areas of the property. Two of these areas, in the northwest corner, are the result of a 2011 shelterwood harvest (Figure 5). Combined these two areas encompass approximately 13 acres. The third area is the powerline corridor that bisects the property east to west and encompasses approximately 14 acres (Figure 6). As this area is managed by a local power company authority and will in all likelihood be perpetually kept in a young forest condition, the management recommendations are not intended for the powerline.

In harvest areas residual canopy is comprised primarily of red oak, setting the stage for significant red oak regeneration. This is a very desirable trend in thinking about the future of the property in terms of projected climate change impacts to forest composition. It also maintains/promotes a high-value insect food source on which songbirds can forage. Currently aspen, red maple, and raspberry/blackberry make up the majority of understory/midstory woody stemmed vegetation. In addition to nesting habitat structure the raspberry/blackberry is a valuable post-breeding – pre-migration fruit resource.

The young forest nesting bird community is very different from the mature forest community. The addition of this habitat condition on the property is therefore extremely valuable for diversifying the overall bird community. Additionally many bird species which nest in the mature forest utilize young forest habitats during the post-breeding – pre-migration time frame for both foraging and finding dense cover from predation.

Figure 5. Harvest-based young forest habitat

Figure 6. Powerline young forest habitat

Habitat Structure

The following table describes desirable young forest habitat conditions for supporting a diversity of bird species, promoting nesting success, and providing post-breeding habitat as well as an assessment of their current condition on the Richmond Town Forest, and example bird species that may benefit from the condition.

Desired Habitat Condition	Current Condition	Satisfactory	Needs work	Birds that may benefit	Notes
Dense shrubs and regeneration of tree species	75-100% cover	X		Chestnut-sided warbler, Mourning warbler	
Abundance and diversity of fruit-producing trees and/or shrubs; lack of invasive, non-native plants		X	X	All	Non-native honeysuckle currently exists in the powerline corridor but does not yet appear to have made it to the harvested areas; minor amounts of phragmities on skid trail
Scattered perch trees and snags		X		Northern flicker	Residual trees well represented throughout harvest area although not many are currently snags/cavity trees
Abundant coarse woody material on the ground (large logs)			X	Ruffed grouse	With exception of areas on skid trails, CWM is minimal
Abundant fine woody material on the ground (tops, brush piles)			X	White-throated sparrow	

Bird Species

Responsibility bird species observed during the field assessment are noted as "observed". Those that were not observed but likely to utilize the Habitat Type during the breeding season are noted as "potential".

Young Forest	Confirmed	Potential
American Woodcock		x
Canada Warbler		x
Chestnut-sided Warbler	x	
Magnolia Warbler		x
Mourning Warbler	x	
Nashville Warbler		X
Northern Flicker	x	
Ruffed Grouse		x
White-throated Sparrow		x
Additional Species Observed Yellow-throated Vireo, Song Sparrow, Indigo Bunting, Common Yellowthroat, Cedar Waxwing		

Management Recommendations and Considerations

In an effort to integrate forest bird habitat considerations with a multiple use approach to management, the following recommendations are provided:

- The two current areas of young forest habitat resulting from timber harvesting are likely to mature beyond young forest habitat around the year 2025. In order to maintain this ephemeral habitat condition on the property it is recommended to create 5-10 acres of new young forest habitat toward the latter part of the 10 year planning cycle. Young forest areas should be at least 1 acre in size, preferably 2. Options for creating young forest habitat from *Silviculture with Birds in Mind: Options for Integrating Timber and Songbird Habitat Management in Northern Hardwood Stands in Vermont* are:

  2A – Expanding Gap Group Shelterwood (groups > 1 acre)
  2B – Single Tree and Small Group Selection (groups > 1 acre)
  3A – Shelterwood with Reserves

  These silvicultural options can help maintain/enhance desirable forest bird habitat conditions for young forest nesting bird species. They will also assist in developing a higher-quality timber resource for the future.

  The most appropriate option and timing of implementation is dependent upon pre-existing stand conditions primarily as they relate to developmental stage/size class and acceptable and unacceptable growing stock levels. This information should come from the detailed forest inventory under the direction of a consulting forester.

- Retain existing large-diameter snags during harvest and consider marking additional trees to be girdled or retained to grow into large-diameter cavity trees that eventually will naturally become snags. Aspen and white birch are good candidates for recruitment.

- Mark some low-value trees 10+ DBH to be cut and left on site for recruitment of additional coarse woody material in the area (e.g. mark ≥4 cut-and-leave trees per acre). Leave all tops in the woods and do not lop slash.

- When possible minimize harvesting during the breeding season (May – mid-July). Winter (frozen ground) harvesting is preferable as it will not result in direct impacts to nesting birds.

- Develop a plan for managing non-native and invasive plants. Ongoing monitoring and eradication efforts can go a long way toward preventing more significant future infestations. The Vermont program of The Nature Conservancy (http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/vermont/volunteer/wise-on-weeds.xml) is among the many sources of useful information related to management on non-native, invasive plant species.

Habitat Type 3: Open/Field

Acres: 6
% of Property: 1%

Open areas on the property take the form of a 1 acre log landing (Figure 7) and 5 acre field. Herbaceous plants dominate and the non-native multi-flora rose was identified in the field. Some open habitats of a minimum size can support nesting grassland bird species such as bobolink. On the Richmond Town Forest property the field area that could be managed to provide nesting habitat are too small to be functional. For the purposes of forest bird habitat, the log landing area is of greater value and may serve as a springtime display ground for American woodcock.

Figure 7. Log landing

Management Recommendations and Considerations

In an effort to integrate forest bird habitat considerations with a multiple use approach to management, the following recommendations are provided:

- Maintain the log landing in an open condition through periodic mowing. Frequency of mowing to be determined by that which is needed to prevent woody stemmed vegetation from encroaching.

- Field should be mowed in accordance with achieving other objectives for the property.

- Develop a plan for managing non-native and invasive plants. Ongoing monitoring and eradication efforts can go a long way toward preventing more significant future infestations. The Vermont program of The Nature Conservancy (http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/vermont/volunteer/wise-on-weeds.xml) is among the many sources of useful information related to management on non-native, invasive plant species.

Habitat Type 4: Wetland

Acres: 1.4
% of Property: <1%

Two areas of wetland currently exist on the property. The first is an abandoned beaver flowage embedded in the mature forest matrix, approximately ¼ acre in size (Figure 8). The small size and structure of this area is not likely to provide a distinct habitat condition capable of supporting wetland bird species. In time, as the margins revegetate, it is possible that white-throated sparrow may find minimal nesting habitat here. The second, more significant wetland area, is located on the southern property boundary (Figure 9). This approximately 1 acre shrub wetland is comprised of alder, willow, elderberry, and herbaceous plants. Although not true young forest habitat, some species that nest in that habitat type were observed here due to similar vegetative structure. The most notable responsibility bird species that may find nesting habitat here is the Canada warbler.

Figure 8. Old beaver flowage

Figure 9. Shrub wetland

Bird Species

Responsibility bird species observed during the field assessment are noted as "observed". Those that were not observed but likely to utilize the Habitat Type during the breeding season are noted as "potential".

Shrub Wetland	Confirmed	Potential
American Woodcock	x	
Canada Warbler		x
Chestnut-sided Warbler	x	
Swamp Sparrow		
White-throated Sparrow		x
Additional Species Observed Common Yellowthroat, Black-billed Cuckoo, Gray Catbird, American Goldfinch, Rose-breasted Grosbeak		

Management Recommendations and Considerations

In an effort to integrate forest bird habitat considerations with a multiple use approach to management, the following recommendations are provided:

- Develop a plan for managing non-native and invasive plants. Ongoing monitoring and eradication efforts can go a long way toward preventing more significant future infestations. The Vermont program of The Nature Conservancy (http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/vermont/volunteer/wise-on-weeds.xml) is among the many sources of useful information related to management on non-native, invasive plant species.
- Beyond monitoring for and managing non-native and invasive plants no active management is recommended for either wetland area.

Terms and Explanations

Big Trees: Live trees great than 19 – 24 inches diameter at breast height (DBH).

Importance for Forest Birds: Big trees are a key characteristic of old forests and high-quality mature forest habitat for songbirds. Researchers in Wisconsin found priority birds were more abundant and successful in forests with >10% of the live basal area in big trees (19+ inches DBH) than in forests with fewer big trees (Managed old-growth silvicultural study (MOSS), Wisconsin Department of Natural Resources, 2013). Structurally-sound, large-diameter trees are important stick nest sites for woodland raptors, such as the northern goshawk. If retained as legacies, these large trees also provide cavity nest sites for large woodland birds including owls and pileated woodpeckers.

Canopy Gap: A small opening in the upper canopy of a mature forest typically the size of one tree crown up to 1/4 acre.

Importance for Forest Birds: Birds such as the eastern wood-peewee forage in canopy gaps, which also allow sunlight to reach the forest floor through the upper canopy stimulating new growth in understory and midstory. Gaps created where trees fall or blow over or are cut down are a normal and important part of a healthy forest and high-quality mature forest habitat.

Downed Deadwood: Coarse woody material (CWM) is downed logs and branches >4 inches diameter. Fine woody material (FWM) is limbs and branches <4 inches diameter including slash.

Importance for Forest Birds: CWM provides 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 inches diameter as drumming perches. When aggregated in piles (e.g tree tops or slash piles) FWM offers a nesting substrate and cover for white-throated sparrows and veeries. Scattered individual pieces have minimal habitat value.

Forest Block: A large area of contiguous forest cover

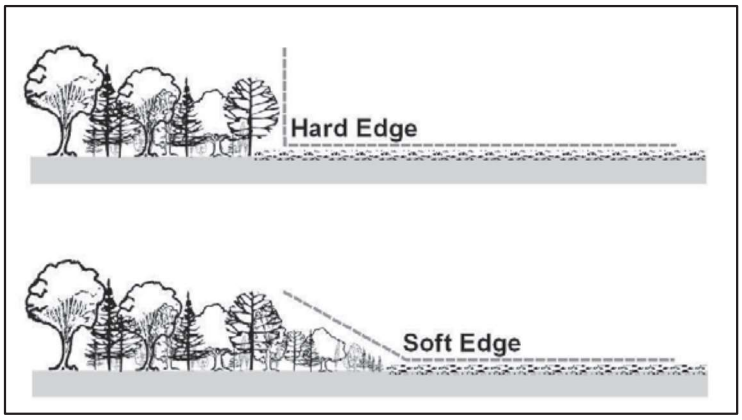
Importance for Forest Birds: Very large (>2500 acres) blocks of contiguous forest provide the highest quality habitat for interior-nesting birds like wood thrush that reproduce more successfully away from edges and development. Large blocks also likely contain the full range of habitat types and conditions required to support most or the entire suite of responsibility birds. Smaller forest patches >500 acres in size provide important habitat in more fragmented landscapes and can connect larger patches. Patches <500 acres in size can still support breeding birds in heavily forested landscapes and area important habitat during the migration season.

Forest Cover: Area of land that is forested or wooded.

Importance for Forest Birds: Heavily forested landscapes (70+% forest cover) provide the greatest quantity, diversity, and quality of habitat for responsibility birds compared to fragmented and/or developed landscapes with lower forest cover.

Forest Edge: The boundary between forest and open land, such as a field or backyard.

Importance for Forest Birds: The transition from low herbaceous vegetation to tree canopy can be considered either a "soft" or "hard" edge. A soft edge is a gradual change in vegetation height moving into the forest. This gradual transition is important for buffering interior forest specialists like the wood thrush from the incursions of nest predators (such as raccoons and skunks) and nest parasites (such as the brown-headed cowbird) that are frequently found in open and developed areas. A gradually increasing canopy height helps to shield interior-nesting birds from view by predators and parasites. Additionally, the brushy conditions that often develop in a soft edge may provide breeding habitat for young forest habitat bird species including chestnut-sided warbler and white-throated sparrow.



Fragmented Forest: Forest that is broken into small, unconnected patches primarily due to some form of development (e.g. residential, commercial, or major roads).

Importance for Forest Birds: A fragmented forested landscape is more likely to support "generalist" wildlife species, such as raccoons and skunks, which can decrease nesting success of interior-nesting forest birds.

Hardwood Forest: A forest dominated by broad-leaved trees which lose their leaves in the fall.

Importance for Forest Birds: Some breeding birds are associated with hardwood forests, such as chestnut-sided warbler, eastern wood-pewee, and scarlet tanager.

Horizontal Structure: The arrangement of different habitat types across the landscape.

Importance for Forest Birds: A landscape with mature and young forest habitats, open fields, and wetlands would be rich in horizontal diversity. Landscapes with greater horizontal diversity support a greater diversity of breeding forest birds and other wildlife.

Interior Forest: Forest condition that occurs with increasing distance from a forest edge.

Importance for Forest Birds: As perceived from a bird's perspective, interior forest conditions begin to occur approximately 200-300 feet from a forest edge. At this distance, negative edge-associated effects such as nest predation and parasitism generally no longer occur. Interior-nesting species, such as scarlet tanager, wood thrush, ovenbird, black-throated blue warbler, and blue-headed vireo, have greater reproductive success when they nest away from forest edges.

Invasive (non-native) Plant: A plant that is able to establish on many sites, grow quickly, and spread to the point of disrupting native ecosystems. Often non-native.

Importance for Forest Birds: Non-native, invasive plants, such as bush honeysuckles, buckthorn, and Japanese barberry, present a variety of threats to forest health in Vermont and the northeast. Although some species of native forest birds successfully use these shrubby, woody plant species as nesting sites and eat their fruits, the fruits generally have low nutritional value and the invasive plants reduce the diversity of other nesting and foraging options in forest ecosystems. Overall, non-native, invasive plant species degrade the quality of native forest bird habitat in our region.

Leaf Litter: Dead plant material such as leaves, bark, and twigs that has fallen to the ground.

Importance for Forest Birds: 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.

Mature Forest Habitat: Forest with a canopy greater than 20 feet tall.

Importance for Forest Birds: Many responsibility birds breed in mature forest habitats where they find nest sites, cover, and food. Typically, the quality of mature forest habitat increases for forest birds as a forest ages and structure diversifies. Pole stands – the youngest type of mature forest habitat - are typically structurally simple and attract a small suite for forest birds including ruffed grouse and American redstart. Older stands with understory and midstory layers, canopy gaps, large trees, snags, and logs, attract a much greater diversity of birds including black-throated blue warbler, wood thrush, Canada warbler, and black-throated green warbler.

Midstory: Live, woody vegetation in the 6-30 foot height range including trees and shrubs.

Importance for Forest Birds: High stem and foliage densities of woody plants in this forest layer provide nest sites, foraging substrates, and protective cover for many forest birds. Stand-wide coverage is desirable but not necessary; well distributed patches are sufficient. The majority of responsibility bird species nest and/or forage within the first 30 feet of the forest. Nests of wood thrush, American redstart, black-throated green warbler, and blue-headed vireo are most commonly found in the midstory level.

Mixed Forest: A forest made up of hardwood and 25-75% softwood tree species.

Importance for Forest Birds: Some breeding birds are associated with mixed forests, such as black-throated blue warbler, Canada warbler, and white-throated sparrow.

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

Importance for Forest Birds: Snags provide opportunities for nesting cavity excavation by yellow-bellied sapsuckers and northern flickers, and existing cavity trees provide potential nesting cavities for chimney swifts. Aspen and birch species are frequently chosen as trees to excavate. Cavities are often made in trees with the heartwood and sapwood decay fungi. Suggested targets for snags and cavity trees

combined in are ≥ 6 per acre, with one tree >18 inches DBH and 3 >12 inches DBH. Branches on snags may be used as foraging perches and nest sites.

Soft Mast: Soft fruits and berries.

Importance for Forest Birds: Fruits including cherry, apple, *rubus* species (e.g. blackberry and raspberry), dogwood, and others are important food sources for forest birds. In the late summer and early fall, after fledging and before migrating, many birds feed on these fruits and the insects that are attracted to them in order to build up critical fat reserves needed to endure long fall migrations.

Softwood Forest: A forest dominated by coniferous trees, usually "evergreen" (the exception being tamarack), with needles or scale-like leaves.

Importance for Forest Birds: Some breeding birds are associated with softwood forests, such as magnolia warbler and blue-headed vireo. Other birds, such as blackburnian and black-throated green warbler, are associated with small clusters of softwood trees called exclusions in hardwood stands. For this reason, maintaining or increasing the softwood component of hardwood stands increases their overall habitat value. Several responsibility species are associated with softwood forests that are dominated by spruce and fir. Bicknell's thrush is associated with these forests found at high-elevations in the mountains, and species including boreal chickadee, spruce grouse, and black-backed woodpecker, are associated with lowland spruce-fir forests in the northern parts of our region that are characterized by a short growing season and cold climate.

Understory: Live vegetation in the 1-5 foot height range, including tree seedlings and saplings, shrubs, and herbaceous vegetation.

Importance for Forest Birds: High stem and foliage densities of woody plants in the understory provide nest sites, foraging substrates, and protective cover for many forest birds. Stand-wide 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 sugar maple, American beech, hobblebush, red spruce, *rubus* species, and striped maple. Black-throated blue warbler and wood thrush place nests in this layer, and Canada warbler and veery tend to nest on or near the ground, concealed by dense understory growth. The best breeding habitats for mourning warbler and chestnut-sided warbler are patches of dense, low growth with <30% overstory cover in patches >1 acre in size (young forest habitat conditions).

Vertical Structure: The complexity of vegetation and other structures as they are vertically arranged in the forest.

Importance for Forest Birds: A forest with a well-developed understory, midstory, and canopy exhibits complex or diverse vertical structure, which offers habitat for a greater array of bird species compared with a structurally simple forest. Non-living features, such as coarse woody material and the microtopography of the forest floor, add to the complexity of vertical structure as well.

Young Forest Habitat: Forest patches greater than one acre in size dominated by a high density of seedlings, saplings, and shrubs less than 20 feet tall.

Importance for Forest Birds: Several responsibility birds and many other wildlife species use young forests during all or part of their life cycle. Chestnut-sided warbler, American woodcock, and magnolia warbler all use young forests during the breeding season. Although these species may be found in patches smaller than one acre in size, research has shown that abundance and nesting success is greater in larger patches. Young forest habitats include regenerating patchcuts, clearcuts, and old fields. Early-successional young forest habitats dominated by intolerant species such as aspen and paper birch are particularly valuable for woodcock and grouse. Shrublands that will never mature into forest, such as those associated with beaver wetland complexes, can also attract species associated with young forest habitats since they have a similar vegetative structure. Recent research has also shown the importance of young forest habitats as post-breeding habitat for birds that nest in mature forest, such as scarlet tanager and wood thrush. Young forest provides dense, protective cover for juveniles, as well as abundant sources of soft mast, which are important pre-migration food sources. Young forest habitats are ephemeral; they generally only persist 10-15 years where forest regenerates after a patch or clearcut and slightly longer on old field sites. Due to natural forest succession and development, the amount of this habitat type is decreasing in our region, which is a threat to the species associated with it.