A Land Manager's Guide to

Improving Habitat for Forest Thrushes

CORNELL LAB *of* ORNITHOLOGY

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Spotted Thrushes by James Coe

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Preface

Purpose and Use of this Guide

This publication is a tool to help improve habitat for populations of forest-interior birds. These guidelines are written for two types of land managers: those responsible for large landscapes, such as public lands or entire states; and private landowners who manage small blocks of forest. We first discuss concepts associated with forest fragmentation at both landscape and smaller habitat scales and provide general management suggestions that benefit many forest-interior birds. We then focus directly on the habitat-area requirements of the Veery, Swainson's Thrush, Hermit Thrush, Wood Thrush, and Varied Thrush. Specifically, we provide estimates of how much appropriate forest habitat is necessary to sustain breeding populations of each of these species in three geographic regions of the U.S. and Canada.

Why thrushes?

Nearly every forest in North America is inhabited by one or more thrush species. These drab-colored songbirds are not often seen, yet their beautiful, flute-like songs are one of the most characteristic sounds of our forested landscapes in summer. Forest thrushes, like their more familiar cousin the American Robin, feed primarily on the ground and build their nests on or near the ground in low, dense vegetation. Each species selects its own habitat, in terms of forest type, elevation, and moisture regime, and all are sensitive to the structure, productivity, and configuration of the forest. These birds are therefore good indicators of forest health and the ability of our forests to support healthy bird populations. As several thrush species continue to decline, managing forest habitats for these and other songbirds is one way that landowners and managers can contribute to bird conservation efforts.

Summary

This is the second publication in a series of forest habitat management guidelines produced by the Cornell Lab of Ornithology as a tool to help those interested in managing and protecting habitat for birds. The first publication, *A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other Forest-interior Birds*, was published in 1999 and has been used widely by agencies and private landowners. These guidelines offer a set of "management prescriptions"—descriptions of the kinds and amounts of habitat that are required to sustain healthy bird populations. This guide is focused on improving habitat for five forest-dwelling thrushes, including the Veery (*Catharus fuscescens*), Swainson's Thrush (*Catharus ustulatus*), Hermit Thrush (*Catharus guttatus*), Wood Thrush (*Hylocichla mustelina*), and Varied Thrush (*Ixoreus naevius*). Providing well-managed habitat for these wide-ranging species that use a variety of forest habitats also will benefit a host of other forest birds. We first offer a series of general management guidelines that are applicable in both eastern and western landscapes. These include preventing the fragmentation of large forest tracts, minimizing the creation of edge habitats, establishing forested corridors to reduce isolation of small patches, and maintaining structural and plant-species diversity within existing forests.

Unlike tanagers, thrushes are birds of the forest understory, requiring dense shrub or sapling layers and a well-developed layer of leaf litter on the forest floor. These conditions exist in some mature and old-growth forest types, but most often are enhanced by small-scale disturbances within forested regions. Silvicultural practices that mimic natural disturbance and promote deciduous shrubs and saplings can benefit thrush populations, as long as overall forest cover in a landscape is not permenantly reduced. In all forested regions, general guidelines for thrushes and other forest species include: (1) maintaining large and unfragmented forest blocks; (2) promoting understory growth through natural disturbance or management; and (3) limiting overbrowsing by deer, livestock, and other ungulates. In the western region, protection and enhancement of riparian forest are critical for thrush and other bird populations. In eastern and northern forests, patches of 150 acres (62 ha) or larger generally will provide thrushes with high to moderate levels of habitat suitability.

Figure 1. *Vast coniferous forests of western North America support diverse bird communities, including large populations of Hermit Thrush, Swainson's Thrush, and in some regions, Varied Thrush. Photo by Melissa S. Barker.*

Introduction

Few choices that a bird makes during its life will affect its survival and ability to reproduce as profoundly as its choice of habitat. A bird's habitat must contain all the resources needed for that individual's growth, survival, and reproduction, including food, water, cover, and roosting and nesting sites. The process can be complicated, as each bird is faced with a mosaic of acceptable habitats from which to choose, and each choice often occurs at different geographic scales (Hames et al. 2001). For example, a migratory Wood Thrush returning to its breeding grounds must first select an appropriate forest patch, then a territory within the patch, and finally a nest site within the territory (Figure 2). These choices are made based on habitat type and quality. Each bird species has a unique set of habitat requirements based on its ecology and behavior. Some species, such as the Bicknell's Thrush, which only nests in montane forest dominated by balsam fir, have very specific habitat requirements. Other species may key in on a specific habitat type, such as forest, but will tolerate a range of conditions within that habitat type. Suites of species may respond similarly to variation in basic forest characteristics such as size, shape, and surrounding land use. For this reason, targeted forest management for selected species will often benefit a larger guild of forest-dwelling birds.

Sometimes two locations may contain all the basic requisites for appropriate breeding habitat, but they may differ in overall habitat quality. For example, one location may contain more food, better nest sites, or fewer brood parasites (i.e., Brown-headed Cowbirds) and nest predators. Such quality differences among habitats often are revealed by their rate of occupancy by breeding birds (Hames et al. 2001) and the nesting success experienced by those occupants. The guidelines contained in this publication were created by statistically modeling the relationships between thrush occupancy rates and numerous forest characteristics thought to affect habitat quality.

In our first forest management publication, *A Land Manager's Guide to Improving Habitat for Scarlet Tanagers and other Forest-interior Birds*, we focused on eastern forests, as this was the extent of the Scarlet Tanager's breeding distribution (Rosenberg et al. 1999b). In this publication, the second in our management series, we expand our taxonomic and geographic scope by providing management guidelines for the Wood Thrush, Hermit Thrush, Swainson's Thrush, Veery, and Varied Thrush. Like the tanager management guidelines, the thrush guidelines will also benefit many other forest-dwelling birds. The five forest thrushes considered in this publication have a combined geo-

graphic distribution that includes much of the forested habitat in North America, spanning eastern deciduous forest, boreal forest, and western montane forest. As a group, the forest thrushes require a set of similar habitat conditions. Each species, however, occupies a unique ecological niche and thus requires a specific set of forest conditions to breed successfully and sustain viable populations. Furthermore, individuals of the same species breeding in geographically disjunct populations, may have somewhat different habitat needs, thus requiring slightly different management actions. For example, appropriate forest patch size is important for Hermit Thrushes nesting in both Vermont and Idaho (Hames et al. 2002); however, because of differences in forest type and the amount of forest available in the landscape, management actions designed to achieve the same population goals for this species may be very different in the two states. The degree to which individual characteristics, such as forest size or shape, play a role in determining habitat quality is highly variable from place to place (Rosenberg et al. 1999b), as geographic location can have profound effects on factors like climate and presence of competitors and predators. To measure geographic variation in species-specific habitat requirements, we studied each thrush species throughout its range (see sidebar, page 6). The goal of this publication is to provide forest managers with regionally specific, science-based guidelines for assessing habitat quality, making important forest planning and mitigation decisions, and improving habitat conditions for thrushes and other forest birds.

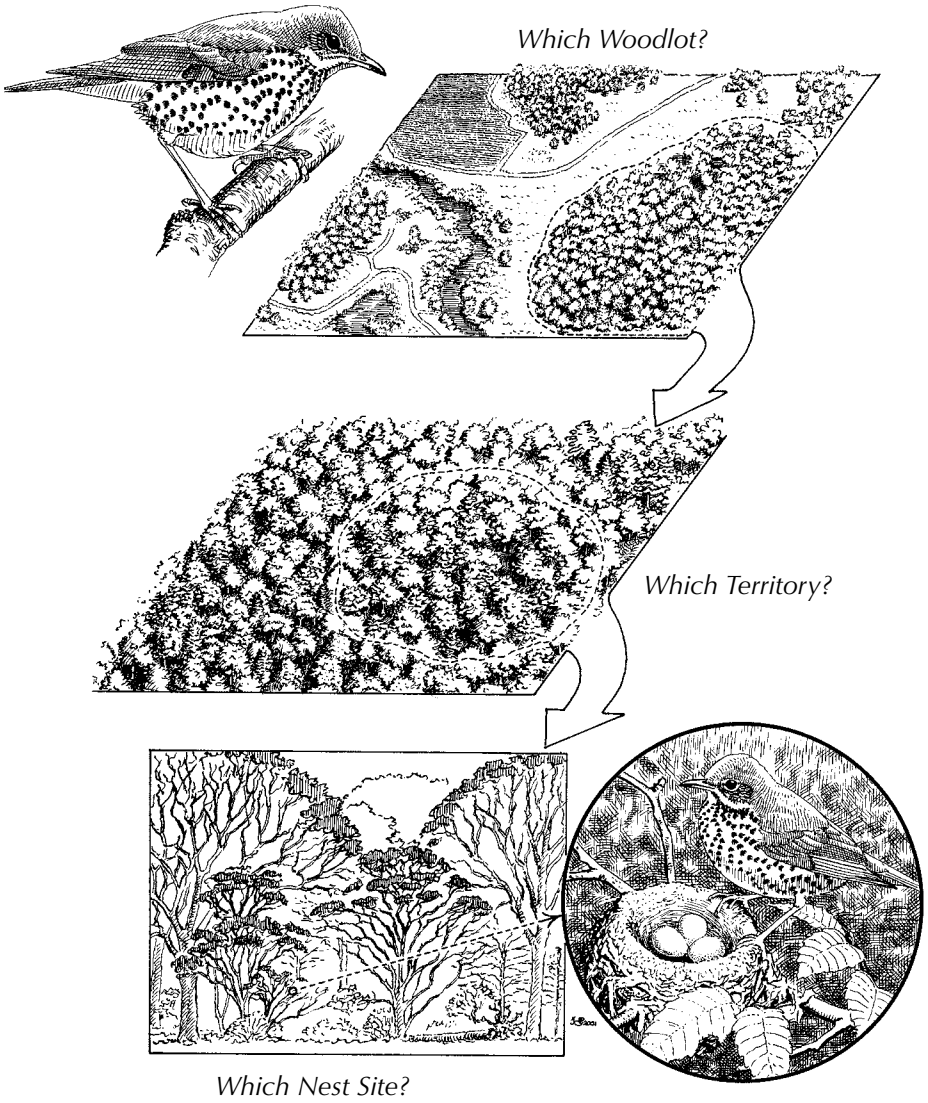


Figure 2. Wood Thrush Habitat Selection: *For many species, including the Wood Thrush, selecting a place to nest involves making choices at several geographic scales. A migrating Wood Thrush returning to its natal breeding area in an agricultural setting is first faced with locating a woodlot suitable for establishing a breeding territory. The woodlot must be of appropriate size, age, shape, and distance to key landscape features, such as water. After selecting a woodlot, the bird must then stake out a territory of about five acres (2 ha), usually containing a mix of understory and canopy trees. Finally, the bird must select an appropriate place within the territory to build its nest, which is placed on a forked branch of an understory tree or shrub, such as flowering dogwood. From the Lab's* Home Study Course in Bird Biology *(Podulka et al. 2001). Illustration by N. John Schmitt.*

Managing the Contemporary Forest

Throughout North American history, forests have received intense pressure because of their ability to provide renewable resources and sites for agriculture and development. The amount and quality of forest habitat available for breeding birds is constantly changing because of a cycle of forest clearing followed by regrowth. In the 1800s, millions of acres of forest in the East and Midwest were cleared for agriculture and the wood products they provided. Much of the farmland created during this era of agriculture has been subsequently abandoned and replaced by forest, causing a net increase in forest area in the rural Northeast during the past 100 years. Conversely, residential and commercial development is outpacing forest regrowth in the suburban Southeast and Midwest, causing a net forest decline in those regions. The amount of forest in the mountainous West has remained roughly stable during the past few decades because of vast acreages owned and protected by the federal government. The end result is a dynamic situation where the amount of forest is constantly changing within and among major geographical regions.

In addition to forest loss, there are a variety of threats that degrade habitat quality for forest birds. A number of forest health issues, such as hemlock wooly adelgid, beech bark scale, viburnum leaf beetle, acid rain deposition, and overbrowsing by white-tailed deer, threaten eastern forests. In western coniferous forests, fire suppression has altered the natural forest structure and composition. Furthermore, increased fuel loads in fire-suppressed areas lead to wildfires that are devastating as opposed to rejuvenating. Finally, pervasive forest fragmentation reduces habitat quality for breeding birds in both eastern and western landscapes (Hames et al. 2002).

Effective forest management for bird populations relies on long-term planning, periodic needs assessment to ensure adequate amounts of high-quality forest habitat in all regions, and science-based guidelines that consider forest bird ecology and contemporary threats. The responsibility for long-term planning at ecoregional scales falls mostly to state and federal agencies and some large conservation landowners such as The Nature Conservancy. Yet, the contributions of private landowners, individual natural resource managers, and commercial forest owners is paramount to providing adequate amounts of quality breeding habitat for forest birds.

Some key characteristics that determine a forest's quality as breeding bird habitat include its size and shape, how isolated it is from other forests, the land-use surrounding it, and its age and structural development. Most of these characteristics can be manipulated by forest managers to benefit birds. Furthermore, these characteristics are interrelated and influenced by the amount of forest fragmentation in the surrounding landscape, permitting managers to focus on one or two key characteristics that can potentially improve the overall quality of the habitat. Management activities that benefit forest birds will often involve the replication of small-scale natural disturbances that would naturally influence ecological succession. For instance, removal of selected overstory trees can create gaps in the forest canopy, thus simulating damage caused by storms. These gaps stimulate understory growth, which ultimately provides food and nest sites for forest birds.

Figure 3. *Forests fragmented by agricultural development persist as isolated patches that may vary in size, shape, and degree of isolation. Photo by Kenneth V. Rosenberg.*

What Is Forest Fragmentation?

Forest fragmentation occurs when large, contiguous forests are divided into smaller patches by residential and commercial development, roads, agriculture, and, in some cases, timber harvesting (Figure 3). Clear-cutting can temporarily fragment mature, contiguous forest until the clear-cut area has regenerated to a successional stage in which it no longer poses an ecological barrier to forest-interior birds. As mature forests become fragmented, less habitat is available for breeding

birds, and a variety of factors, such as increased brood parasitism and nest predation, result in lower reproductive success in the habitat that remains (Brittingham & Temple 1983; Wilcove 1985; Martin 1988; Robinson et al. 1995). Thus, forest fragmentation not only causes a net loss of habitat, it can also reduce the suitability of remaining habitat in a region.

It is important to distinguish between a forest that is fragmented by agricultural or urban development and a forested landscape composed of a mosaic of mature and regenerating stands that result from timber harvesting. The first situation typically is more damaging to forest bird populations and may represent permanent habitat loss, whereas the latter situation may only cause a temporary reduction in habitat for certain forest-interior species that rely on mature forests. Furthermore, early successional forests do provide habitat for many bird species, including some Neotropical migrants that are declining. Forest fragmentation plays an important role in determining the characteristics described below.

Figure 4. *The Varied Thrush breeds primarily in the wet coniferous forests of the Pacific Northwest. Photo by Donald Waite/CLO.*

Birds in Forested Landscapes: A scientific approach to managing forest birds

Photo by Kenneth V. Rosenberg

The Birds in Forested Landscapes (BFL) project began in 1997, evolving from the highly successful Project Tanager. Together, these projects amassed perhaps the largest dataset ever collected on forest fragmentation and birds. Project Tanager and BFL have proved that it is possible for birders and amateur scientists alike to conduct continent-wide field research, helping to answer important scientific questions that can only be addressed through the collective efforts of thousands of volunteer citizen-scientists.

BFL, with support from the National Fish and Wildlife Foundation, the USDA Forest Service, and the Environmental Protection Agency has focused its efforts on forest hawks, thrushes, and, since 2001, additional species identified as high conservation priorities. Over 1,000 trained volunteers surveyed more than 3,000 study sites throughout North America, helping to determine the habitat and landscape requirements of forest-dwelling birds.

BFL participants follow a simple yet rigorously tested protocol that includes selecting suitable study sites, visiting these sites at least twice during the breeding season to search for thrushes and hawks and look for evidence of breeding, measure a suite of habitat variables, and then return data to Cornell for analysis. Many land managers contributed to the project as active participants and site coordinators, helping volunteers with landscape measurements, obtaining maps, or gaining access to study sites. The management guidelines for thrushes, resulting directly from this important study, are the second in a series of conservation plans developed to help maintain and enhance populations of forest birds into the future.

General Guidelines: Key Forest Characteristics

Forest Size and Isolation

Effects

The number of bird species breeding in a forest patch is directly related to the size of the patch (Freemark and Collins 1992). As the size of the forest increases, the number of breeding bird species increases. Bird species whose occurrence or reproductive success is reduced in small habitat patches are referred to as *area sensitive* (Robbins et al. 1989). For example, some species will only establish breeding territories in the interior of large forest tracts, far from an edge; these are known as forest-interior specialists. Area-sensitive species may attempt to nest in small forest patches but are often unable to raise young successfully because of high rates of nest predation or brood parasitism. For area-sensitive species, the size and shape of forest tracts are crucial factors for successful breeding (Whitcomb et al. 1981). Forest patches that are too small may not offer enough interior habitat to sustain breeding individuals. Similarly, a forest in the shape of a long corridor or peninsula does not offer as much interior habitat as a circular or square forest.

The degree of isolation, or the distance between a patch and the surrounding forest, may also be important in determining the long-term persistence of bird populations (Hames et al. 2001). For nonmigratory species, such as woodpeckers and owls, the ability of young birds to disperse and establish new territories is greatly reduced when the habitat is isolated (Figure 5). Forested corridors connecting isolated patches may be critical for these populations. Also, if fragments are separated by agriculture or regenerating forest, the possibility for dispersal may be greater than between fragments that are separated by residential or commercial development where movement is limited.

Management Tips

- **Maintaining Large Forest Tracts:** Whenever possible, avoid fragmenting large contiguous forest

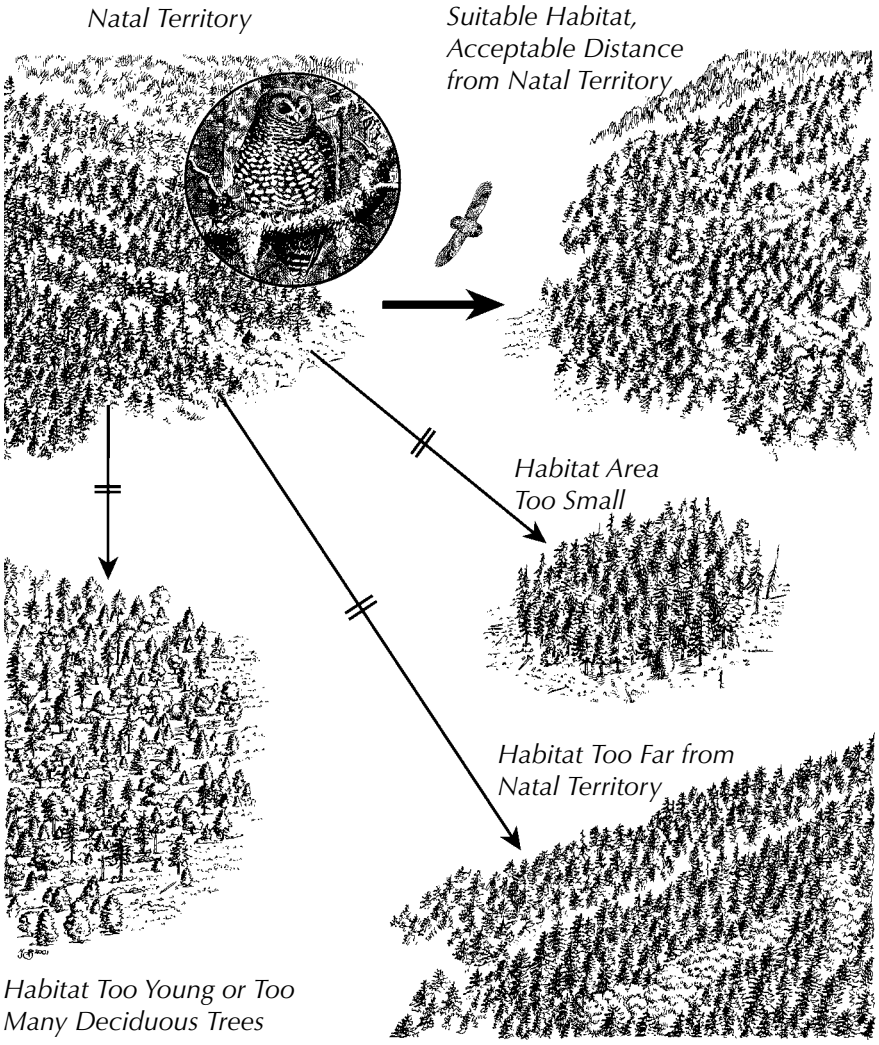


Figure 5. Dispersal of Fledgling Northern Spotted Owl: *When young birds disperse from their natal areas, their survival often depends on their ability to find suitable habitat nearby. Dwindling habitat in the Pacific Northwest makes this especially true for the Northern Spotted Owl: loss and fragmentation of the old-growth coniferous forests where the subspecies makes its home leave young owls with few habitat choices and expose them to many risks. Studies indicate that if immature Northern Spotted Owls cannot find suitable habitat within approximately 12 miles (about 20 km) of their natal territory soon after dispersing, they often succumb to starvation or predation by Great Horned Owls. Some old-growth forest patches fail to meet the bird's needs because they are too far away or are too small in area. Other unsuitable forests are too young, or contain a high proportion of deciduous trees. From the Lab's* Home Study Course in Bird Biology *(Podulka et al. 2001). Illustration by N. John Schmitt.*

Brood Parasitism and Nest Predation

Among the primary causes of lowered reproductive success of forest-interior birds in fragmented habitats are increased rates of both brood parasitism and nest predation. Brood parasites, notably Brown-headed Cowbirds (*Molothrus ater*), are birds that do not build nests or raise young on their own; instead, they lay eggs in a host bird's nest. The cowbird nestling generally hatches first, outcompetes the host's nestlings for food, and receives the majority of the parental care. As cowbirds expanded their historic range from midwestern prairies into newly created agricultural land and fragmented forests in the East, they encountered many new potential host species (Robinson et al. 1995). Forest birds that have had no long-term exposure to cowbirds often do not have mechanisms for rejecting cowbird eggs and are particularly vulnerable to parasitism. Researchers believe that parasitism by Brown-headed Cowbirds is a significant factor contributing to declining numbers of many songbirds in North America (Robinson et al. 1995).

In addition to parasitic cowbirds, nest predators such as jays, crows, raccoons, and domestic and feral cats that are not usually found in extensive forests gain access to the interior of forest patches via roads, power-line cuts, and other openings. Studies consistently show that nest predators have a greater affect on the reproductive success of forest birds in forest fragments than in contiguous forest (Wilcove 1985, Small and Hunter 1988).

Brown-headed Cowbird nestlings grow rapidly, frequently outcompeting the host's nestlings for food and parental care. This adult Common Yellowthroat is feeding a cowbird fledgling that's more than twice its size. Photo by John Gavin/CLO.

tracts; these areas have the ability to support the largest number of forest-interior birds and will also be more likely to provide habitat for area-sensitive species. Also, it is much easier to protect existing forest than to "create" new forested areas. The total amount of contiguous forest required to support healthy populations depends on a given species' area sensitivity. Some area-sensitive species such as the Northern Goshawk require hundreds of acres to breed successfully, while other less sensitive species may require only 25 acres (10 ha). In addition, it's important to note that the landscape context (see page 9) plays a critical role in determining a species' habitat-area requirements.

- **Minimizing Isolation:** Minimize isolation of forest patches by promoting reforestation of gaps between disconnected forest tracts. Forest birds generally have higher reproductive success in forest that is either connected to or in close proximity to other forest patches. This also facilitates dispersal and territory establishment.

Edges

Effects

The plight of many forest-nesting songbirds has brought into question the benefits of certain traditional wildlife management techniques. For example, historically land managers were trained to "develop as much 'edge' habitat as possible because wildlife is a product of the places where two habitats meet" (Giles 1971). Creating edges increases local diversity by attracting game species such as rabbits and deer, as well as a variety of nongame bird species such as Song Sparrows and Northern Cardinals. We now know, however, that forest-interior species may disappear from areas that contain extensive edge habitat. Gates and Gysel (1978) proposed the idea that edges may serve as "ecological traps" for some breeding birds by providing a variety of attractive habitat characteristics, while at the same time subjecting the birds to higher rates of nest predation and parasitism. Evidence from several studies indicates that the detrimental effects of an edge can extend from 150–300 feet (45–90 m) into the forest interior.

Management Tips

- **Managing Forest Shape:** Attempt to manage for forest shapes that create the least amount of edge. Circular plots are the best at maximizing forest interior, whereas square or rectangular plots are better than long, narrow strips (Figure 6). Circular forest plots offer less access to the interior for predators and nest parasites while maximizing habitat for area-sensitive species. Research shows that area-sensitive species tend to use forested areas that are at least 330 feet (100 m) from an edge.

Landscape Context

Effects

The amount of forest in the landscape plays a critical role in determining the suitability of forest patches, especially regarding patch size. In general, as the amount of forest in the surrounding landscape increases, the minimum required forest patch size for many species decreases. In the Midwest, for example, landscapes that remain at least 70% forested tend to minimize adverse effects of fragmentation on Scarlet Tanagers (Rosenberg et al. 1999b; Figure 7).

Management Tips

- **Developing a Broad-scale Plan:** Develop a long-range forest management plan at as large a scale as possible. Plan to designate tracts that will be mature at each stage in the management plan and maintain connections (corridors) between regenerating forests and mature tracts to facilitate repopulation by birds. In regions where public lands contain the majority of contiguous or large forest tracts, the most beneficial management strategies may involve protection or minimal disturbance to compensate for habitat loss and fragmentation on adjacent private lands.
- **Promoting Reforestation:** Promote reforestation of artificial forest openings, areas surrounding forest peninsulas, gaps between isolated forest tracts, and riparian corridors to create more forest interior for area-sensitive species. Reforestation can be achieved by succession, essentially leaving the area untouched for a number of years, or by planting native trees. Avoid planting monocultures, especially of exotic species; these are less attractive to most forest birds. Monitor forested plots for nonnative, invasive plants, and devise a removal plan if necessary.
- **Working Within Your Community:** Work with your neighbors and adjoining landowners to conserve adjoining forest to maintain contiguously forested areas. Consider creating a landowners association, or work with a land trust or forest manager to produce guidelines for people within your community who wish to maintain the commercial value and ecological integrity of their forests. Take part in your state or regional Partners in Flight Working Group.

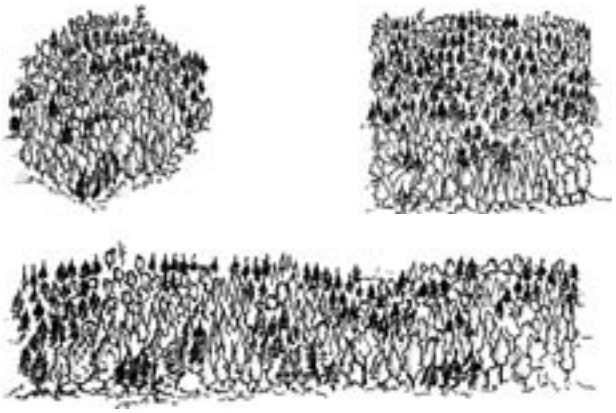


Figure 6. *The shape of a forest patch affects the amount of edge and forest-interior habitat that is present. Round and square patches have less edge and more forest interior than long narrow-shaped patches. From the Lab's* Home Study Course in Bird Biology *(Podulka et al. 2001). Illustration by Keila Sydenstricker.*

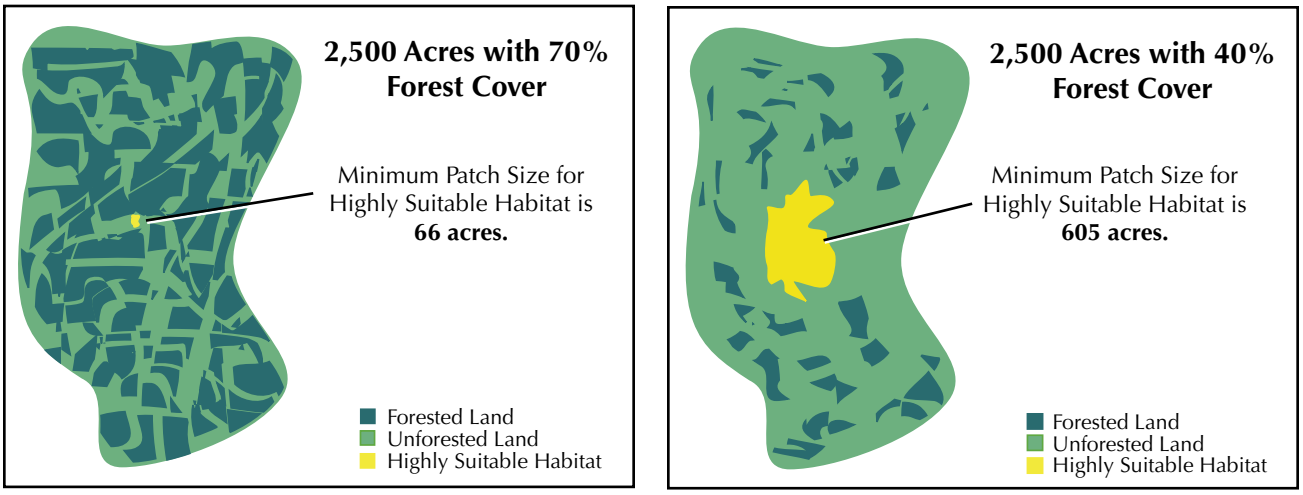


Figure 7. *Minimum area requirements for area-sensitive species may depend on the amount of forest remaining in the surrounding landscape. In this example from the midwestern US, Scarlet Tanagers in a landscape that is 70% forested require only a 66-acre (27 ha) forest patch for breeding. If the landscape is reduced to 40% forest, however, the minimum area required by tanagers is 605 acres (245 ha).*

Forest Structure

Effects

When all the landscape level characteristics, such as forest size, degree of isolation, and landscape context are acceptable, forest structure and age become the key characteristics that determine a habitat's suitability for a particular bird species. A healthy forest aging under the natural forces of ecological succession typically has the most diverse vegetation structure. An important aspect of forest structure is the amount of vertical layering. Early and mid-successional forests often have two layers—an understory of shrubs and young trees and an overstory (canopy) of interlocking branches created by mature trees. Late-successional (mature) forests usually provide the greatest amount of vertical layering. It's possible to have several layers, including herbaceous ground cover, an understory of shrubs and saplings, an intermediate layer of small trees, a lower canopy of medium sized trees, and a primary canopy of mature trees (Figure 8). The diverse habitat associated with this vertical layering supports a wide variety of birds. For example, you may have Wood and Hermit thrushes in the understory, Red-eyed Vireos and Rose-breasted Grosbeaks in the intermediate layers, and Scarlet Tanagers and Black-throated Green Warblers in the canopy. Many forest birds, including the thrushes, depend on the cover, food, and nest sites provided by a diverse and well-developed understory.

Figure 8. *Late-successional forests often provide a high degree of vertical layering, including a dense shrubby understory important for thrushes and other birds. Photo by Kenneth V. Rosenberg*

Management Tips

- **Creating a Broken Canopy:** Permitting sunlight to reach the forest floor by creating gaps in the forest canopy will help to stimulate a poorly developed understory in mid-successional and mature forests. When understory vegetation is very deficient or absent, planting appropriate native, shade-tolerant shrubs, in addition to maintaining a broken canopy, may be required to establish an understory layer.
- **Employing Silviculture:** Silvicultural practices that create uneven-aged forests with well-developed, but broken, canopies usually provide the best habitat for forest birds. Avoid loss or change in tree-species diversity and fitness by minimizing "high-grading" (the removal of only the most valuable species and the most structurally superior trees). Where possible, preserve existing old-growth stands and provide for the development of future old growth by leaving areas undisturbed or unharvested for 150 years or more.
- **Controlling Ungulates:** Given the tremendous increase in white-tailed deer densities during the past three decades, it may be necessary to control deer numbers or forest access to preserve a well-developed understory (Figure 9). Where appropriate, hunting can help to control deer numbers. When hunting isn't feasible, deer exclosures (fences) can help to protect understory vegetation. In addition, grazing by livestock should be monitored carefully to detect signs of damage to the understory layer.

Figure 9. *Heavy browsing by white-tailed deer sometimes results in complete loss of understory shrubs and saplings, reducing the suitability of forests to thrushes and many other birds. Photo by Kenneth V. Rosenberg.*

Regional Management Guidelines for Thrushes

Using These Guidelines

The following sections provide specific information about the habitat requirements of forest thrushes in three forested regions—Eastern/Midwestern Forests, Western Forests, and Northern Forests. These guidelines are based primarily on the results of the Birds in Forested Landscapes project and focus on mitigating the effects of forest fragmentation on breeding thrushes. They describe the minimum area required to provide thrushes with high, moderate, or low levels of habitat suitability. In addition, for some species they describe the importance of selected patch-level characteristics, such as forest structure and amount of core habitat area.

Results from Birds in Forested Landscapes suggest that each species of forest thrush responds differently to forest fragmentation, and the degree of area sensitivity expressed varies by geographic region. We present specific guidelines for each of the three forest regions to assess more accurately the effects of forest fragmentation, and provide guidelines that are relevant within various portions of each thrush species' breeding range. For each forest region, we provide information designed to help land managers evaluate and improve habitat for thrushes in their area. Each regional profile includes:

- a map and description of available forest types
- literature review of habitat relationships for thrushes in that region
- estimates of minimum habitat areas required to support each thrush species
- the most common trees at sites containing thrushes
- results of forest structure analyses for each thrush species
- regional summaries that briefly present the most important management strategies for that region.

Using Minimum-Area Tables

Within each region, the likelihood that a forest patch of a given size will attract a given species of thrush varies based on the amount of forest remaining in the surrounding landscape and how close the patch is to the nearest large forest (more than 500 acres or 200 ha). We define a landscape as a 2,500-acre (1,000-ha) block surrounding each forest patch. Because the probability of finding thrushes in a forest patch may be dependent on the amount of forest in the surrounding landscape, we offer a range of minimum-area estimates for landscapes with differing proportions of forest. The minimum-area estimates are arranged in Minimum Area Tables that provide a range of patch sizes required to achieve varying levels of habitat suitability.

The Minimum-Area Tables can be used to help improve habitat for breeding thrushes. For instance, the tables can be used:

- In conjunction with topographical maps, aerial photos, and Geographic Information Systems (GIS), to remotely identify forest patches with a high probability of supporting breeding thrushes. Identifying forest patches remotely allows managers to maximize their inventory and management efficiency by first focusing their efforts on sites with the greatest need for protection and management.
- To predict the impacts of proposed management actions or land-use changes on the suitability of habitat for breeding thrushes.
- To determine the degree of habitat enhancement (reforestation) needed to increase the probability of attracting thrushes to a given forest patch.
- To develop long-term management plans at local, state, and regional scales.
- To make planning and mitigation decisions when habitat loss and fragmentation are unavoidable.

In the Minimum-Area Tables provided with each regional profile, acreage estimates are listed for three levels of habitat suitability. These are defined as follows:

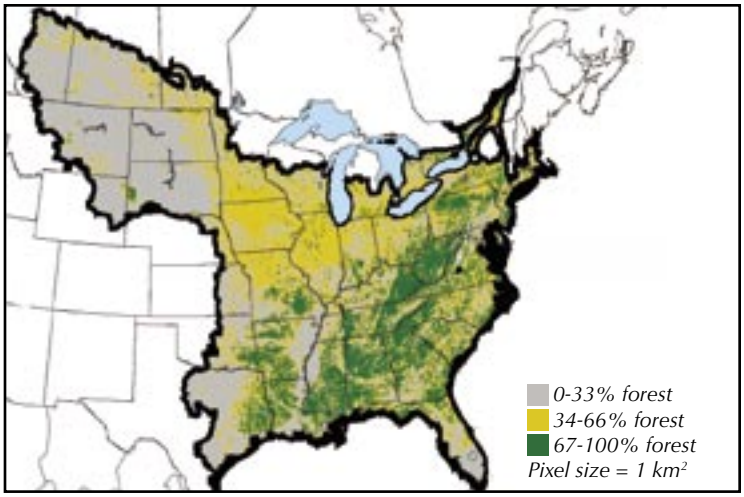
- **High Suitability:** Habitats of this size have the same probability of supporting breeding thrushes as a large patch of unfragmented forest.
- **Moderate Suitability:** Habitats of this size are 25% less likely to support breeding thrushes relative to unfragmented forest.
- **Low Suitability:** Habitats of this size are 50% less likely to support breeding thrushes relative to unfragmented forest.

To use the minimum-area tables, first estimate the percentage of forested land occurring in a roughly 2,500-acre (1,000-ha) block surrounding your area of interest. Then, read across the row to determine the minimum area required to achieve desired habitat suitability for thrushes. You can also use the tables to determine the suitability of your particular forest patch based on its size.

East/Midwest Forest Region

Description

We define the East/Midwest Forest Region as the vast area east of the Great Plains dominated by deciduous forest. Although highly variable in tree composition and forest structure, this large region tends to support a rather uniform bird community, including many widespread forest-breeding species such as the Wood Thrush.



Because the Great Plains experiences less precipitation than areas to the east, the broadleaf deciduous forests of this area tend to include more of the drought-tolerant oak-hickory association (Bailey 1995). Forests in the northern and eastern parts of the Midwest contain more maples, American beech, and basswood, whereas the western part becomes savanna-like as it gradually gives way to prairie. Oaks and hickories dominate upland forests in the prairie region, whereas farther west, floodplain forests contain cottonwood, willows, and elms (Bailey 1995). The more mountainous areas of Arkansas support oak-hickory forests that include coniferous trees, especially pines. Forests of the Midwest are typically highly fragmented by agricultural and, more recently, by urban development.

The Appalachian Mountains area is more heavily forested, with tree species composition changing with elevation. Vast forests are dominated by oaks, yet include some of the most diverse forests in North America. Lower valleys support mixed oak-pine forests, which are largely cleared, while at higher elevations the composition includes birches, American beech, maples, elms, oaks, and basswood, with some eastern hemlock and white pine. Finally, spruce-fir forests and meadows can be found on the highest peaks in some areas.

Along the Atlantic Coast, relatively small forested areas are typically found within a largely urban and suburban landscape. This is especially true in the corridor between Boston and Washington, D.C. Some extensively forested areas occur in central Massachusetts, southern New Jersey, and Virginia. The forests of the northern part of this area are mostly deciduous, especially the Appalachian oak association. Pine-oak forests (pine barrens) are also found in dry sandy locations that are frequently exposed to naturally occurring fires (Bailey 1995). Oaks, hickories, sweetgum, blackgum, red maple, and winged elm are also common.

Farther south along the coastal plain, evergreen oaks, laurels, and magnolias are common, while gum and cypress dominate coastal swamps. Historically, savannas of pine forests (longleaf, slash, and loblolly) with an understory of grasses and sedges dominate most of the uplands in this area. The piedmont forms a transition between the southeastern coastal plain and the Appalachian Mountains. It is dominated by both southern pines (such as loblolly and shortleaf) and mixed southern hardwoods (such as oak, hickory, sweetgum, blackgum, red maple, and winged elm). The Lower Mississippi River Valley was covered by huge tracts of bottomland-hardwood forest; however, most of the forests have now been cleared for agriculture. Other large and small river valleys still support important tracts of bottomland hardwoods.

Habitat Guidelines for Thrushes

Wood Thrush

The Wood Thrush is the most common thrush species throughout most of the East/Midwest Forest Region, occurring in many forest types from southern Canada to the Gulf Coast and the Great Plains. Although often considered a bird of mature, intact forests, this species shows much variability in habitat preferences across its range, and it certainly inhabits small woodlots in highly fragmented landscapes. A number of studies have shown, however, that habitats used by Wood Thrushes do not always provide the requisites for positive reproductive success, and that populations in highly fragmented forests may not be sustainable, perhaps contributing to regional population declines. Therefore, our guidelines below regarding minimum areas for Wood Thrush occupancy must be considered in combination with other habitat features that may be necessary for successful breeding.

In the Birds in Forested Landscapes study, Wood Thrushes were detected at 848 (54%) of 1,568 sites surveyed in the East/Midwest Region. Fifty-three percent of sites with Wood Thrushes were located in deciduous forest, 45% in mixed forest, and 1% in co-

niferous forest. The most common trees on sites occupied by Wood Thrush were oaks (65%), maples (62%), pines (25%), American beech (22%), and hickories (19%). Results from this study indicate that Wood Thrushes choose habitats based more on the structure of the forest than on the degree of forest fragmentation in the landscape. Specifically, Wood Thrushes selected areas at lower elevations with a higher density of saplings in the understory and a taller canopy. They avoided areas with a high proportion of coniferous trees. In addition, the Wood Thrush proved to be area sensitive, although the size of patches required did not appear to change with amount of forest fragmentation in the landscape. High suitability forest patches are at least 200 acres (80 ha), and suitability declines rapidly in patches less than 100 acres (40 ha; Figure 10). Small patches offer moderate suitability in terms of occurrence during the breeding season, but other research has shown that Wood Thrushes in small patches suffer decreased reproductive success.

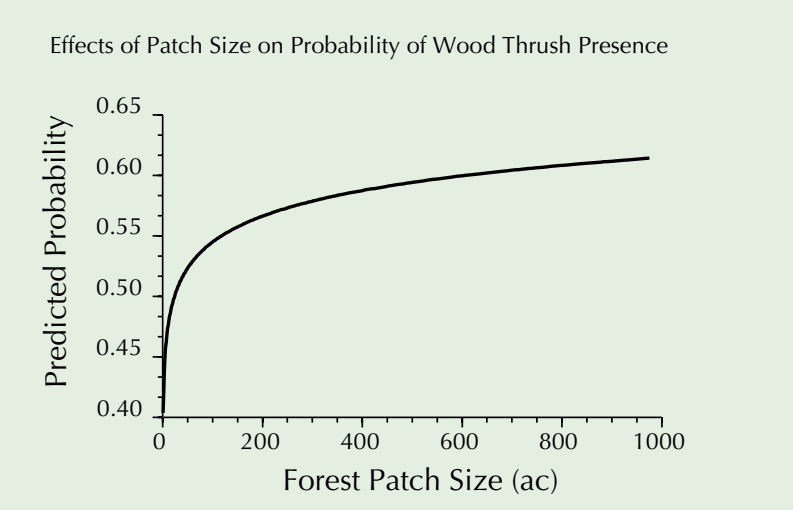


Figure 10. *The probability of finding breeding Wood Thrushes in the East decreases sharply in forest patches less than 200 acres (80 ha).*

In addition to landscape level considerations, most studies, including Birds in Forested Landscapes, indicate that a dense understory of saplings and shrubs is a key habitat requirement. In fragmented landscapes, an appropriate combination of habitat characteristics, such as forest size, amount of core area, amount of edge, and vegetation structure must be met to ensure adequate levels of reproduction that offset adult and fledgling mortality (Hoover 1992, Robinson and Wilcove 1994, Driscoll et al. in press). Driscoll et al. (in press) further documented that Wood Thrush populations in fragmented habitat with much edge suffered negative population growth rates, whereas populations in forest interiors or fragmented forests with less edge experienced positive population growth.

In a study of two riparian areas in central Ohio, Groom and Grubb (2002) found that the width of forested riparian corridors was less important than the amount of forest in the landscape for predicting Wood Thrush presence. Hoover (1992) found that nesting success was significantly higher in large (1,200 acre or 480 ha) forest patches versus small patches (23 acre or 9.2 ha) in Pennsylvania. The author also indicated that nesting survival was positively correlated with percent forest within a 1.2-mile (2-km) radius and the amount of forest core area. High rates of nest predation in small forest tracts (less than 200 acres or 80 ha) explained the lower nesting success in highly fragmented landscapes (Hoover et al. 1995). Numerous authors have found Wood Thrushes to be more abundant and successful in large forest patches, especially in highly fragmented landscapes such as the Midwest (Whitcomb et al. 1981, Galli et al. 1976, Lynch 1987). In general, forest patches exceeding 250 acres (100 ha) foster adequate rates of nesting success by mitigating the effects of predation and sometimes cowbird parasitism.

Robinson and Wilcove (1994) suggest that the effects of silvicultural practices depend on the landscape context and that low-volume selective logging is preferable to clear-cutting. Crawford et al. (1981) found that Wood Thrush tolerate uneven-age forest management and selective removal of mature trees scattered throughout a stand creates favorable conditions for the species.

In the Piedmont National Wildlife Refuge in central Georgia, which is actively managed for Red-cockaded Woodpeckers, Lang et al. (2002) found that small-scale thinning and burning had little effect on Wood Thrush populations. In southeastern Missouri, Wood Thrushes were most abundant in mature forest stands when compared with forest stands harvested by clearcut, shelterwood, group selection, and single-tree selection forest regeneration methods (Annand and Thompson 1997).

Veery

The Veery is a common thrush in the northern portions of the East/Midwest Forest Region and throughout the higher Appalachian Mountains. They tend to occur at higher elevations than the Wood Thrush and are associated more with northern-hardwood forests than with oak-hickory or bottomlands. The Veery has a strong affinity for wet sites, and although they may be common in disturbed or regenerating forests, they are highly area sensitive and not tolerant of high levels of forest fragmentation.

In the Birds and Forested Landscapes study, Veeries were detected at 302 (31%) of 971 sites surveyed in the East/Midwest Region. Fifty-five percent of

sites with Veeries were located in mixed forest, 44% in deciduous forest, and 1% in coniferous forest. The most common trees on sites occupied by Veeries were maples (73%), oaks (60%), pines (28%), American beech (21%), and hemlock (20%).

Results from this study indicate that Veeries are most affected by the degree of fragmentation in the landscape and by the size of forest patches, especially the amount of "core forest" away from edges. The most suitable sites are also those with a denser deciduous shrub understory. Highest-suitability habitat only occurs in landscapes with at least 70% forest cover, and in these landscapes, patches larger than 1,000 acres (400 ha) are required (Table 1). Even in landscapes with 80% forest, patches of roughly 400 acres (165 ha) are required; minimum area is reduced to 127 acres (51 ha) if forest cover increases to 90%. Smaller forest patches in more fragmented landscapes do provide moderate habitat suitability, however, patches greater than 300 acres (120 ha) are still required in landscapes with 40% forest.

Other studies suggest that Veeries use a variety of habitats in different parts of their range. In New York State, Veeries select early successional forest for breeding (Kendeigh 1945, 1946). In highland areas of North Carolina, it's a bird of mature oak forest (Odum 1950) and on Apostle Island in Wisconsin, it's found primarily in aspen and red oak forests where the understory is most dense (Beals 1960). In New Jersey, Veeries prefer moist forests that are 40–60 years old with a dense understory (Suthers 1987–1988).

Unlike the other forest thrushes, Veeries show a strong tolerance for disturbed forest with a well-developed understory (Dilger 1956). Noon et al. (1976) found that Veeries bred in 77% of available disturbed and successional forests, but only 18% of mature undisturbed habitat. Bertin (1977) suggested that in mature woodlands, moisture regime was the primary factor driving habitat selection, with the dampest areas occupied first and pointed to available shrub cover as the most critical habitat component. Veeries may benefit from selective harvesting that opens up the canopy and allows the understory to develop (Webb et al. 1977, Thompson and Capen 1988). Derleth et al. (1989) found that Veeries tolerated small clearcuts (2–20 acres or 1–8 ha), but Morgan and Freedman (1986) noted that Veeries were absent from large clearcuts for six years following the harvest.

Habitat selection may vary when other thrushes are present. In many portions of their range, Veery breed primarily in deciduous forest, even when coniferous forest is available. In a study conducted in Tennessee, in areas where their breeding range overlapped with Swainson's Thrush, the Veery used deciduous, coniferous, and mixed forests (Noon 1977). Although it was once absent from higher elevation spruce forests in the Appalachian Mountains, Veerys have expanded into the southern Appalachian spruce forests when congeners are not present (Noon 1981).

Hermit Thrush

In the East/Midwest Forest Region, Hermit Thrushes are restricted largely to the northernmost portions and also to higher elevations through the Appalachians where coniferous forests are dominant. Small populations occur in other coniferous habitats at lower elevations, including cedar swamps, hemlock ravines, conifer plantations, and pine barrens. Although this thrush is common and apparently increasing, it is nonetheless shown to be highly area sensitive and intolerant of forest fragmentation within its range.

In the Birds in Forested Landscapes study, Hermit

Table 1. *Minimum area required to provide high, moderate, or low habitat suitability for Veery based on analysis of 685 study sites in the East/Midwest region (see page 11 for definitions of habitat suitability).*

Percentage of forest in 2,500-acre block	Minimum area (acres) required for		
	High	Moderate	Low
90	127	3	Any size
80	396	10	Any size
70	1004	26	Any size
60	NA[a]	61	1
50	NA	136	2
40	NA	305	4
30	NA	708	9
20	NA	NA	24
10	NA	NA	74

[a]*Not Available—acreage values exceed the amount of forest in the 2,500-acre block.*

Table 2. *Minimum area required to provide high, moderate, or low habitat suitability for Hermit Thrush based on analysis of 347 study sites in the East/Midwest region (see page 11 for definitions of habitat suitability).*

Percentage of forest in 2,500-acre block	Minimum area (acres) required for		
	High	Moderate	Low
90	32	5	Any size
80	56	9	1
70	88	14	1
60	132	22	2
50	196	32	3
40	289	47	4
30	435	71	6
20	NA[a]	111	10
10	NA	193	18

[a]*Not Available—acreage values exceed the amount of forest in the 2,500-acre block.*

Thrushes were detected at 142 (26%) of 553 sites surveyed in the East/Midwest region. Seventy-seven percent of sites with Hermit Thrushes were located in mixed forest, 20% in deciduous forest, and 2% in coniferous forest. The most common trees present at sites occupied by Hermit Thrush were maples (75%), oaks (53%), pines (41%), hemlock (32%), and beech (27%).

Results from this study indicate that Hermit Thrushes are most attracted to forests with a high coniferous component, and they avoid sites with a largely deciduous shrub understory. They are also area sensitive, although less so than the Veery or Wood Thrush. In highly fragmented landscapes, single large forest patches may still offer highly suitable habitat for Hermit Thrush (Table 2), and even in more intact (50% forest) landscapes, patches roughly 200 acres (80 ha) in size are required. Smaller forest patches do offer moderately suitable habitat, especially if they contain the conifers.

In New York, Hermit Thrushes selected sites in dry coniferous, mixed, or deciduous forests and were sometimes associated with internal forest edges (Andrle and Carroll 1988, Dilger 1956). In forest communities in northwestern Wisconsin the abundance of Hermit Thrushes was related to the amount of edge and variables relating to patch shape (Hawrot and Niemi 1996).

Researchers compared two harvest techniques in riparian areas of northern Wisconsin (full tree harvest and cut-to-length (CTL)). Bird surveys one year prior to harvest and three years after harvest showed that bird communities were affected by both harvest types. Hermit Thrush, along with Ovenbird and Black-throated Green Warbler showed significant declines. Within three years of harvest no individuals of these species were observed (Hanowski et al. 2003).

Management Summary for the East/Midwest Forest Region

Landscape Level

In this region, the primary consideration for all thrush species is the maintenance of large contiguous forest patches that promote reproductive rates that compensate for adult and nestling mortality. Thrushes in this region will tolerate and may even benefit from patch-level disturbances such as light selective harvesting that does not contribute to forest fragmentation. The Veery and Wood Thrush are the most area sensitive of the three species in this region and thus set the bar for minimum forest size. The required forest patch size needed for consistent successful reproduction is highly related to surrounding land use (see Tables 1 and 2); in general however, forest patches of 150 acres (62 ha) or larger will be adequate to provide moderate levels of habitat suitability, except in landscapes with little forest. In landscapes with greater than 50% forest, smaller woodlots can provide suitable habitat. In highly fragmented forests or landscapes with very little forest cover, minimizing edge and increasing connectivity among forest patches may increase habitat quality in small patches. For Veeries, maximize core forest by reducing the amount of edge habitat associated with forest fragments. This can be done by managing patch shape, creating transitional, as opposed to abrupt edges, and reforesting areas between disconnected patches. In lowlands, especially in damp sites, management should focus on Wood Thrush; at higher elevations and in moist, mixed forests management should focus on both Veeries and Wood Thrushes; and in mostly coniferous forests and on drier sites, management should focus on Hermit Thrushes.

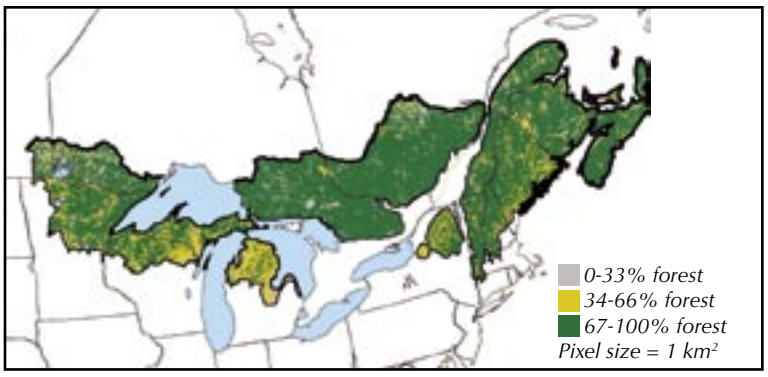
Site Level

For Wood Thrush and Veery, create and maintain forest habitat with a dense understory of deciduous saplings and shrubs. Because of its area sensitivity, focus site-level management for Wood Thrushes on patches greater than 200 acres (80 ha). This can be accomplished by planting appropriate native trees and shrubs, creating gaps in the canopy that permit sunlight to reach the forest floor, and controlling browsing by white-tailed deer and livestock. Moderate selective harvesting of timber is often tolerated by thrushes, and serves to increase the shrub layer. Clear cutting and heavy selective cutting are not recommended for thrush management. Hermit Thrush prefer a strong coniferous component and may benefit from conifer plantings or silvicultural practices that favor existing conifers, especially pines and eastern hemlock. Protecting stands of hemlock and cedar swamps within hardwood forests, as well as protecting large areas of pine-barrens habitat will also benefit Hermit Thrushes.

Northern Forest Region

Description

We define the Northern Forest Region as a wide band of coniferous and northern hardwood forest from the western Great Lakes to the Adirondacks of New York, northern New England, and the Canadian Maritime Provinces. This region corresponds to the Boreal-Hardwood Transition and Atlantic Northern Forest Bird Conservation Regions (U.S. NABCI Committee 2000).



The region is heavily forested throughout. The northern portion is boreal spruce-fir forest with deciduous species becoming more common further south. The area surrounding the Great Lakes and along the Atlantic coast is transitional between southern deciduous forests and the northern boreal spruce-fir forest. Deciduous forests tend to occur on favorable sites with good soils whereas coniferous forests are found on less-favorable sites with poor soils. Common tree species are yellow birch, sugar maple, American beech, white pine, and eastern hemlock (Bailey 1995). The mountainous areas of New York and New England have a vertical zonation of tree species. The valleys have deciduous forests of sugar maple, yellow birch, beech, and some hemlock. The lower slopes have mixed forests of spruce, fir, maple, beech, and birch. Finally, pure stands of balsam fir and red spruce can be found above the mixed-forest zone (Bailey 1995).

Habitat Guidelines for Thrushes

Wood Thrush

Within the Northern Forest Region, Wood Thrushes are common only in the transitional mixed-hardwood forests around the Great Lakes, southeastern Canada, and the Adirondack Mountains. They are strongly tied to the deciduous component of these forests and occur primarily at lower elevations. Wood Thrushes are a declining species in this region, and management to enhance populations is a high conservation priority.

In the Birds in Forested Landscapes study, Wood Thrushes were detected at 71 (30%) of 236 sites surveyed in the Northern Forest Region. Sixty-nine percent of sites with Wood Thrushes were located in mixed forest, 14% in deciduous forest, and 15% in coniferous forest. The most common trees on sites occupied by Wood Thrush were maples (70%), pines (51%), hemlock (38%), birch (38%), and beech (30%).

The relatively small sample of Wood Thrushes from this region indicates a high degree of area sensitivity that increases with degree of fragmentation in the landscape. For example, in landscapes with 70% forest cover, 200-acre (80-ha) patches are required to achieve high suitability for the Wood Thrush, and as forest cover drops below 40%, high habitat suitability cannot be achieved (Table 3). For moderate suitability, smaller patches may suffice; for example, a 50-acre (20-ha) patch in a 50% forested landscape (Table 3).

In Quebec, preferred habitat for this species is described as mature, undisturbed forest, with damp ground, dense shrubby undergrowth, and a thick layer of ground litter (Gauthier and Aubry 1996). Thus, Wood Thrush may be more of a habitat specialist in the northern portion of its range than further south.

Veery

The Veery is common throughout the southern and eastern portions of the Northern Forest Region, from Manitoba to the Maritime Provinces, northern New England, and the Adirondack Mountains. They

Table 3. *Minimum area required to provide high, moderate, or low habitat suitability for Wood Thrush based on analysis of 108 study sites in the Northern region (see page 11 for definitions of habitat suitability).*

Percentage of forest in 2,500-acre block	Minimum area (acres) required for		
	High	Moderate	Low
90	69	8	1
80	125	14	1
70	201	22	2
60	310	35	2
50	470	52	4
40	712	79	6
30	NA[a]	123	9
20	NA	198	14
10	NA	NA	26

[a]*Not Available—acreage values exceed the amount of forest in the 2,500-acre block.*

are most abundant in northern hardwood and transitional forests with a strong deciduous component at lower elevations. In Ontario, the range extends north where deciduous growth occurs in wetlands, after forest fires, or following timber harvest (Cadman et al. 1987).

In the Birds and Forested Landscapes study, Veeries were detected at 124 (49%) of 253 sites surveyed in the Northern Forest Region. Seventy-four percent of sites with Veeries were located in mixed forest, 17% in deciduous, and 8% in coniferous forest. The most common trees present on sites occupied by Veeries were maples (67%), birches (38%), pines (37%), hemlock (35%), and ash (21%).

Results of this study indicate that Veeries are less area sensitive than they are further south, with virtually any size forest patch providing suitable habitat in landscapes that are at least 50% forested. They are most strongly associated with dense deciduous shrubs in the forest understory.

In Maine, where Veery and Wood Thrush overlap, successional stage was found to be the most important difference in their habitat. Veeries inhabit younger forests and wetter areas than the Wood Thrush, while Hermit Thrushes and Veeries are sometimes found together in mixed coniferous-deciduous and/or mixed alder and maple forests (Morse 1971). Hagan and Grove (1999) found Veery to be most abundant in partially-cut forest in northern Maine. In Quebec, Veeries prefer an open canopy and dense understory (Gauthier and Aubry 1996), and they were predicted to benefit from tree removal in mature forests, resulting in greater shrub cover and understory development (Clark et al. 1983). In the White Mountains of New Hampshire, Welsh and Healy (1993) found Veeries significantly more abundant in managed rather than unmanaged stands.

Swainson's Thrush

The range of the Swainson's Thrush overlaps the entire northern forest region and extends northward into the boreal forest. In the southern portions, they occur generally at higher elevations than the Veery or Wood Thrush and are associated more with coniferous forests, especially spruce and fir.

In the Birds in Forested Landscapes study, Swainson's Thrushes were detected at 37 (25%) of 146 sites surveyed in the Northern Forest Region. Seventy-three percent of sites with Swainson's Thrushes were located in mixed forest, 22% in coniferous forest, and 5% in deciduous forest. The most common trees present on sites occupied by Swainson's Thrushes were birches (41%), maples (41%), firs (35%), spruces (35%), and aspens (32%). The small sample in this study did not indicate an affect of forest fragmentation on the Swainson's Thrush or allow the calculation of minimum area of forest required for high habitat suitability.

This species has been described as a bird of the extensive spruce-fir forests of Quebec, in areas of relatively mature forest with "not very heavy understory" (Gauthier and Aubry 1996). In Maine, Hagan and Grove (1999) found Swainson's Thrush to be the only thrush showing a significant association with mature forest, and to be more abundant in landscapes managed with partial-cut, rather than clearcut techniques. In a comparison of forest management techniques in Labrador that attempted to emulate natural disturbance, researchers compared bird abundances among burned and clear cut former black spruce sites after 5, 14, and 27 years of succession. Hermit Thrushes and Swainson's Thrushes were lower in clear-cut sites and peaked in the 14-year old burns where abundance exceeded that of mature forests. Swainson's Thrush was positively correlated with deciduous tree cover and negatively correlated with conifer cover. Logged areas did support some of the same bird species but did not mimic fire. This study suggests that forest managers may want to allow some forests to burn naturally (Simons et al. 2002).

Hermit Thrush

The Hermit Thrush occupies the entire northern forest region and extends northward through the boreal forest. It is common in both northern-hardwood and coniferous forests and is more strongly associated with conifers than the other thrush species. It also occurs on drier sites, such as jack pine and deciduous forests on sandy soils.

In the Birds in Forested Landscapes study, Hermit Thrushes were detected at 143 (54%) of 265 sites surveyed in the Northern Forest Region. Eighty percent of sites with Hermit Thrushes were located in mixed forest, 10% in deciduous forest, and 10% in coniferous

Table 4. *Minimum area required to provide high, moderate, or low habitat suitability for Hermit Thrush based on analysis of 111 study sites in the Northern region (see page 11 for definitions of habitat suitability).*

Percentage of forest in 2,500-acre block	Minimum area (acres) required for		
	High	Moderate	Low
90	25	2	Any size
80	71	7	Any size
70	166	16	1
60	359	34	2
50	750	71	4
40	NA[a]	148	9
30	NA	321	19
20	NA	NA	45
10	NA	NA	127

[a]*Not Available—acreage values exceed the amount of forest in the 2,500-acre block.*

forest. The most common trees present on sites occupied by Hermit Thrushes were maples (66%), birches (48%), pines (39%), hemlock (30%), and oaks (23%).

Results of this study indicate that Hermit Thrushes are adversely affected by forest fragmentation and are highly area sensitive in this region. In landscapes that are 70% forested, highly suitable habitat consists of forest patches at least 166 acres (67 ha). In 50% forested landscapes, the minimum area required increases to 750 acres (304 ha) (Table 4). Smaller patches provide moderately suitable habitat, however, except in highly fragmented landscapes with less than 20% forest cover. Sites with a high proportion of coniferous trees in the canopy are strongly favored.

The Hermit Thrush is often described as the most versatile of the thrushes in terms of habitat use, occurring in conifer or mixed forests on damp or dry sites (Gauthier and Aubry 1996). Morse (1971) found that Hermit Thrushes bred in dry mixed forests, while Veery and Wood Thrush were most commonly associated with wetter sites. In New Hampshire, Holmes and Robinson (1988) reported similar results with Hermit Thrush using dry forests away from streams with relatively little understory. They are also tolerant of clearings, burns, and regenerating areas within the forested matrix, as well as conifer plantations. Freedman et al. (1981) noted that in hardwood forests of Nova Scotia, Hermit Thrushes were present in "strip cuts," but not in clear cuts or thinned forests. In a comparison of burned and clear cut spruce forests 5, 14, and 27 years after succession in Labrador, Hermit Thrush density peaked in 14-year-old burns and was positively correlated with snag density (Simons et al. 2002). They were also most abundant in partially cut forest in northern Maine (Hagan and Grove 1999). Thus, this species appears tolerant of, or even to benefit from disturbance, including active management, within large expanses of forest, but not tolerant of high levels of forest fragmentation.

Management Summary for the Northern Forest Region

Landscape Level

In general, the Northern Forest Region is more heavily forested than the East/Midwest and Western Forest Regions. For this reason, habitat protection through long-term planning and enhancement of forest structure are the most important management considerations. A shifting mosaic of forest habitats at various successional stages will likely benefit the most species as long as disturbance and silvicultural practices don't lead to forest loss or fragmentation over the long-term. Small-scale timber harvesting may be compatible with forest bird management (including all thrushes) as long as forests don't become fragmented. In the Northern Forest Region, the most area sensitive species are the Wood Thrush and Hermit Thrush. Generally, forests of 150 acres (62 ha) or larger will provide these two species with high to moderate levels of habitat suitability. In highly fragmented landscapes with less than 40% forest, patches of 350 acres (140 ha) or larger are needed to supply high to moderate habitat suitability for Wood and Hermit thrushes. Enhancement of forest structure in small forest patches may be beneficial for the less area sensitive Swainson's Thrush and Veery.

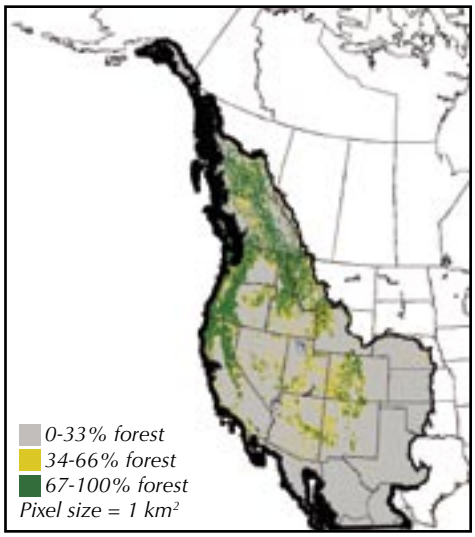
Site Level

In southern portions of the region with more deciduous trees, management should focus on Wood Thrush and Veery by promoting and retaining deciduous understory and maintaining deciduous riparian buffers. In coniferous forest areas, management should focus on Swainson's Thrush and Hermit Thrush—Swainson's Thrush seems to prefer mature, undisturbed spruce-fir forests with a sparser understory, whereas Hermit Thrushes are more tolerant of disturbance, but not forest loss or fragmentation. Create and maintain forest habitat with a dense understory of saplings and deciduous shrubs. This can be accomplished by planting appropriate native trees and shrubs, creating gaps in the canopy that permit sunlight to reach the forest floor, and controlling browsing by white-tailed deer and livestock. Moderate selective harvesting of timber is often tolerated by thrushes, and serves to increase the shrub layer. Clear cutting and heavy selective cutting are not recommended for thrush management. Hermit Thrush prefer a strong coniferous component and may benefit from conifer plantings or silvicultural practices that favor existing conifers, especially pines and eastern hemlock.

Western Forest Region

Description

We define the Western Forest Region as all areas west of the Great Plains, including vast, primarily coniferous forests from the Rocky Mountains west to the Pacific Ocean.



Along the Pacific coast, forests are dominated by cedar, hemlock, and sitka spruce to the north, and Douglas-fir, western red cedar, hemlock, and redwoods further south. Willow, cottonwood, alder, and birch can be found at lower elevations and along rivers (Bailey 1995). The coniferous forests of the Sierra Nevada Mountains are dominated by ponderosa pine on western slopes with lodgepole pine and Jeffrey pine replacing the ponderosa pine on the eastern slopes. Mountain hemlock, fir, spruce, and various pines can be found at higher elevations. In coastal California, the sclerophyll forest contains species such as live oak, laurel, madrone, and bayberry that have thick, leathery leaves that can tolerate dryness.

The remainder of the intermountain west consists primarily of coniferous forests at higher elevations, interspersed with grasslands, sagebrush, and shrubs in the lowlands. Some areas of broadleaf forest, especially aspen, are also found here. Tree species composition is strongly dependent on elevation and slope exposure. Throughout the Rocky Mountains, Engelmann spruce and subalpine fir dominate most of the subalpine areas. Douglas-fir, western redcedar, western hemlock, western white pine, western larch, grand fir, ponderosa pine, and lodgepole pine are common forest types below the subalpine zone (Bailey 1995). In the southern foothills and lower plateaus, scrub oaks are common along with pinyon-juniper woodlands. Mountains of Arizona, New Mexico, south through northern Mexico support diverse pine-oak forests, with important riparian woodlands occurring in canyons and along lowland river valleys.

Habitat Guidelines for Thrushes

Veery

The Veery is an uncommon species in western forests, where it is largely restricted to riparian and other deciduous vegetation at middle and lower elevations. In the Birds in Forested Landscapes study, Veeries were detected at only 15 (11%) of 138 sites surveyed in the Western Forest Region. This small sample did not allow analysis of habitat preference or affects of forest fragmentation.

Tewksbury et al. (2002) found that in riparian areas of the West (Montana, Idaho, Nevada, and Oregon), Veeries were less common in grazed sites, in heavily settled or agricultural landscapes, or in areas with little deciduous riparian habitat. They recommended that "management should focus on (1) preserving and enlarging deciduous habitats, (2) reducing cattle grazing in deciduous habitats, and (3) protecting the few relatively pristine landscapes surrounding large deciduous riparian areas in the West."

Swainson's Thrush

The Swainson's Thrush is widespread in the Western Forest Region, with two distinct populations showing rather different habitat associations. In the interior portions, this species is found in montane coniferous forests, but is often associated with deciduous or riparian vegetation at lower elevations. On the pacific slope, Swainson's Thrush is found to sea level, primarily in riparian forests.

In the Birds in Forested Landscapes study, Swainson's Thrushes were detected at 156 (43%) of 365 sites surveyed in the Western Region. Habitats occupied by Swainson's Thrushes differed between the Pacific and interior portions of the region; in the Pacific, 62% of occupied sites were in mixed forest, 20% in coniferous, and 16% in deciduous forest, whereas in the interior, 49% of sites were in mixed forest, 48% in coniferous, and only 2% in deciduous forest. The most common trees on sites occupied by Swainson's Thrushes were Douglas-fir (56%), pines (33%), alder (22%), cedar (21%), and spruce (21%). Results of this study indicate that Swainson's Thrush is highly associated with deciduous shrubs in the forest understory. In the Pacific portion of the region, this species was not adversely affected by reduction in forest area or patch size, but in the interior portion, they were strongly area sensitive and found highly suitable habitat only in the most extensively forested landscapes (Figure 11).

Although characterized as an area-sensitive species, results from several western studies report conflicting results. Swainson's Thrushes were found to be area sensitive in cedar-hemlock forest in Idaho and

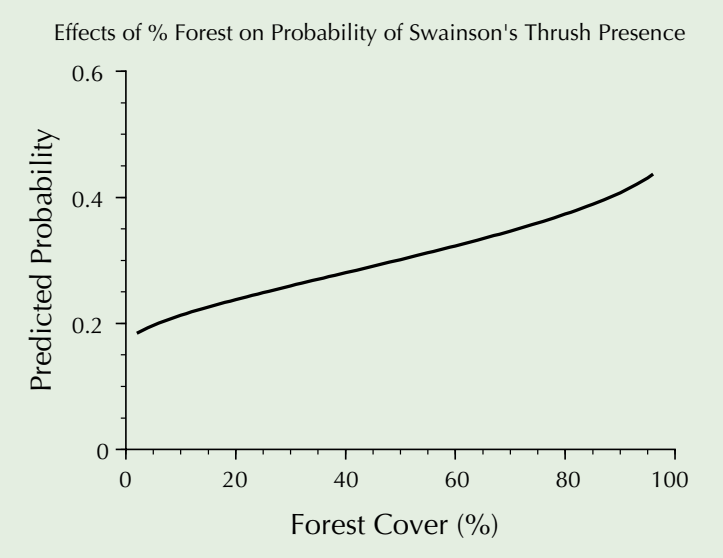


Figure 11. *The probability of finding breeding Swainson's Thrushes decreases as amount of forest in the landscape is reduced.*

riparian areas in Nevada (Freemark et al. 1995), but not in Douglas-fir forests of the Pacific Coast (Lehmkuhl et al. 1991). Evans 1995 found that abundance was not significantly correlated with patch size in mature forest or edge in mixed coniferous forest of the northern Rockies. Stands in more fragmented landscapes; however, had fewer nests and lower nest success than stands in more contiguous landscapes in the same study area (Evans et al. 1998). Hejl et al. (2002) reported that Swainson's Thrushes in the Central Rocky Mountains were positively associated with amount of forest and patch size, and negatively associated with edge in "all coniferous forest," but found no relationship among these habitat variables in "mixed conifer," "cedar/hemlock," or "ponderosa pine forest."

In coniferous forests of the northern Rockies, there is a generally consistent response to silvicultural practices, with the highest abundances occurring in unlogged old-growth stands (Johnston 1949, Hejl et al. 1995). Along the Oregon coast, immediate and significant declines were noted after substantial reductions in forest cover that resulted from silvicultural practices.

In British Columbia, Swainson's Thrushes are sensitive to the silvicultural practice of removing deciduous vegetation from regenerating coniferous forests. In a comparison of 11–22 year old conifer plantations (54–116 acres or 22–47 ha), nest sites were positively correlated with remaining deciduous vegetation. This relationship was strongest in areas with the fewest deciduous trees. Nest success was positively correlated with the amount of willow associated with the nest site (Easton and Martin 2002). In northwestern California, Swainson's Thrush occurred in highest densities along edges, but edges also experienced higher rates of nest predation, suggesting that these habitats may represent ecological traps in this region (Brand and George 2000).

Hermit Thrush

The Hermit Thrush is widespread throughout the Western Forest Region, in coniferous forests of the interior mountains, as well as on the Pacific Coast. In the Birds in Forested Landscapes study, Hermit Thrushes were detected at 142 (30%) of 470 sites surveyed in the Western Region. Fifty-seven percent of sites with Hermit Thrushes were located in coniferous forest, 42% in mixed forest, and 1% in deciduous forest. The most common trees present on sites occupied by Hermit Thrushes were pines (56%), Douglas-fir (44%), fir (30%), spruce (27%), and aspen (23%). Compared with other thrushes, Hermits occupied drier sites, with fewer than expected sites being close to streams or other surface water.

Results of this study indicate that Hermit Thrushes are highly area sensitive and associated with the most extensive forests. In landscapes with 70% forest cover, this species requires patches greater than 160 acres (65 ha) for high suitability habitat (Table 5). If forest cover is reduced to 50%, over 800 acres (320 ha) is required, and landscapes with less than 40% forest cover do not provide any highly suitable habitat. Smaller patches may provide moderately suitable habitat, however. Hermit Thrushes in the West are not as strictly associated with coniferous forest cover as this species is in the East.

A study in southeastern Wyoming of the effects of timber harvest that, at least initially, interrupted large expanses of old-growth forest with small strip or patch clearcuts compared avian species composition

Table 5. *Minimum area required to provide high, moderate, or low habitat suitability for Hermit Thrush based on analysis of 302 study sites in the Western region (see page 11 for definitions of habitat suitability).*

Percentage of forest in 2,500-acre block	Minimum area (acres) required for		
	High	Moderate	Low
90	20	1	Any size
80	64	2	Any size
70	163	5	Any size
60	385	12	Any size
50	873	26	Any size
40	NA[a]	60	1
30	NA	141	1
20	NA	361	4
10	NA	NA	12

[a]*Not Available—acreage values exceed the amount of forest in the 2,500-acre block.*

and abundance in uncut forests, forest interiors, meadow edges and clearcuts. Of the 16 species studied, Hermit Thrushes were one of the most negatively affected by fragmentation (Keller and Anderson 1992). The authors suggest that the distribution of birds may not strictly be a preference or avoidance of forest edges and interiors but a result of the loss of resources from clearcutting or preferences for the habitat adjacent to the forest stand (meadows or clearcuts). Franzreb and Ohmart (1978) found that in the White Mountains of Arizona the number of territories in unlogged 40-ha forests were almost twice that of selectively logged areas of the same size. Hejl et al. (2002) found that Hermit Thrushes were positively associated with patch size and negatively associated with edge in the central Rocky Mountains.

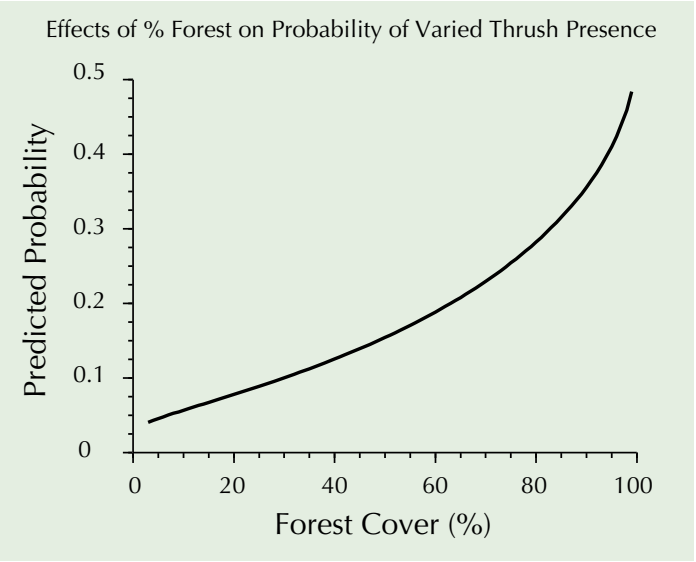


Figure 12. *The probability of finding breeding Varied Thrushes decreases sharply as amount of forest in the landscape is reduced.*

Varied Thrush

The Varied Thrush is a characteristic species of the tall coniferous forests of the northern Pacific Coast and northwestern mountain ranges. In the Birds in Forested Landscapes study, Varied Thrushes were detected at 40 (21%) of 186 sites surveyed in the Western Forest Region. Fifty-eight percent of sites with Varied Thrushes were located in coniferous forest, and 42% were in mixed forest. The most common trees on sites occupied by Varied Thrushes were spruce (58%), hemlock (43%), cedar (38%), pines (38%), and Douglas-fir (35%). Occupied sites were also more often closer to streams or other water than expected. The small sample in this study indicated a strong reduction in habitat suitability as the amount of forest in a landscape is reduced (Figure 12).

Studies throughout the Varied Thrush's range, indicated that this species has the highest breeding densities in mature and old-growth stands (Carey et al. 1991, Gilbert and Allwine 1991, Manuwal 1991, Tobalske et al. 1991, Bryant et al. 1992, Hazard and George 1999). There is no difference in breeding densities, however, between second-growth (20 year-old stands) in southeastern Alaska and old-growth stands (Dellasala et al. 1996). In northern California, Hurt (1996) found that Varied Thrushes rarely breed in suitable forest stands less than 40 acres (16 ha) in size but stands greater than 40 acres (16 ha) were almost always occupied. Also in northwestern California, Brand and George (2000) found Varied Thrushes to be associated with forest interiors and to avoid edges. In general, logging and fragmentation of mature old-growth forest will likely have negative impacts on Varied Thrush populations.

Management Summary for the Western Forest Region

Landscape Level

On large forests in the Western Region, especially on public lands, long-term management should focus on protecting existing forests and avoiding fragmentation whenever possible. Avoid creating edge by sub-dividing contiguous habitat. Protection and enhancement of riparian habitat will likely benefit Veery and Swainson's Thrush. Long-term planning for the Varied Thrush should include maintaining a high percentage of mature and old-growth forest in the overall landscape.

Site Level

In general, little is known about site-level habitat requirements for thrushes and other forest birds in the Western Region. Managers can contribute by monitoring the effects of pre- and post-fire management, silvicultural activities, grazing and other land uses. As in other regions, thrush populations in the West will most likely benefit from the creation and maintenece of dense understory. For Swainson's Thrush, protect and enhance deciduous shrubs in the understory in both coniferous and riparian forests. Reducing grazing-pressure, especially in riparian zones, will help promote understory vegetation used by western thrushes.

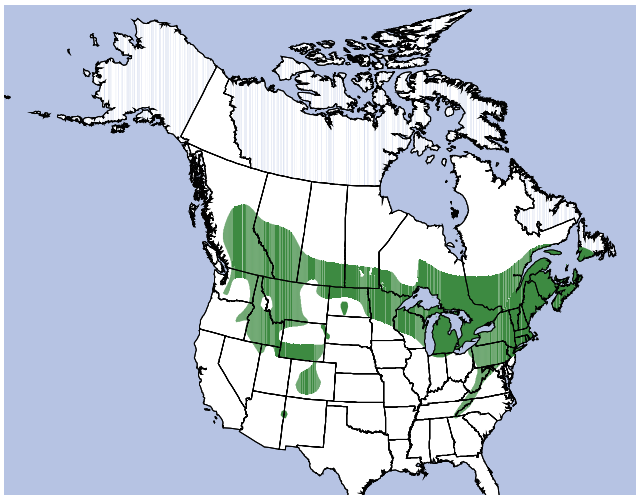
Veery (Catharus fuscescens)

Conservation Status

The Veery is of moderate conservation importance, primarily because of its declining population trend in much of its range (30% decline overall since 1966) and its vulnerability as a long-distance migrant wintering in tropical forests of South America. Fortunately it is still a very common species in most of its eastern range, where it also seems tolerant of some forest disturbance. In the West, this species is indicative of healthy riparian forests.

Habitat and Nest Site

Inhabits damp, deciduous forest and riparian habitats, generally younger stands and secondary growth areas with an open canopy and dense understory. Its preference for riparian areas is strong in several areas, including the Great Plains where forest is limited (Tubbs 1980). Habitat selection may depend on the presence of other thrush species in its breeding range. For example, the Veery may breed in mixed conifer-hardwood forest at middle elevations in areas where it overlaps with the Swainson's Thrush (higher elevations) or Wood Thrush (lower elevations). In other areas, they use alder or willow swamps, hemlock ravines, oak or beech-maple forests, or aspen woodlands. Nests on or just above the ground, generally not higher than 4 feet (1 m), often in a low shrub or brush pile. May be concealed in a grass tussock or under fallen limbs or a stump. Forest fragmentation increases the Veery's vulnerability to Brown-headed Cowbird parasitism. In Ontario, cowbirds parasitize 19% of nests, while in Alberta and Manitoba 87% of nests are parasitized (Friedmann et al. 1977). In winter, Veeries inhabit mature lowland rainforest, primarily in western Amazonia.



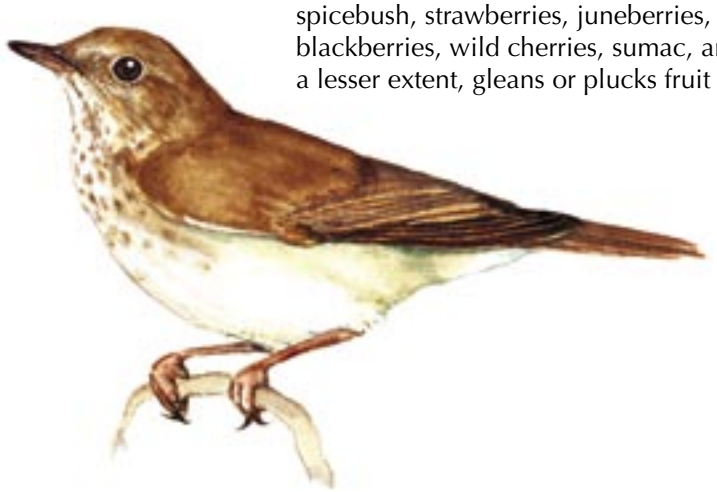
Vocalizations

Song: A resonating, ethereal *da-vee-ur, vee-ur, veer, veer*, consisting of a slurred series of downward inflected notes. Each note gets progressively lower in pitch, creating the sensation of spiraling or cascading down the scale. Some songs may begin with a simple, non-inflected note and end with a rolling note.

Call: The call notes are generally lower pitched than those of other thrushes. The most common call, used in a hostile situation, is a downward inflected *vee-ur* or *veee-oo*. They also have a *jerk* or *njernt* call.

Foraging Behavior/Diet

Forages mostly on the ground for beetles, caterpillars, spiders, centipedes, snails, pill bugs, ants, wasps, and tupulid flies by turning over leaves with bill. Sometimes searches for prey from a perch, such as a low branch in a shrub or tree or from a rock generally close to water. Swoops to the ground and grabs prey when sighted. In the fall and winter eats more fruit; spicebush, strawberries, juneberries, honeysuckle, blackberries, wild cherries, sumac, and blueberries. To a lesser extent, gleans or plucks fruit from the foliage.



Veery by Evan Barbour

Swainson's Thrush *(Catharus ustulatus)*

Conservation Status

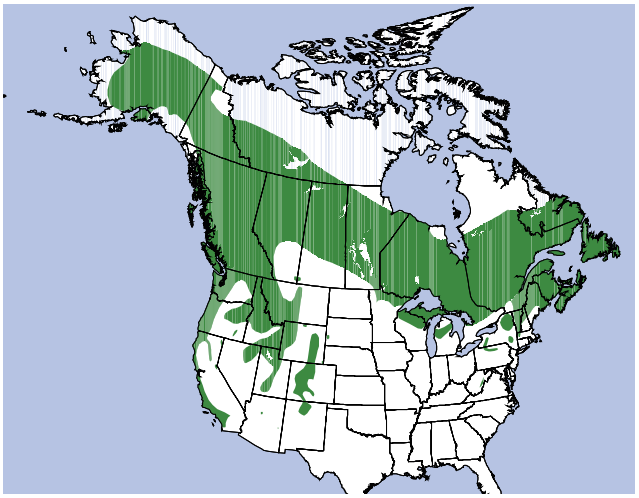
The Swainson's Thrush has a large range and is very common in many areas, yet it is experiencing steady population declines in regions such as California and the Maritime Provinces. It is of conservation importance because of its association with many types of coniferous as well as riparian forests for breeding, and because of its vulnerability to tropical deforestation in South America.

Habitat and Nest Site

Breeds primarily in coniferous forests, or mixed forest dominated by spruce, fir, white cedar, or tamarack. They may be found in both undisturbed and disturbed woodlands with dense understory, often near canopy gaps produced by fallen trees or other disturbances. Nest is typically 4–7 feet (1.2–2 m above ground in a small fir, spruce, hemlock, vine maple, alder, or willow on a horizontal branch near the trunk. In winter, Swainson's Thrushes inhabit mature Amazonian and Andean rainforests, as well as other mature tropical forests in Central America.

Vocalizations

Song: A slurred series of notes spiraling upward in pitch. It is quite complex and variable and has been characterized as *whip-poor-will-a-will-e-zee-zee-zee* with the last notes often running together in a high trill.



Call: The most common call is a loud, sharp *whit*; also a clear, slightly inflected whistled note, *feee-ee*. The nocturnal flight call is an abrupt whistle that sounds very similar to the spring peeper.

Foraging Behavior/Diet

Mostly a ground feeder; also forages from branches as well as by hawking insects on the wing. Eats beetles, weevils, ants, wild bees, wasps, caterpillars, spruce bud moths, mosquitoes, crane flies, treehoppers, cicadas, spiders, millipedes, snails, sowbugs, and earthworms. Most frequently hunts from a low branch, hopping from perch to perch searching for prey on the ground or within low branches. Becomes more frugivorous during the late summer, fall, and winter, when diet includes cherries, blackberries, raspberries, seeds of twinberry, and elderberry.

Swainson's Thrush by Evan Barbour

Hermit Thrush *(Catharus guttatus)*

Conservation Status

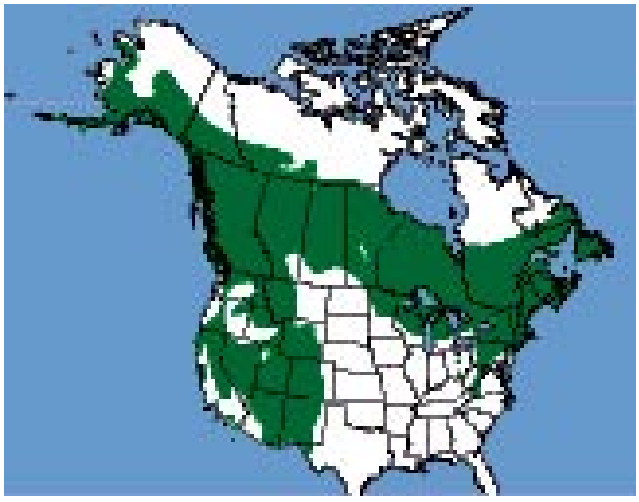
Among the forest thrushes, the Hermit Thrush is the one species that shows stable or even increasing population trends throughout its large range. It is seemingly tolerant of various disturbances, but in many areas it is a species associated with large and mature forests. Why this species is so successful while closely related thrushes are declining is one of the mysteries conservation biologists are presently studying.

Habitat and Nest Site

Inhabits coniferous and mixed coniferous-hardwood forests, chiefly at higher elevations up to tree line in the northern Appalachians and in the western mountains. Also breeds at lower elevations across the northern coniferous forests, in hemlock ravines, conifer plantations, and even to sea level in pine barrens and cedar swamps. In the East, the nest is usually on the ground, well hidden under a small tree, bush, fern, or in a natural depression. In the West, it generally nests above ground in a tree or shrub, conifer sapling, or on top of a stump or log. There are some accounts of nests under eaves of a building or on a rock ledge. Generally found near an edge or gap rather than in the interior of a forest. In winter, Hermit Thrushes are found in a variety of wooded habitats, including suburban yards and woodlots, in the southern United States and Mexico.

Vocalizations

Song: A melodious, flute-like warble, made up of a series of varied phrases separated by long pauses, beginning with a clear whistled introductory note. The



phrases vary considerably in pitch and seem to trail off at the end of each phrase.

Calls: Two common call notes: a soft *chuck* or *chup* and a harsh, rising *wee-er*, similar to the call of a catbird, given as an alarm or when the bird is agitated.

Foraging Behavior/Diet

Forages on ground by scanning and turning fallen leaves over with bill to search for beetles, ants, caterpillars, grasshoppers, crickets, spiders, sow bugs, snails, earthworms, and sometimes salamanders. Also gleans from foliage and branches in the understory and in young saplings, occasionally higher up in the trees. In the fall and winter eats more fruit: pokeberries, serviceberries, grapes, elderberries, mistletoe berries, and raspberries. Sometimes takes insects or berries from vegetation above ground while hovering.

Hermit Thrush by Evan Barbour

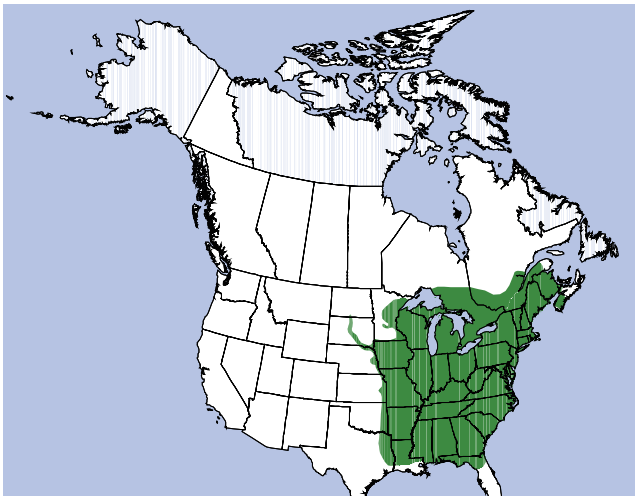
Wood Thrush (*Hylocichla mustelina*)

Conservation Status

Even though it's one of the most common species in eastern forests, the Wood Thrush is of high conservation concern because of long-term, range-wide declines that have resulted in a 43% overall population decline since 1966. It is included on Partners in Flight's Watch List for the United States and Canada. This species seems to be dependent on large tracts of mature forest in some parts of its range, but is tolerant of fragmentation in other areas. In winter, it is highly vulnerable to tropical deforestation in the lowlands of Central America.

Habitat and Nest Site

Breeds in the interior and edges of deciduous and mixed forests, generally in cool, moist sites, often near water. Requires moderate to dense understory with a lot of shade, moist soil, and decaying leaf litter. Shows much variation in habitat use, from mature deciduous forests in the Southeast, to shrubby second-growth forests and suburban parks in the Northeast to riparian habitats in the Great Plains. The nest is usually on the lower limbs of a tree or shrub, usually 10–13 feet (3–4 m) above ground; 2–70 feet (0.5–21 m) possible. Nest is placed generally near or against the trunk, hidden among leaves in a shady area. Also found in a crotch or fork supported by small branches. It may be anchored to a branch with mud. In winter, Wood Thrushes inhabit mature, lowland tropical forests.



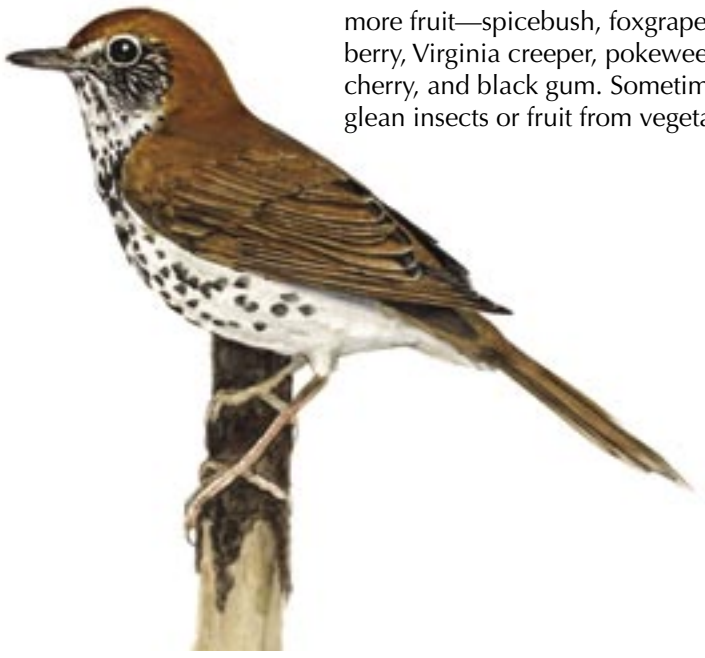
Vocalizations

Song: A series of yodeled phrases with a pause in between each phrase. A phrase consists of three distinctive parts: one or two short, low notes, quickly followed by a complex, flute-like note. It ends with a short, high trill. The phrase sounds like *ee-oh-lay*.

Calls: A rapid series of notes that sound like *pit-pit-pit* or *wik, wik, wik, wik, wik*. Nocturnal flight call an emphatic buzzy *heeh*, given on the same tone or only slightly descending.

Foraging Behavior/Diet

Forages by gleaning and probing for beetles, ants, moths, caterpillars, millipedes, and isopods in the leaf litter on the forest floor. In the late summer and fall eats more fruit—spicebush, foxgrape, blueberry, holly, elderberry, Virginia creeper, pokeweed, dogwood, black cherry, and black gum. Sometimes hawks or hovers to glean insects or fruit from vegetation above the ground.



Wood Thrush by Evan Barbour

Varied Thrush *(Ixoreus naevius)*

Conservation Status

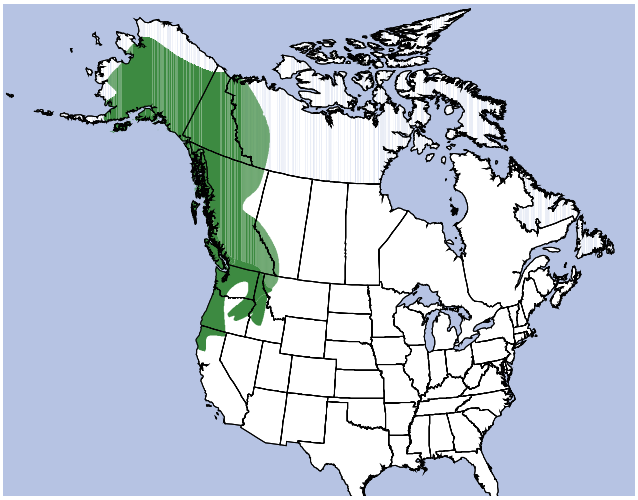
The Varied Thrush is of regional conservation importance, primarily because of its association with mature coniferous forests of the Pacific Northwest, and because of its relatively small total range. Populations appear to be stable at present, although they fluctuate greatly in many areas.

Habitat and Nest Site

This thrush loves shady, cool, and damp areas and is a characteristic species of the Pacific coastal rainforests. It inhabits mostly tall coniferous forests, such as redwoods, Douglas-fir, and spruce, from coastal to subapline, usually with a dense understory. Also inhabits some deciduous forests, especially at the northern edge of the range. Nest is usually 6–20 feet (2–6 m) above the ground in a small conifer, but occasionally built in a deciduous tree, small fir, spruce hemlock, vine maple, or willow. The nest is generally built against the trunk, supported by small branches and hidden in the foliage. Varied Thrush occupy a broad range of habitats in the winter and are most frequently observed in areas where fruiting shrubs provide a food source. Will also visit bird feeders in the southern part of their wintering range.

Vocalizations

Song: Each song phrase is a single note: a long, vibrating, metallic whistle, with a long pause between notes. Each note is delivered in a slightly different key and pitch, with no particular order. It may sing these notes in continuous succession for several minutes.



Call: Low *chook* and a variety of ringing whistles similar to the notes in the song. It will often call in a soft, faint tone while feeding on the ground.

Foraging Behavior/Diet

Commonly forages on the ground under damp and thickly matted leaves for beetles, ants, bees, wasps, flies, caterpillars, grasshoppers, crickets, some spiders, myriapods, snails, sowbugs, and earthworms. Scratches the dead leaves aside with both feet at once, seizing some litter in its beak and scattering leaves in various directions. Generally keeps under shady retreats among mosses and rocks. In the fall and winter feeds mostly on madrone berries, acorns, weed seeds, sowberries, juniper berries, blackberries, blueberries, raspberries, buckthorn, poison oak, and pepperberries. Occasionally gleans or picks invertebrates or fruit from vegetation.

Varied Thrush by Evan Barbour

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