

GOLDEN-WINGED WARBLER HABITAT

Best Management Practices for Forestlands in
Maryland and Pennsylvania



ACKNOWLEDGEMENTS

Development of this Best Management Practices was funded through a grant from the National Fish and Wildlife Foundation in cooperation with American Bird Conservancy and Appalachian Mountains Joint Venture. Contributors to this publication include Daniel Brauning, Tammy Colt, Douglas D'Amore, Douglas Gross, Timothy Ladner, Bruce McNaught, Tricia Miller, Daniel Petit, Debra Reynolds, Amber Roth, Samara Trusso, and Justin Vreeland. We would like to thank Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry, the Pennsylvania Game Commission, and Blooming Grove Hunting and Fishing Club for personnel, resources, and access to their lands, and Cathy and Warren Cooke for their financial contribution. Technical review of this publication was provided by: Kyle Aldinger, John Confer, James Finley, Mack Frantz, Douglas Gross, Scott Stoleson, Petra Wood, and Andrew Vitz.

Authors of this publication are Marja H. Bakermans and Jeffery Larkin, Indiana University of Pennsylvania; Brian Smith and Todd Fearer, Appalachian Mountains Joint Venture, American Bird Conservancy; and Benjamin Jones, Pennsylvania Game Commission.

Recommended citation. Bakermans, M. H., J. L. Larkin, B. W. Smith, T. M. Fearer, and B. C. Jones. 2011. Golden-winged Warbler Habitat Best Management Practices for Forestlands in Maryland and Pennsylvania. American Bird Conservancy. The Plains, Virginia. 26 pp.

Design by Debra Reynolds, U.S. Fish and Wildlife Service. Cover photo provided by ©David Speiser www.lilibirds.com.



Golden-winged Warbler, Christian Artuso

CONTENTS

Introduction.....	1
Goals.....	2
Conservation Concerns.....	2
Associated Species.....	3
Where to Focus Efforts.....	4
Golden-winged Warbler Biology.....	5
Identification.....	5
Breeding Biology.....	6
Habitat Needs.....	7
Nesting Habitat.....	8
Habitat Management.....	9
Landscape Scale.....	11
Forest Cover.....	11
Elevation.....	11
Disturbances.....	11
Proximity to Other Suitable Stands.....	12
Temporal Scale.....	13
Stand Scale.....	15
Forested Edge.....	15
Stand Shape.....	15
Edge Type.....	15
Within-stand Considerations.....	16
Residual Trees and Snags.....	16
Saplings and Low-growing Woody Cover.....	18
Ground Cover and Patchiness.....	19
Dead or Downed Wood.....	20
Unique or Important Features.....	20
Additional Management Tools.....	21
Integration with Energy Development.....	22
Integration with American Woodcock BMP.....	23
Summary.....	24
References.....	25



Golden-winged Warbler nestlings. Keith Watson

INTRODUCTION



Female Golden-winged Warbler. ©William Majoros at <http://www.billmajoros.com>

The Golden-winged Warbler (*Vermivora chrysoptera*) is a migratory songbird that spends its summers in the eastern and north-central portions of the United States and southern Ontario and winters in Central and northern South America. Throughout late spring, Golden-winged Warblers can be heard singing their buzzy song (zee bee bee bee) in a variety of early successional habitats throughout portions of Pennsylvania and Maryland. This species is one of the most critically threatened, non-federally listed vertebrates in eastern North America. In 2010, the Golden-winged Warbler was petitioned for listing under the Endangered Species Act. Golden-winged Warbler population declines are due to competition and hybridization with a close relative, the Blue-winged Warbler (*Vermivora cyanoptera*) and loss of young forest habitats. As such, management for Golden-winged Warbler breeding habitat in areas devoid of Blue-winged Warblers is a conservation priority.

This BMP was developed from two primary sources: existing Golden-winged Warbler habitat literature from studies across its breeding range and data collected in Pennsylvania specifically for this publication. Pennsylvania data were collected at 203 timber harvests that varied in size (range = 3 – 583 acres), age (0 – 17 years since harvest), forest cover within 0.6 miles (26 – 100%), and residual basal area (0 – 140 ft²/acre). All of the stands used in this study were created through regular operations and none were planted restorations. Over two field seasons, we surveyed 239 point counts over 2 - 3 occasions (total n = 619 visits) to document Golden-winged Warbler presence across these varied stands. Golden-winged Warblers were detected in 23% of stands allowing us to compare stand- and landscape-level habitat variables in stands with and without Golden-winged Warblers. In addition, we are creating this Best Management Practices (BMP) document with an adaptive management framework where subsequent research in Pennsylvania and Maryland will be used to modify or add additional management recommendations.

Golden-winged Warblers are one of 50 species of birds in eastern North America that rely on early successional habitat. While early successional habitat is clearly important for species that use it for breeding, it also provides post-fledging and migratory stop-over habitat for mature-forest breeders.

GOALS

The goal of this BMP is to present management prescriptions to forest managers interested in providing breeding habitat for Golden-winged Warblers through management actions associated with timber harvesting. We provide a science-based approach in an adaptive management framework to understanding breeding habitat use of Golden-winged Warblers across a range of timber harvest prescriptions in Pennsylvania and Maryland. This document is intended for use by state and private foresters, biologists, and other land managers. We anticipate that this BMP is the first document in a series that will address management of other early successional habitat used by Golden-winged Warblers including old fields, reclaimed strip mines, scrub oak barrens, and aspen cuts.

CONSERVATION CONCERNS

Across its breeding range, Golden-winged Warbler populations have declined annually by a rate of 2.3% over the last 40 years (Figure 1). Yet Breeding Bird Survey data for Pennsylvania and Maryland reveal that Golden-winged Warblers have declined at a stunning 6.8 and 5.5% per year, respectively (Figure 1). Several factors are thought to be driving the decline of this species across most of its historic breeding range. Loss of young forest habitat explains the general decline of shrubland birds; however, Golden-winged Warbler population declines are about 5x greater than the average rate of change for all other shrubland species. This is partially due to the expansion of, and hybridization with Blue-winged Warbler.

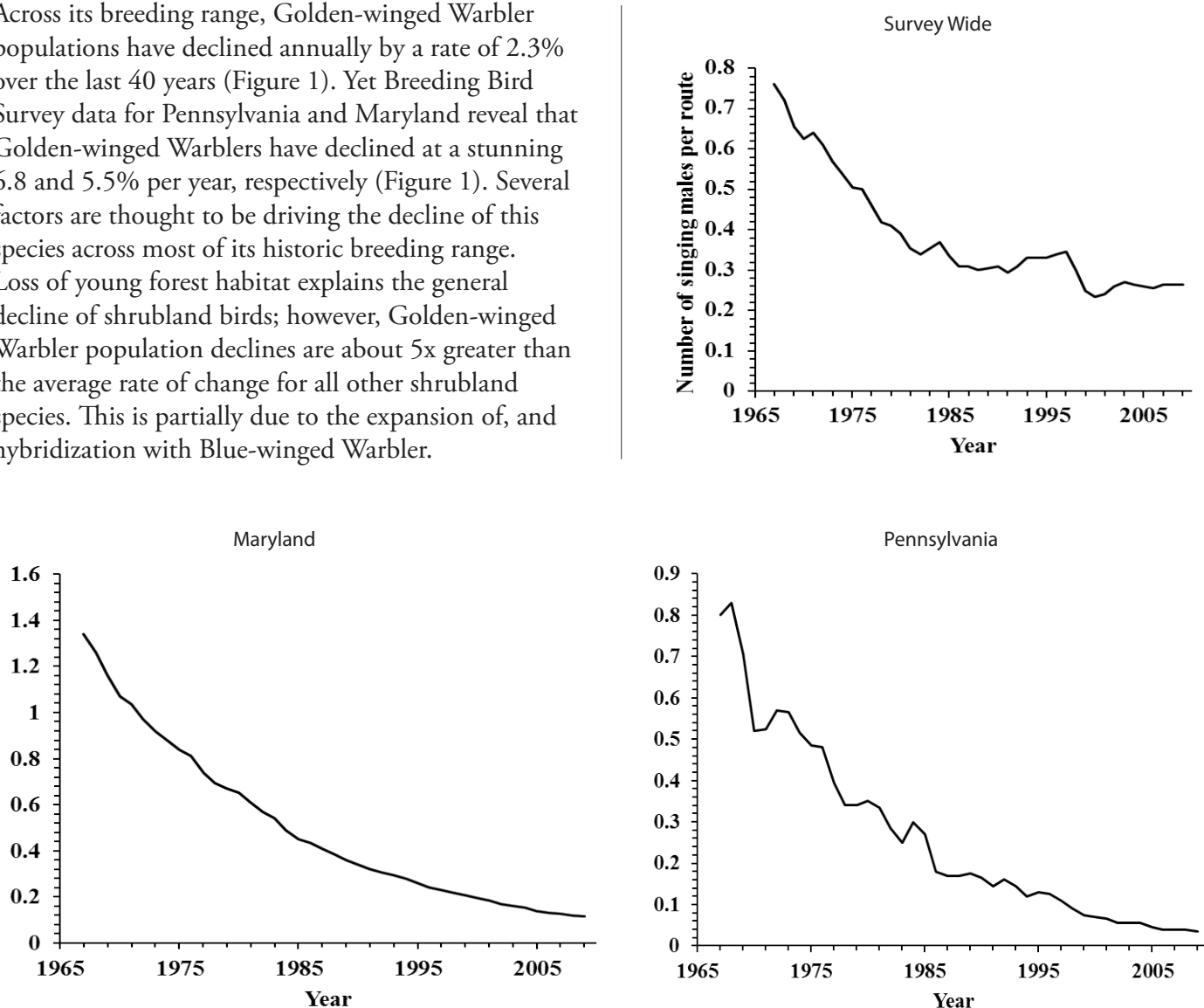
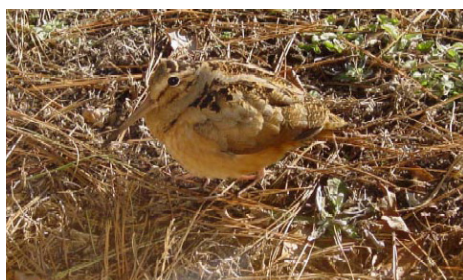


Figure 1: Long-term trends according to Breeding Bird Surveys that began in 1966 (Sauer et al. 2011)

ASSOCIATED SPECIES



American Woodcock, USFWS; Chestnut-sided Warbler, William Majoros; Common Yellowthroat, William Majoros; Appalachian Cottontail, Jeffery Pippin

Other wildlife species that rely on early successional habitats also would benefit from habitat management for Golden-winged Warblers, particularly American Woodcock (*Scolopax minor*; see Integration with the American Woodcock), Ruffed Grouse (*Bonasa umbellus*), Eastern Whip-poor-will (*Caprimulgus vociferus*), and Appalachian cottontail (*Silvilagus obscurus*). See Table 1 (below) for songbirds commonly found in stands with Golden-winged Warblers. Many of these disturbance-dependent species also are experiencing population declines and are of high conservation concern.

Many mammals use the same young forest habitats as Golden-winged Warblers. These include important game animals such as black bear (*Ursus americanus*) and white-tailed deer (*Odocoileus virginianus*). Appalachian cottontail, snowshoe hare (*Lepus americanus*), and fisher (*Martes pennanti*) are mammals of conservation concern that will benefit from habitat management for Golden-winged Warblers. An area of Sproul State Forest in north-central Pennsylvania that supports a core breeding population of Golden-winged Warblers also is designated an Important Mammals Area due to its Appalachian cottontail population. Just like Golden-winged Warblers, Appalachian cottontails require dense understory cover, typically with blackberry (*Rubus* spp.) as the dominant shrub species, for concealment from predators.

Table 1. Percent occurrence of songbird species found in timber harvests where there were ≥1 detections of Golden-winged Warblers.

Species	Scientific Name	% Occurrence
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	95
Chestnut-sided Warbler	<i>Setophaga pensylvanica</i>	92
Common Yellowthroat	<i>Geothlypis trichas</i>	85
Black-and-white Warbler	<i>Mniotilta varia</i>	77
Ovenbird	<i>Seiurus aurocapillus</i>	72
Red-eyed Vireo	<i>Vireo olivaceus</i>	64
Scarlet Tanager	<i>Piranga olivacea</i>	59
American Redstart	<i>Setophaga ruticilla</i>	59
Yellow Warbler	<i>Setophaga petechia</i>	46
Gray Catbird	<i>Dumetella carolinensis</i>	46
Veery	<i>Catharus fuscescens</i>	44
Eastern Wood-Pewee	<i>Contopus virens</i>	41
Indigo Bunting	<i>Passerina cyanea</i>	33
Northern Flicker	<i>Colaptes auratus</i>	26
Cerulean Warbler	<i>Setophaga cerulea</i>	23
Field Sparrow	<i>Spizella pusilla</i>	23
Least Flycatcher	<i>Empidonax minimus</i>	23
Prairie Warbler	<i>Setophaga discolor</i>	23
Wood Thrush	<i>Hylocichla mustelina</i>	21

WHERE TO FOCUS EFFORTS

Throughout the Golden-winged Warbler's range, the distribution of breeding populations appears to be influenced by the interplay of elevation, landscape-scale forest cover, and presence of Blue-winged Warblers. These critical factors drove the identification of focal areas to direct management of young forests for Golden-winged Warbler conservation. In general, these focal areas are in regions of high forest cover (>70%), high elevation (>900 ft), and deficient of Blue-winged Warblers. Pennsylvania and Maryland are unique with greater than 5.7 million acres of forested land within Golden-winged Warbler focal conservation areas. The many public landholdings within focal areas can serve as cores or hubs from which to radiate management outward onto private lands.

The focal areas of Maryland and Pennsylvania can be divided into 4 groups: south-central, north-central, and northeast Pennsylvania and western Maryland.

Northeast: This focal area includes Schuylkill, Columbia, Luzerne, Carbon, Lackawanna, Monroe, Wayne, and Pike counties. The counties of this region are found in the Anthracite Upland, Blue Mountain, Glaciated Pocono Plateau, and the Glaciated Low Plateau provinces which average lower in elevation than the other focal areas and are characterized by rounded hills and valleys where swamps and peat bogs are common.



The undulating landscape of the Appalachian Mountains.

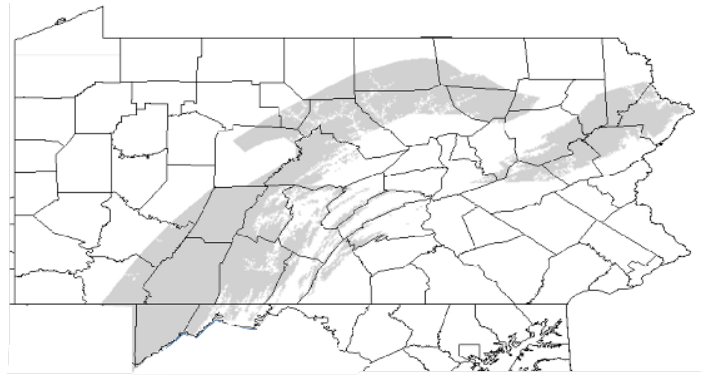


Figure 2: Focal (shaded) areas of Golden-winged Warbler habitat management in Pennsylvania and western Maryland.

North-central: The north-central focal area consists of Clearfield, Centre, Cameron, Clinton, Potter, Tioga, Lycoming, Sullivan, and Wyoming counties. This region typically has elevations ranging from 600 - 2,500 feet and the majority of the focal area falls within the Deep Valleys and Appalachian Mountain provinces.

South-central: The south-central focal area consists of Fayette, Somerset, Bedford, Fulton, Franklin, Perry, Juniata, Mifflin, Huntingdon, Blair, Cambria, Indiana, and Westmoreland Counties. The majority of this region falls within the Allegheny Mountain, Allegheny Front, and Appalachian Mountain physiographic provinces and is characterized by undulating ridges and valleys. This region includes Pennsylvania's highest elevation at Mt. Davis (3,213 feet) in Somerset County.

Western Maryland: The single focal area identified for Maryland includes Garrett, Allegany, and Washington counties in the western portion of the state and is an extension of the south-central Pennsylvania focal area. This region is in the Appalachian Mountain physiographic province and is characterized by high, flat mountain tops in a heavily-forested area. The highest point in Maryland, Backbone Mountain (3,360 feet), is found in Garrett County.

GOLDEN-WINGED WARBLER BIOLOGY_____



Adult male Golden-winged Warbler.
© Bill Hubick at <http://billhubick.com>

IDENTIFICATION

You can recognize the male Golden-winged Warbler by its gray back with white belly. The most distinguishing features are its chickadee-like black cheek and throat patches that contrast with patches of bright yellow on its crown and wings. The female is similar in appearance to the male, but is a duller, more muted color overall.

Because Golden-winged Warblers can breed with Blue-winged Warblers and produce fertile offspring, identification of hybrids can be difficult. Blue-winged Warblers can be identified by their bright yellow body and head, bold black eye-line, blue wings, and white wing bars. Offspring of pure parents (e.g., Golden-winged Warbler male x Blue-winged Warbler female or Blue-winged Warbler male x Golden-winged Warbler female) produce a hybrid called the Brewster's Warbler which displays a dark eye-line and whitish underparts. When a hybrid is paired with either species they can produce a variety of backcrosses, with the Lawrence's Warbler as one example. This variant has a head pattern of the Golden-winged Warbler paired with the body pattern of the Blue-winged Warbler.



Female Golden-winged Warbler.
©David Speiser www.lilibirds.com



Adult male Blue-winged Warbler.
Mandy Weston



Young female Blue-winged Warbler.
Powdermill Avian Research Center



Adult male Lawrence's Warbler. Powdermill
Avian Research Center



Brewster's Warbler. ©David Speiser www.lilibirds.com

BREEDING BIOLOGY

Golden-winged Warblers leave their wintering grounds in March and April and arrive on breeding grounds the last week of April. Depending on the number of birds in the area and quality of habitat, males defend territories that range in size from 1 – 12 acres. Each territory must provide everything the birds will need during the nesting season – food, shelter from predators and the elements, and nesting sites. Nest building is initiated in Maryland and Pennsylvania during the first two weeks of May. Successful first nesting attempts allow young birds to leave the nest around mid-June when adults and juveniles use a variety of thick habitats. Birds then initiate their migration back to wintering grounds in August and September.

During the summer months, Golden-winged Warblers typically eat insects, mostly moths and their larvae. Foraging birds glean food from all strata of vegetation - shrubs, saplings, and trees. A concurrent study on Golden-winged Warblers in northcentral Pennsylvania found substrates most often used for foraging include blackberry, black locust (*Robinia pseudoacacia*), pin cherry (*Prunus pensylvanica*), black walnut (*Juglans nigra*), and elms (*Ulmus* spp.). Indeed, these and the following plants support high numbers of Lepidoptera species and are likely important for Golden-winged Warblers: oaks (*Quercus*), poplar (*Populus*), birch (*Betula*), and hickory (*Carya*).

Results from the second (2004-2008) Pennsylvania Breeding Bird Atlas (BBA) indicate a 62% reduction in the number of survey blocks within which Golden-winged Warblers were detected as compared to the first BBA period (1984-88). Current population estimates for Pennsylvania range from 5,000 – 7,000 singing males. Careful comparison of the Golden-winged and Blue-winged Warbler distribution maps during the second Atlas period (Figure 3) provides a sobering reminder of the profound influence the Blue-winged Warbler has on the distribution of Golden-winged Warbler. This is why we suggest that managers assess for the presence of Blue-winged Warblers and avoid creating habitat in sympatric regions.



Female Golden-winged Warbler on nest.
Keith Watson

*Young forest stands that are
5 - 10 years post harvest
provide the highest value as
breeding habitat for
Golden-winged Warblers.*

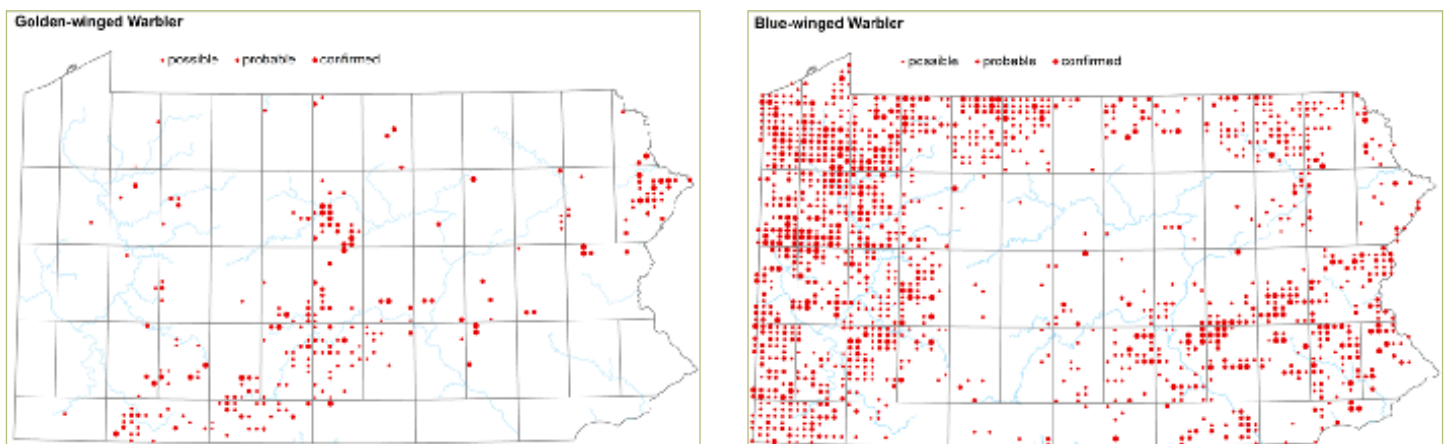


Figure 3: Distribution of Golden-winged (left) and Blue-winged (right) Warblers in Pennsylvania during the second Breeding Bird Atlas (2004 – 2008).

HABITAT NEEDS



Old field succession. Jeff Larkin



Post-wildfire regeneration. Jeff Larkin



Wetland. Douglas Gross

Breeding Golden-winged Warblers require a diverse vegetation structure, often found in early successional patches within forested landscapes. Habitat types used for nesting include young forest created by timber harvests, wind or wildfire, abandoned farmland, scrub barrens, managed shrublands, utility rights-of-ways, edges of reclaimed strip mines, grazing land, beaver glades, oak savannas, and swamp forests with partially open canopies.

Because early successional habitat is an ephemeral resource for breeding Golden-winged Warblers, patches need to be created or maintained continuously across the landscape to ensure viable long-term breeding populations.

Approximately 17 species of birds that depend on young forests are experiencing population declines, including the Golden-winged Warbler. Additionally, other species of conservation concern, like the Appalachian cottontail, would likely benefit from management of young forests.



Scrub-oak barrens. Douglas Gross

NESTING HABITAT

From May to July you can find this bright-colored bird breeding in a wide variety of patchy habitats that provide a mix of grasses, herbs, shrubs, and scattered trees along a forest edge.

Golden-winged Warbler nests are often located along ‘microedges’, especially those between young forest patches and herbaceous openings dominated by forbs. Plants that Golden-winged Warblers prefer to nest in include goldenrod (*Solidago* spp.), blackberry, and gooseberry (*Ribes* spp.). Nests are built on the ground at the base of a cluster of herbaceous vegetation, generally within 3 ft of a shrub clump. Nests are constructed by females over several days and are composed of woven leaves, shreds of bark from grape (*Vitis* spp.) or *Viburnum* spp., and strips of plant material.

Females build nests within defended male territories. These territories include herbaceous nesting cover (e.g., grasses, goldenrod, etc.) and adjacent high density saplings (<4 inches dbh; 1350 - 3000 stems/acre) and shrubs (100 - 300/acre) for foraging. Predation on Golden-winged Warbler nests by animals, like snakes and chipmunks, is the largest cause of nest failure.

Song perches also are important components of harvested stands because they allow males to delineate territories. A study of song perches used by Golden-winged Warblers in a concurrent study in Pennsylvania found that the majority of singing posts were located in retained trees and snags. Tree species most commonly used as song perches were white oak (*Quercus alba*), sweet birch (*Betula lenta*), pin cherry, white ash (*Fraxinus americana*), elms, and black walnut.

DID YOU KNOW?
Male Golden-winged Warblers have high site fidelity with many birds returning to the same territory they occupied and defended the previous year.



Golden-winged Warbler nest. Keith Watson

HABITAT MANAGEMENT

Golden-winged Warbler breeding habitats are ephemeral by nature. Even if thousands of young forest acres were created today, the species would again be in trouble in 15 – 20 years when those stands succeeded into pole stage. Golden-winged Warbler habitats are disturbance-dependent; therefore, stands must be re-treated on short rotations or new young stands must be created continuously over time. The latter approach fits well with standard forest rotations in northern hardwoods, mixed hardwoods, and oak. The short rotation concept applies mostly to aspen, a minor component in Pennsylvania and Maryland forests.

Additional management opportunities may be found in forests that experienced insect-induced mortality in the 1980s and 90s (largely from gypsy moths, *Lymantria dispar*, and elm spanworm, *Ennomos subsignarius*). Many of these areas, now in pole-stage, regenerated with species (e.g., sassafras, birch, maple) that are undesirable for timber. Current low grade wood markets may make commercial harvests feasible depending on location and accessibility. However, many of these species that are undesirable for timber are still used by Golden-winged Warblers as foraging substrates and singing posts.



Timber harvest. Robin Wildermuth



Abandoned farmland. Jeff Larkin



Reclaimed mineland. Jeff Larkin



Beaver meadow. John Confer

At this point, it should be clear that Golden-winged Warblers require early successional habitat. Within that general habitat type, prescriptions can be adjusted to maximize attractiveness of young stands to Golden-winged Warblers. Throughout the harvesting process there are many steps that managers need to consider including assessing regeneration, retaining seed sources, creating light conditions, keeping deer in balance, and controlling competitive plants. This BMP provides following guidelines are ordered from the coarsest to finest spatial scale.

Management activities for Golden-winged Warblers should be avoided during the breeding season from April to August.



Managed shrubland. John Confer

Golden-winged Warblers are dependent on young forest habitats that occur in a landscape dominated by contiguous forest (>70% forest cover).



An example of three patchy early successional stands (each 25 acres) created in winter 2009/2010 in a forested landscape in Sproul State Forest. John Long



A highly forested landscape with early successional habitats interspersed throughout. Andrew Vitz

LANDSCAPE SCALE

Forest Cover

At the landscape scale, Golden-winged Warblers nest and breed in early successional habitat with a high proportion of forest in the surrounding landscape. **As a rule of thumb, 70% of the landscape within 0.5 mile of the harvest should be in forest cover.** The forest cover can be in various age classes as represented in the balanced age class distribution of the management compartment illustrated in the Temporal Scale section on pages 13 - 14. Forested landscapes with areas of extensive disturbances (e.g., tornado swaths and wildfires) may attract breeding Golden-winged Warblers.

Elevation

In order to limit hybridization between Golden-winged and Blue-winged Warblers, higher elevation locations should be selected for Golden-winged Warbler management. Elevation above 950 feet is recommended for the majority of the focal areas in Pennsylvania and Maryland. Blue-winged and Golden-winged Warbler hybridization is more likely to occur below these elevation thresholds. However, overlap of Golden-winged Warblers and Blue-winged Warblers can still occur up to approximately 1300 feet. Whenever Blue-winged Warblers and Golden-winged Warblers occupy habitat in the same location, then there is a high chance that Blue-winged Warblers will replace Golden-winged Warblers. This is why it is important that managers need to consider placing harvests in those areas with high percentages of forest cover (>70%) regardless of elevation.

Disturbances

All disturbances, past and present, should be taken into consideration when coordinating forest management plans for Golden-winged Warblers. Insect damage, tornadoes, or past fires are appropriate locations for placement of new harvests. For example, a wildfire in Sproul State Forest set back succession on approximately 10,000 acres, resulting in a large breeding population of Golden-winged Warblers which was previously undocumented in that area. In both Delaware and Forbes State Forests, young forest created from tornadoes in the late 1990s supported breeding Golden-winged Warblers. **Managers should take advantage of such large scale disturbances by planning future harvests, prescribed fires, or other mechanical disturbances nearby.** If large areas of young forest do not exist from previous disturbance, they can be created through active forest management.

Proximity to Other Suitable Stands

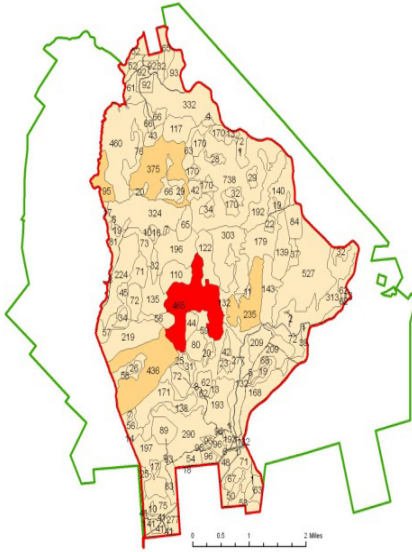
If possible, harvests should be within one mile of other habitats, like wetlands, barrens, old fields, or other timber harvests. A study in southeast Ohio of several early successional bird species found that young birds moved farther (1 mile) than adults (0.2 mile) between years. Thus, clustering patches within 1 mile is recommended. Nearby suitable stands may be permanent human disturbances (as discussed in relation to energy development) or ephemeral in nature. But both types may serve as source populations of Golden-winged Warblers for new disturbances created through timber management. Furthermore, creating multiple and localized harvests over time ensures that when one timber harvest succeeds out of suitable habitat (i.e., >15 years post harvest), other suitable stands remain in the landscape (see Temporal scale below). Recall that male Golden-winged Warblers have high site fidelity so they return to the same general area year after year searching for breeding habitat.



*Adult male Golden-winged Warbler.
Marja Bakermans*

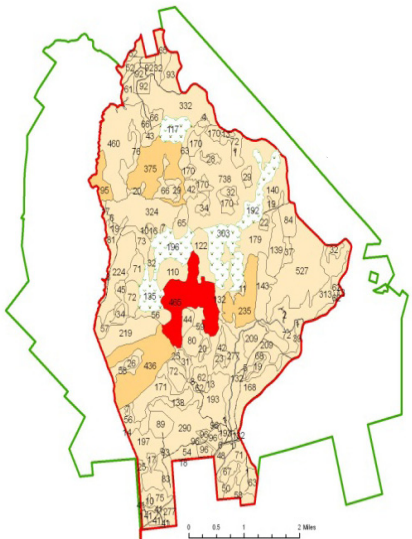


Several stands of young forest across a 4 square mile landscape in northeast, PA. The stands on the bottom, right were salvage-logged after a tornado damaged the forest and the stands on the top, left were harvested through overstory removal prescriptions. The majority of the stands pictured here were occupied by Golden-winged Warblers in 2010.



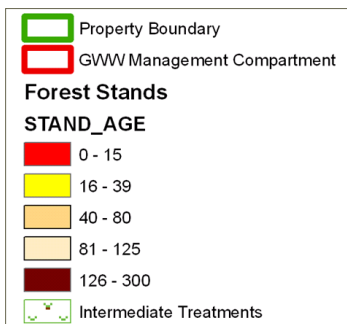
2010

A large regeneration harvest or major natural disturbance occurred in the 465-acre stand. The rest of the compartment is heavily weighted toward the 81 – 125-year old age class.



2010 – 2020

Intermediate treatments conducted to initiate regeneration in five additional stands (i.e., first stage shelterwood, competing vegetation removal, prescribed fire, deer fence, etc.).



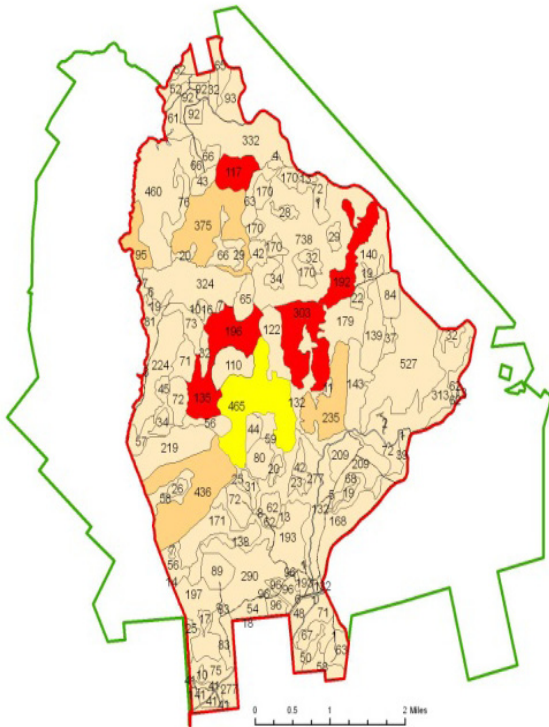
TEMPORAL SCALE

Historically, Golden-winged Warbler habitat was maintained by natural disturbances that occurred across large forested areas. Today, many wetlands have been cleared and drained, wildfires are effectively suppressed, and storms are just as likely to destroy housing developments than create young forest; therefore, maintaining habitat for Golden-winged Warblers and other early successional specialists depends on active forest management. Long-term planning efforts should focus on providing young forest habitat across the landscape over time. This is not a foreign concept to forest managers who strive for sustained yield of timber or wildlife by interspersing forest age classes across their management areas.

Vegetation structure is suitable for Golden-winged Warblers typically starting 4 – 5 years post-harvest until early stem exclusion or pole stage at 15 – 20 years (note: year targets are mere guidelines). On the ground, harvested stands are ideal when young trees and shrubs are 10 – 20 feet in height and abundant forbs grow along edges. Use by Golden-winged Warblers subsides when the new canopy closes, reducing understory vegetation and structural diversity. The greatest challenge to managers is maintaining a component of 4 – 20 year old forest across large areas.

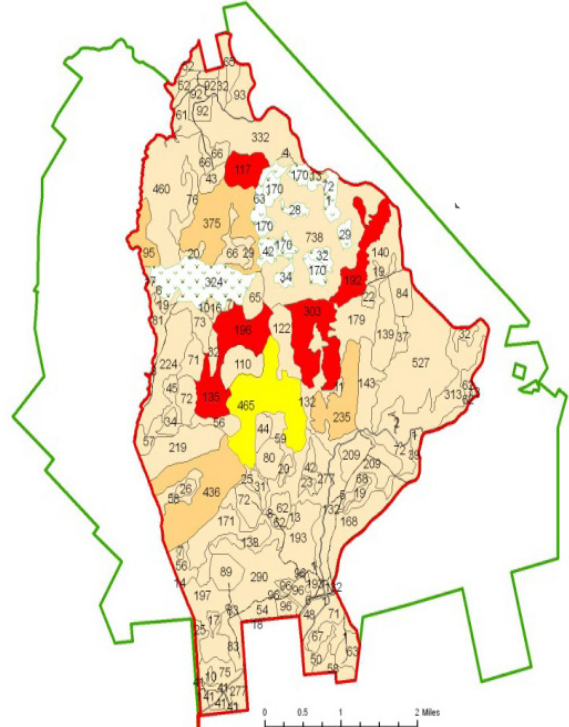
Before a stand can be harvested sustainably, adequate revegetation must be present. This often requires time and resource investments. It can take up to 10 years of site preparation before a stand is harvested and that time must be incorporated into rotations and planning. Without good planning, bottlenecks could occur when no young stands exist and when new harvests have not been implemented.

The conceptual models (left and following page) describe a general approach to interspersing forest age classes over time. Here we illustrate an example rotation to maintain Golden-winged Warbler habitat on a 10,000-acre management compartment. Approximately 10% of the compartment is regenerated every 15 years. Following regeneration harvests, stands to be regenerated in the future receive intermediate treatments such as low shade removal, shelterwood, prescribed fire, competing vegetation removal, or others to initiate regeneration. Conditions in the intermediate treatments are conducive to many wildlife species, including Cerulean Warbler (*Setophaga cerulea*). With this general approach, a balanced age class distribution is achieved by the year 2145 with approximately 20% in young forest, 10% in pole-stage, 30% in 40 – 80-year age class, 30% in 81 – 125-year age class, and 10% in the 125+ year age class. Numbers in each stand indicate acres.



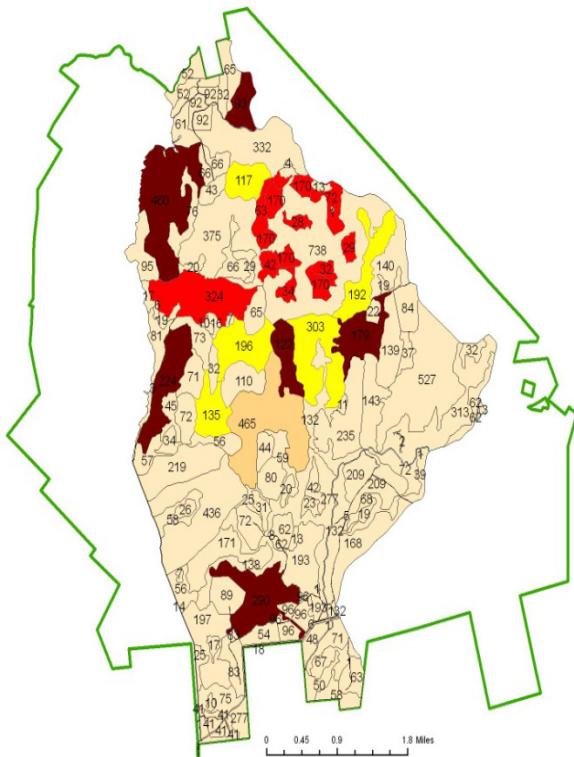
2025

Stands that received intermediate treatments in 2010 – 2020 are regenerated, creating new Golden-winged Warbler habitat. Note the 465-acre stand succeeded into pole-stage and out of Golden-winged Warbler habitat.



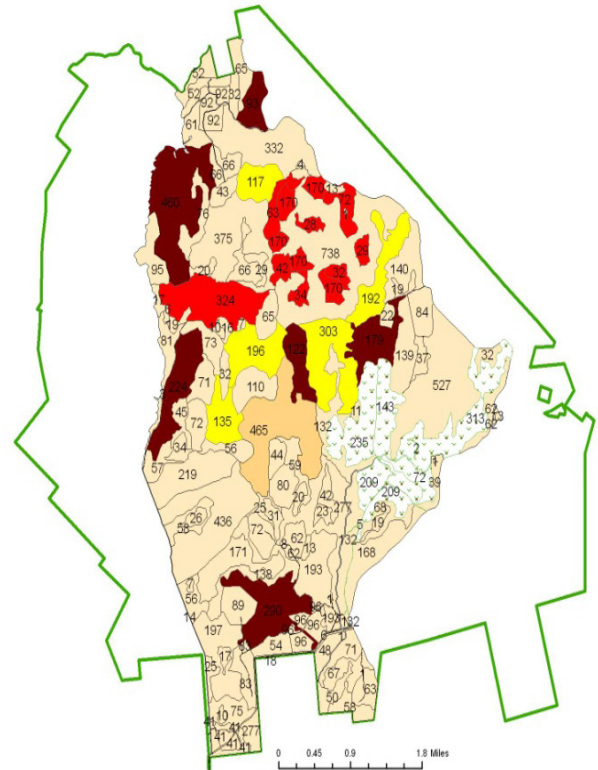
2025 – 2035

Intermediate treatments conducted to initiate regeneration in thirteen additional stands.



2040

Stands that received intermediate treatments 2025 – 2035 are regenerated, creating new Golden-winged Warbler habitat. Note the five stands regenerated in 2025 succeeded into pole-stage while other stands have aged past 125 years.



2040 – 2050

Intermediate treatments conducted to initiate regeneration in seven stands.

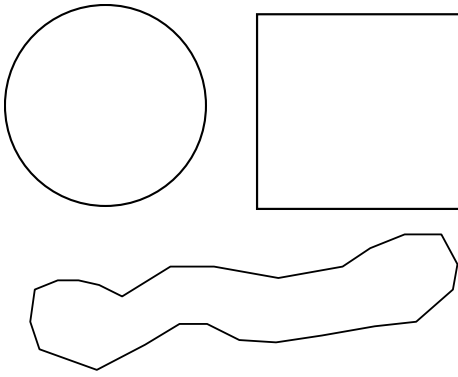


Figure 4. Amount of edge habitat provided by 50-acre harvest units of various shapes, circular (26 acres), square (28 acres), and irregular linear (50 acres). Edge habitat defined as 250 feet inward from unit boundary.



A gradual forested edge that transitions from canopy trees to saplings to shrubs.
Marja Bakermans

STAND SCALE

Forested Edge

Golden-winged Warbler density is highest on edges of young forest stands. Studies have shown that most Golden-winged Warbler territories are within 250 feet of an edge. Edges can be along roads, trails or landings, transition zones along timber harvests, margins of old fields or shrublands, or other places where young forest transitions into adjacent habitats. Edges between early successional forest and older stands are particularly important because taller trees in the uncut stands provide song perches. However, mature forest edge may not be important in stands that provide ample residual basal area (see Residuals Trees and Snags below).

Stand Shape

The proportional amount of edge can be adjusted by modifying harvest unit shape. In general, as the shape of the harvest unit becomes more complex, more edge is provided. Linear, meandering units have a greater proportion of their area in edge habitat than circular units. Of course, there are many ways to adjust the amount of edge in a harvest layout (Figure 4).

Ultimately, harvest unit shape will be influenced by vegetation, soils, slope aspect, topography, and accessibility. If these factors dictate simple shapes with relatively low edge density, then other measures can be taken to improve suitability for Golden-winged Warblers (e.g., retain residual canopy trees or islands of trees).

Edge Type

Edge can be manipulated to improve the habitat value of a stand. Feathered edges that promote gradual transition from older forest into the timber harvest are recommended (not just for Golden-winged Warblers but other wildlife as well). Edges can be feathered by thinning adjacent to the harvest unit. This gradual transition will provide the stratified vegetation that Golden-winged Warblers prefer.



Increasing the complexity of the shape of a large stand can be beneficial to Golden-winged Warblers by increasing the amount of forested edges.



This opening contains a gradual edge on the bottom and left sides where thinning occurred. Andrew Vitz

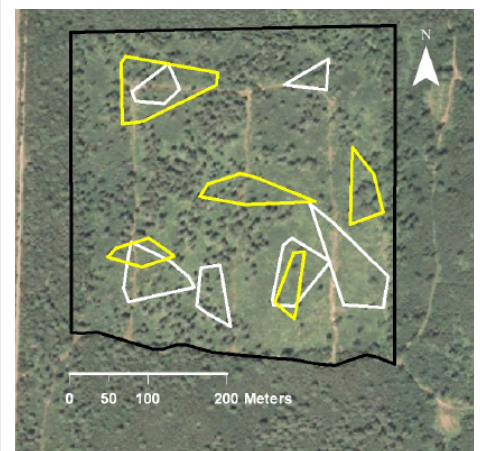
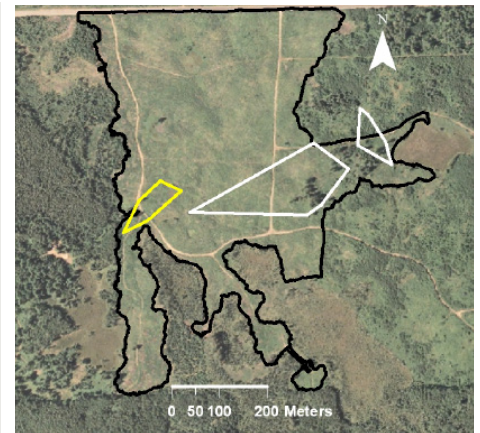
WITHIN-STAND CONSIDERATIONS

In general, Golden-winged Warblers select and successfully breed in habitats that contain a patchy, heterogeneous environment that promotes both horizontal and vertical structure. In this BMP, we refer to within-stand patchiness as varying amounts of shrubs, saplings, herbaceous plants, and bare ground with scattered trees and snags. Plantings and restoration of harvests are not necessary, and many of the characteristics mentioned in this section will occur through harvesting and natural regeneration processes. Diversity of cover in and adjacent to a harvest is critical to high quality Golden-winged Warbler habitat. Typical harvests used by Golden-winged Warblers have about 10 – 25% herbaceous cover, 30 – 50% sapling and shrub cover, 10 - 20% tree cover, and up to 30% bare ground cover.

Residual Trees and Snags

Golden-winged Warblers need some trees and snags to delineate breeding territories and serve as foraging sites; therefore, residual trees and snags are important. The majority of residual trees should be deciduous and have healthy crowns that serve as a foraging substrate for Golden-winged Warblers. Recommended residual basal area is 10 – 40 ft²/acre, or retain 10 - 15 trees per acre that are >9 inches dbh. If the residual basal area is < 10 ft²/acre, then the stand should be ≤ 10 acres in size to provide adequate edge habitat.

The best way to maintain residual basal area is through retaining evenly scattered trees throughout the harvest, as shown in the bottom photo. Edge habitat tends to be used more by birds when there is little to no retained residual trees as illustrated in the top, right photo.



Golden-winged Warbler territory boundaries in aspen stands in Wisconsin that vary in residual basal area. The stand with little to no residual trees (top photo) had low densities (1 – 2 males) and males did not attract mates. These territories used the forest edge. In contrast, the stand with ample residual trees (bottom photo) supported high densities (5 – 6 males) with ~50% nest success. Notice that these territories do not include the stand edge. Amber Roth



A timber harvest where the residual trees are scattered throughout the stand. Marja Bakermans

If scattering trees evenly throughout the stand is not feasible given high mortality at the site due to sun or wind, then an alternative strategy is to leave ‘mini islands’ of trees throughout the harvest, as shown in the top photo below. Another method is to create small islands of trees in the center of harvests, as shown bottom photo below. This will reduce the distance to an edge and provide song perches for nesting Golden-winged Warblers. The stand can be improved further by leaving a few scattered trees (5 trees >5 inches dbh per acre) in the rest of the stand, allowing more Golden-winged Warblers to establish territories.



A mini island of trees retained to reduce tree mortality due to wind and tree mortality. Marja Bakermans



A timber harvest where an island of trees was retained within the harvested stand. Andrew Vitz

Table 2. Number of trees per acre by diameter (D; dbh) class in inches and residual basal area (RBA). See text below on how to use the table.

D	RBA10	RBA20	RBA30	RBA40
4	22	44	65	87
5	14	28	42	56
6	10	19	29	39
7	7	14	21	29
8	6	11	16	22
9	4	9	13	17
10	7	14	21	28
11	6	12	18	24
12	5	10	15	20
13	4	9	13	17
14	4	7	11	14
15	3	6	10	13
16	3	6	9	12
17	3	5	8	11
18	3	5	7	10
19	2	4	6	8
20	2	4	6	8

It is best to retain a range of sizes of residuals. In stands where Golden-winged Warblers were detected, 19% of residuals were 4 - 9 inches dbh, 39% were 10 - 15 inches dbh, and 42% were >15 inches dbh. Table 2 (above) shows the number of trees per acre by diameter (dbh) class in inches and residual basal area (RBA) after taking into account the distribution of residuals in stands where Golden-winged Warblers were detected. When using the table, remember to include residuals from each group of sizes.

Retaining an appropriate number of residual trees and snags has been proven to be an effective management tool to increase breeding densities of Golden-winged Warblers within a stand.



Golden-winged Warbler chick. Katie Percy

Saplings and Low-growing Woody Cover

Although Golden-winged Warblers breed in dense, regenerating forests, they often select within-stand microsites with 1300 – 3300 stems/acre. The selection of pockets with lower stem density reflect their need for combined herbaceous cover, bare ground, and woody stems, instead of maximized woody stem density. These patchy conditions occur inherently within a harvested stand due to spatial variation in soil, hydrology, and harvesting logistics.

Low-growing woody plants such as blackberry, blueberry (*Vaccinium* spp.), and sweetfern (*Comptonia peregrine*) and stump sprouting hardwoods provide foraging habitat and cover for nesting birds. Golden-winged Warblers will use stands with moderate amounts of honeysuckle (*Lonicera* spp.), autumn-olive (*Elaeagnus umbellata*), and multiflora rose (*Rosa multiflora*); however due to their invasive tendency, these shrubs and other invasive exotics should not be promoted. The number of shrubs or stump sprouts in Golden-winged Warbler habitat ranges from 100 to 350 per acre.

In most cases, underplanting is not necessary because seedling and shrub density from natural regeneration is adequate. Establishment of shrubs, like *Rubus* spp., also is promoted by leaving harvested tree tops where songbirds will perch, hence depositing seeds below.



An example of a stand approaching canopy closure where the herbaceous cover has been shaded out and understory saplings and shrubs are too dense for breeding Golden-winged Warblers. Jeff Larkin



A stand with a mix of grasses, forbs, saplings, and retained trees that attracted breeding Golden-winged Warblers. Marja Bakermans

Ground Cover and Patchiness

Goldenrod and other forbs are particularly important because they are used as a nesting substrate. Loss of herbaceous cover causes Golden-winged Warblers to abandon seemingly suitable stands. The essential herbaceous component can be provided through properly retiring skid trails, haul roads, and landings. Expensive native seed is not necessary because the forbs used by nesting Golden-winged Warblers are wind disseminated and available in the seedbank. The following minimal maintenance approach will provide habitat for Golden-winged Warblers as well as excellent brooding habitat for grouse and turkeys (*Meleagris gallapavo*), fawning cover and forage for white-tailed deer, and soft mast for various wildlife:

- Grade roads and landings to minimize erosion per current BMPs.
- Seed with plants that establish quickly to prevent erosion, yet will not dominate permanently. Avoid non-native perennial cool-season grasses such as redtop, fescue, smooth brome, and orchardgrass because they outcompete the forbs used by nesting Golden-winged Warblers.
- A good mix contains annuals and non-invasive perennials such as the following (per acre rates):
 - 25 lbs wheat or oats (use wheat if seeded in late summer or fall)
 - 10 lbs crimson clover (annual)
 - 5 lbs either white or la-dino clover
 - 2 lbs birdsfoot trefoil

Or use

- 50 lbs annual rye grass
- Mulch with wheat or oat straw to prevent introduction of undesirable plants whose seeds are often found in mulch hay.
- After establishment, planted species will be joined by vegetation growing from the site's seed bank; this is a desirable outcome.
- Maintenance is necessary when trees begin to invade herbaceous edges. Biennial mowing should keep woody invasions in check.



Examples of within-stand patchiness that attract Golden-winged Warblers. Jeff Larkin



Leaving downed or dead wood will contribute to patchiness within a stand. Mack Frantz

Dead and Downed Wood

Retain dead and downed wood to help maintain patchiness of vegetation. This adds to the heterogeneous nature of suitable harvest stands and has clear nutrient cycling and wildlife benefits.

Unique or Important Features

Wetlands, ponds, rocky outcrops, and other unique features are all important features to maintain within or adjacent to harvested stands. These unique features help break up the microtopography and contribute to biodiversity. Often these unique areas are occupied by herbs and shrubs not found within drier parts of harvested stands, thus, promoting increased patchiness important to Golden-winged Warblers.

Managing for patchy habitat involves providing a mix of interspersed residual trees and snags, saplings, shrubs, forbs, grasses and bare ground.



Preserving a wetland preserves in-stand diversity. Jeff Larkin



A patchy stand that includes a mix of structural and floristic diversity including residual trees and snags, saplings, shrubs, grasses, forbs and bare ground. Mack Franz

ADDITIONAL MANAGEMENT TOOLS

There are tools in addition to timber management that will both enhance and extend the suitability of stands for Golden-winged Warblers.

When white-tailed deer populations approach or exceed habitat carrying capacity, they can inhibit the diverse vegetation structure sought by Golden-winged Warblers. In these cases, increased deer harvest via hunting or deer-deterrent fencing are necessary.

Prescribed fire may play a role in creating and maintaining Golden-winged Warbler habitat. In quality oak stands, fire is a useful step when moving from commercially mature forest to a regenerated stand. In many forested habitats, fire helps establish regeneration that must be present before harvesting can occur. Fire also is an appropriate management tool to extend habitat suitability by maintaining early successional structure. This is particularly true in shrub and scrub barrens habitats.

Periodic mechanical treatment, using equipment similar to the Fecon shown below, is useful in maintaining areas of early successional habitat after timber harvesting if prolonged occupancy by breeding Golden-winged Warblers is an objective of a land manager.



A prescribed burn used to promote desirable regeneration prior to timber harvest on Pennsylvania State Game Lands. Howard Wurzbacher



Fecon equipment used at Bald Eagle State Park, Howard, PA. Jeff Larkin



Deer fencing improves regeneration of stands when in high deer-browse areas. Marja Bakermans



Infrastructure including roads, well pads, and pipelines are part of natural gas development. Maintenance of these features results in herbaceous edges. Note the predominantly forested landscape.



Regeneration harvests can be planned to intersperse herbaceous edges with young forest. This could lead to suitable Golden-winged Warbler habitat.

Integration with Energy Development

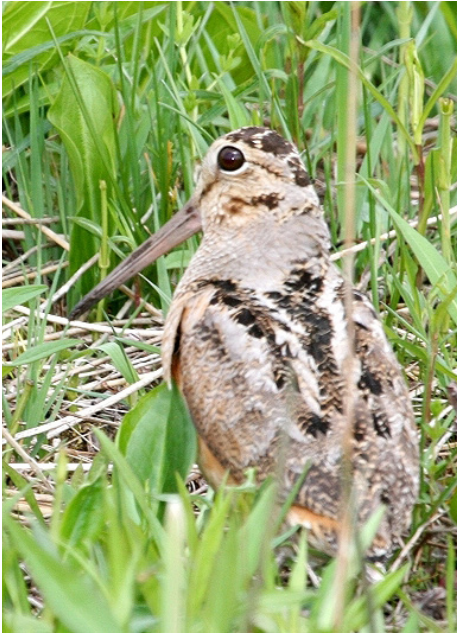
Habitat manipulations resulting from energy development may enhance Golden-winged Warbler habitat if done properly and within forested landscapes. Management of features like utility rights-of-ways will be detailed in a future BMP. From a forest management perspective it is of benefit to mention energy development here, especially relating to natural gas. With the Marcellus fields in the northern Appalachians, including Maryland and Pennsylvania, the infrastructure required to extract, store, and deliver natural gas is causing changes to forest habitat on a landscape scale with well pads, pipelines, and roads traversing much of the Golden-winged Warbler focal areas. Although the long- and short-term wildlife impacts are unknown, it is known that natural gas development will continue. Therefore, habitat managers should pursue all possible opportunities to mitigate potential negative impacts.

After construction, road margins, pipelines, and well pads are re-vegetated with herbaceous mixes that are maintained to facilitate access and inspection. By themselves, these linear herbaceous habitats are not Golden-winged Warbler habitat. However, if reclaimed properly and combined with forest management within adjacent stands, they may supply the herbaceous edges needed by Golden-winged Warblers. It is of utmost importance to follow the re-vegetation standards discussed on page eighteen to ensure the herbaceous structure sought by nesting Golden-winged Warblers. A minimal maintenance approach is best, similar to the landing and skid road re-vegetation strategy.

A shallow gas well pad that has retained trees, shrubs, grasses and forbs adjacent to the well pad. This reclamation was successful in attracting Golden-winged Warblers. Jeff Larkin



INTEGRATION WITH AMERICAN WOODCOCK BMP



American Woodcock.

©Bill Hubick at <http://billhubick.com/>

Both Golden-winged Warbler and American Woodcock can use similar early successional habitat, and there is tremendous potential to manage for both species in areas of overlapping ranges.

Management efforts directed at creating Golden-winged Warbler habitat also can create habitat for American Woodcock. In expanded surveys in 2011, we also surveyed timber stands ($n = 66$) for American Woodcock. American Woodcock were detected in a higher proportion of timber stands in northeastern (83%) compared to southcentral (26%) Pennsylvania and were detected in more stands than Golden-winged Warblers. In timber stands where American Woodcock were detected, the average number of males peenting were 1.6 and 1.3 birds per 25 acres for northeastern and southcentral regions, respectively. American Woodcock selected similar habitat features as Golden-winged Warblers including residual trees (1 - 33 per acre) and a mix of cover (grasses, forbs, and shrubs).

Additional management at Bald Eagle State Park and Sproul State Forest has been successful in attracting both species. In a separate study, data were collected to identify “manageable habitat variables” to create site-specific habitat manipulation prescriptions (via mechanical cutting) for Golden-winged Warblers. During the first breeding season surveys after implementation, we observed at least 1 territorial male Golden-winged Warbler in 5 of 7 manipulation plots. Simultaneously, woodcock surveys detected between 5 and 11 displaying American woodcock/25 acres on the Bald Eagle State Park plots. While we only detected 1 American Woodcock on the Sproul State Forest manipulation plots, observers were hampered by the excessive “noise” of Eastern Whip-poor-wills singing on the plots.

However, some management activities for American Woodcock do not provide habitat for Golden-winged Warblers. First, although Golden-winged Warblers may use swampy habitats they also are known to use dry uplands. American Woodcock, however, require wet habitats for foraging on earthworms. Golden-winged Warblers require retention of residual basal area. In woodcock management areas where all canopy trees were removed, no Golden-winged Warblers returned after habitat manipulation even though they were breeding in the same stand in previous years. Golden-winged Warblers appear a bit more rigid in their habitat use, and thus, if the goal is to manage for Golden-winged Warblers then managers need to use the Golden-winged Warbler guidelines, which may attract American Woodcock to the same stands.

Habitat management plot, opposite page, at Bald Eagle State Park where the left side of the photo shows manipulated habitat and the right side was maintained as a control. The management prescription was geared toward creating habitat for breeding Golden-winged Warblers but also was effective in attracting American Woodcock. Jeff Larkin

SUMMARY

Habitat previously used by Golden-winged Warblers (e.g., abandoned farmland) is becoming increasingly scarce. Thus, Golden-winged Warbler populations will continue to decline unless immediate conservation action occurs. The Golden-winged Warbler Working Group's long-term goal is to reverse the decline of Golden-winged Warblers and double the present-day population by the year 2050 through habitat management. The most important contribution to Golden-winged Warbler conservation will be to maximize the amount of young forest that can be sustainably managed in areas devoid of Blue-winged Warblers and where Golden-winged Warblers are a priority (i.e., focal areas). As such, timber management will be an essential approach to meeting the ambitious early successional habitat goals established for the region. Efforts to increase Golden-winged Warbler populations in Pennsylvania and Maryland will have the greatest impact and success when following the management guidelines from this BMP. The rotational framework combined with the specific habitat recommendations are intended to guide land managers in their efforts to contribute to Golden-winged Warbler habitat goals in a sustainable fashion.

Research in managed stands in Pennsylvania demonstrates that Golden-winged Warblers will respond to young forests created via regular timber operations. These data form the foundation of the management guidelines in the BMP. Namely, this BMP highlights the importance of high forest cover and elevation, nearby disturbances, and a forested edge habitat in areas devoid of Blue-winged Warbler. At a smaller scale, we emphasize the need for varying amounts of shrubs, saplings, herbaceous plants, and bare ground with scattered trees and snags retained. Pennsylvania and Maryland are in a unique situation in that vast areas of publicly owned forestland exist within the Golden-winged Warbler focal areas. Thus, there is excellent potential to boost Golden-winged Warbler population numbers through timber management. Further, creation of young forest will not only benefit Golden-winged Warblers, but a suite of other early successional dependent species as well.



Golden-winged Warbler.
©David Speiser www.lilibirds.com



REFERENCES AND FOR MORE INFORMATION



A timber stand with complex vertical and horizontal diversity that attracted Golden-winged Warblers. Marja Bakermans



Jeff Larkin discussing Golden-winged Warbler habitat specifics at a land managers workshop. Marja Bakermans



A thick patch of Rubus in a timber stand. Marja Bakermans

Information on Golden-winged Warbler Conservation Initiatives can be found at www.gwwa.org; Woodcock Conservation Plan and Habitat Initiatives at www.timberdoodle.org; Resources for these and other bird conservation initiatives and issues at www.amjv.org; and SILVAH regeneration guidelines at www.nrs.fs.fed.us/tools/silvah.

Buehler, D.A., A.M. Roth, R. Vallender, T. C. Will, J. L. Confer, R. A. Canterbury, S. Barker Swarthout, K.V. Rosenberg, and L.P. Bulluck. 2007. Status and conservation priorities of Golden-winged Warbler (*Vermivora chrysoptera*) in North America. *Auk* 124:1439-1445.

Confer, J.L. 1992. Golden-winged Warbler (*Vermivora chrysoptera*). In *The Birds of North America*, No. 20 (A. Poole, P. Stettenheim, and F. Gill, editors). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Confer, J. L., K. W. Barnes, and E. C. Alvery. 2010. Golden- and Blue-winged Warblers: distribution, nesting success, and genetic differences in two habitats. *Wilson Journal of Ornithology* 122:273 – 278.

Gill, F.B. 1980. Historical aspects of hybridization between Blue-winged and Golden-winged Warblers. *Auk* 97:1-18.

Gill, F.B. 1992. Golden-winged Warbler. Pages 300-301 in *Atlas of Breeding Birds in Pennsylvania* (D. W. Brauning, Ed.). University of Pittsburgh Press, Pittsburgh, PA.

Klaus, N. A. and D. A. Buehler. 2001. Golden-winged Warbler breeding habitat characteristics and nest success in clearcuts in the southern Appalachian mountains. *Wilson Bulletin* 113:297-301.

Kubel, J.E. 2005. Breeding ecology of Golden-winged Warblers in managed habitats of central Pennsylvania. Masters Thesis, Pennsylvania State University, State College, PA, USA.

Lehnen, S. E. and A. D. Rodewald. 2009. Dispersal, interpatch movements, and survival in a shrubland breeding community. *Journal of Field Ornithology* 80:240-252.

Orndorff, S. and T. Patten. 2007. Management guidelines for barrens communities in Pennsylvania. Report for State Wildlife Grant. The Nature Conservancy, Harrisburg, PA.



When reclaimed properly, log landings and haul roads can provide herbaceous cover required by breeding Golden-winged Warblers.
Mack Frantz

Patton L.L., S. Vorisek and J.L. Larkin. 2004. Golden-winged Warbler on surface mines in Kentucky. *Kentucky Warbler* 80:73-75.

Rossell, C. R., Jr. 2001. Song perch characteristics of Golden-winged Warblers in a mountain wetland. *Wilson Bulletin* 113:246-248.

Sauer, J.R., J.E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966-2007, version 6.2.2006, U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Stevens, M.A., and R.E. Barry. 2002. Selection, sizes, site, and use of home range of the Appalachian cottontail, *Sylvilagus obscurus*. *Canadian Field-Naturalist* 116:529-535.

Tallamy, D. W. 2010. Bringing nature home: How you can sustain wildlife with native plants. Timber Press, Portland, OR.



A timber stand in northeast PA. Robin Wildermuth



A female Golden-winged Warbler. Powdermill Avian Research Center



A timber harvest in Delaware State Forest. Brian Smith





pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES
www.dcnr.state.pa.us

A view of Sproul State Forest, where one of the greatest concentrations of Golden-winged Warblers in Pennsylvania occurs after a 10,000 acre tract was burned by a wildfire in 1990. ENV

