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WOODLAND FISH AND WILDLIFE: MANAGING FOREST HABITATS FOR MIGRANT SONGBIRDS

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MISC0198

Woodland
Fish and Wildlife

Managing Forest Habitats for Migrant Songbirds

Hearing the song of a yellow-rumped warbler or an olive-sided flycatcher during the early morning hours is a sure sign that spring has arrived. Many bird enthusiasts look forward to the annual return of birds we associate with the end of winter. The majority of the bird species that spend the spring and summer in the forests and woodlands of the Pacific Northwest are classified as Neotropical migrants (see the Glossary for technical terms). These birds spend the winter months in the Neotropics, which includes Mexico, Central and South America, tropical North America, and the Caribbean Islands. In the spring, they travel to North America to breed and nest, and many of them are found in the forests of Washington, Oregon, and Idaho as summer residents. Warblers, flycatchers, hummingbirds, thrushes, swallows, and vireos are common examples. Birds seen here throughout the year are called permanent residents and include such species as the spotted towhee and the black-capped chickadee. Winter residents, such as the Bohemian waxwing, spend the winter in Washington and Oregon, but migrate northward in the spring to nest.

Varied Thrush

Migration

Everyone knows that some birds fly south for the winter and north in the spring. Birds traveling through Washington and Oregon follow a migration route called the Pacific flyway (Fig. 1). Some birds migrate short distances and remain within the contiguous United States. Others, such as many of the Neotropical migrants, travel much farther. The precise routes of migration used by most species are largely unknown. Those birds that migrate long distances generally fly for most of the day and into the night, stopping to feed at sunrise. Short distance migrants will often travel only in daylight.

Many of the songbirds migrate long distances and go for extended periods without eating. Since these birds can lose up to 50% of their body weight while migrating, they need to put on enough fat during the winter months to see them through the spring migration. The better the winter habitat, the better the bird's chances of survival.

Seasonal migrations help birds survive by allowing them to use resources that may be available only in specific geographic areas at certain times of the year. During the winter months, southern habitats supply birds with food that is seasonally not available farther north. Northern spring and summer habitats provide more productive food, such as insects, which are important for raising young. Competition for food and shelter may be less intense on summer habitat than in wintering areas, thereby increasing the breeding success of adults and the survival of young birds.

Importance of Migrant Songbirds

Neotropical migrant birds play an important role in the forest ecosystem. They help control insects, disperse seeds, and some species may be important pollinators for plants. They also are a major food resource for predatory birds such as owls and hawks. Because Neotropical migrants are typically sensitive to habitat disturbance, they are often viewed as indicators of overall forest health. In Pacific Northwest forests, many Neotropical birds are closely associated with riparian zones, vegetation adjacent to lakes, streams, creeks and wetlands. (See extension bulletin MISC0133, "Riparian Areas: Fish and Wildlife Havens,")

Population Status

For the past several years, breeding populations of several eastern North American Neotropical migrants have been declining. Many factors, including predation, failed reproductive efforts and stresses of winter and migration, contribute to their natural mortality, The factor most strongly implicated in the decline of forest-dwelling Neotropical migrants is the fragmentation and destruction of forested habitat.

Data for the western United States is not complete. However, population trends for some western Neotropical migrants are becoming apparent. Although the western U.S.

Figure 1. The Pacific flyway.

breeding populations seem to be managing better than their eastern counterparts, some western species may be at risk.

Habitat Features

What is it about a particular area that attracts birds? Factors that affect habitat selection occur on two levels: (1) the local habitat and (2) the individual forest stand. Influential components of local habitat are distribution of plants across the landscape and the existence of special features such as cliffs, snags, and streams. Selection features at the individual stand level may include the successional stage(s) represented and the site's disturbance history, as well as the nature of surrounding habitat.

To understand more about conservation of Neotropical migrants, it is important to realize how birds depend on the quality of habitat. These birds apparently select habitats that increase their reproductive potential. To reproduce successfully, food abundance and nesting habitat are important. Neotropical migrants, like most species of animals, are sensitive to change. Dramatic changes, such as intense forest fragmentation, clearcutting, and the removal of trees from riparian zones alter the structure of the habitat. Forests may lose structural diversity (i.e., variability in vegetation size and height) if they are intensively managed exclusively for wood production. Loss in habitat diversity, especially reduction in forest vegetation of varying heights, diminishes nesting opportunities for many Neotropical species. This transformation may eventually affect the composition of the year-round bird community.

Snags

Dead trees, called snags, are important to both migratory and resident birds. Snags and dying trees supply cavity-nesting habitat for Neotropical migrants such as swallows, swifts, sapsuckers, small owls, kestrels, and wrens. They also provide homes for insects and other invertebrates that are food for many breeding Neotropical birds. Studies suggest that larger diameter snags enhance both of these habitat features. (See extension bulletin MISC0160 "Managing Small Woodlands for Cavity Nesting Birds,")

Riparian Areas

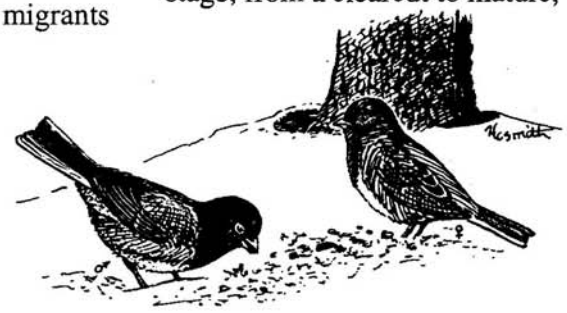
Many Neotropical migrants live in riparian zones because of the high productivity and diversity of the vegetation. Streams, lakes, and creeks are characterized by dense vegetated areas that provide water, cover, and a wide variety of food sources. Riparian regions are especially important in the drier landscapes of eastern Oregon and Washington.

Canopy Gaps

During the breeding season, many Neotropical migrants prefer to nest in areas with both coniferous trees and deciduous shrubs. Openings in the forest canopy can provide this structural and vertical diversity. When light is allowed to penetrate to the forest floor, there is increased growth of deciduous shrubs. These shrubs help create small patches of habitat important for birds attempting to escape from predators and for young birds in the process of dispersing. New nesting and feeding opportunities may also arise within these habitat patches.

Stand Age

The age of a forest is a strong influence in the distribution and composition of bird species. Each successional stage, from a clearcut to mature,



old-growth forest, has a different community of Neotropical migrant birds associated with it. As one stage develops into another, the species composition of the bird community also changes. An increase in one species and a decrease in another may occur at the same time. Because of this relationship, most studies suggest that stands with a mix of as many age classes as possible provide the optimum habitat for these birds.

Nesting Habitat

A mix of trees and shrubs of different heights creates habitats for many different birds and increases the diversity of the overall bird community (Table 1). The structural features of good nesting habitat are important on many scales, from the area immediately surrounding a single nest site to the entire forested landscape. The success of a single nesting attempt may be highly influenced by the foliage in the immediate vicinity. The denser the foliage surrounding a nest, the less likely a predator will be able to locate it. However, when predators hunt, their success depends on more than just physical barriers. The efficiency of their search for prey may be influenced by the structural complexities of a larger habitat patch that contains many potential nest sites. For example, the hermit thrush prefers to nest in small white fir (*Abies concolor*). As the density of white fir increases, the odds of predation go down for each individual hermit thrush nest. Domestic cats prey on wild bird populations and can reduce the population dramatically.

Forest Fragmentation

Forest fragmentation is believed to be one of the greatest threats to Neotropical migrant survival. In the eastern United States, many studies have examined the effects of forest stand size on the species composition of Neotropicals. These studies have found fewer breeding bird species in stands of less than 10 acres in size. This reduction in species may be a function of limited habitat availability (i.e., increased competition for food and nesting sites), or it may be a result of the species' sensitivity to stand size. Some bird species, such as the hermit thrush and the red-eyed vireo, are considered area-sensitive because they require large tracts of land for their territories. There is concern that these types of birds may become locally extinct in isolated forest fragments where the stand is not big enough to maintain natural populations.

The most dramatic reductions in the numbers of Neotropical migrants have been noted for those birds that use interior forested habitat on both the wintering grounds and the summer breeding areas. Many Neotropical migrant birds that breed in North America spend the winter months in areas less than one-fifth the size of their breeding grounds. Deforestation of wintering grounds thus affects large numbers of birds. The decline of many Neotropical

migrants in the eastern United States corresponds to the extensive clearing of the forests of Mexico and Central America, which began in the late 1970s. When winter resources become limited, the remaining habitat can support fewer and fewer birds, potentially reducing the breeding population.

Edge

When a large tract of forest land is broken up into smaller patches, edge is created. Edge is the area of transition between two different vegetation communities, such as forest and meadow. Any serious bird-watcher knows that the greatest variety of birds is found along edges. But too much edge can greatly affect those Neotropical migrants that nest primarily within the forest interior. When an edge is expanded, the amount of edge relative to the amount of interior is increased, and the effects are felt deeper within the interior. Although these edges may support a greater variety of birds, they also attract a large number of predators such as crows, hawks, raccoons, and house cats. As the edge widens, predators venture farther into the interior. Many Neotropical migrants build nests low to the ground, making them extremely vulnerable to predation. If a clutch of nestlings is eaten or destroyed, many birds will not nest again until the following year and will have lost an entire breeding season.

Brood Parasitism

Another danger Neotropical migrants face with increased edge is brood parasitism, a phenomenon that occurs when one bird species lays its eggs in the nest of another. The host birds often raise the brood parasite's offspring at the expense of their own. Some birds are able to distinguish between the parasitic eggs and their own, and will destroy the alien eggs. Others, such as the vireos and many of the warblers, have developed no defensive reactions to brood parasites, and are experiencing dramatic population declines. The best known brood parasite in Oregon and Washington is the brown-headed cowbird. The cowbird is a Neotropical migrant that is not dependent on interior forest cover, favoring riparian areas and centering its feeding and breeding activities along forest edges. The smaller the fragment of forest, the closer to the edge many interior birds are forced to nest. This increases their vulnerability to brood parasitism by brown-headed cowbirds and the risk of reproductive failure.

Brown-headed cowbird populations increased as forests across the eastern United States became fragmented. They have since extended their range into the northwestern states.

Forest Management and Succession

There is a relationship between wildlife existence and the composition of trees, shrubs, and other forest vegetation. Diverse habitats can be enhanced or created as part of forest management activities. Proper forest management allows for both forest products and wildlife, including Neotropical migrants.

An important concept in wildlife management is succession, the orderly, predictable change in the kinds and numbers of trees, shrubs, forbs, and animals that inhabit a given place over time. For example, if you wish to maintain populations of birds typically found in the early stages of succession, you must periodically disturb the forest by logging or fire. Conversely, other Neotropical migrants are adapted to older forest habitats. Birds select only those stages of succession to which they are adapted. As stands develop over time, the habitats change, and so do species using those habitats. Many successional stages are relatively short, and the presence of the birds associated with them is equally short-lived. Changing an environment to benefit one species may affect a different species in a negative way. This may also result in changes in successional stages present on a landscape needed by other

animals. Thus, by managing for a variety of habitats, a landowner can expect to increase the variety and general abundance of wildlife.

Age Structure

Most forests in Washington and Oregon are even-aged. Figure 2 depicts the development over time of a typical even-aged coastal Douglas-fir forest. Similar development with different species occurs east of the Cascades in the absence of fire. Even-aged stands, intensively managed for timber, are generally low in habitat diversity. Such diversity can be increased if these stands are partly harvested or thinned, and if some defective or dead trees (snags) and some healthy or live trees (green or recruitment trees) are left standing. Recruitment trees are those trees left to become snags at a future date.

Snags are critical habitat components. At least three hard and three soft snags (see Glossary) of the larger sizes should be retained per acre to maintain a cavity-nesting bird population. Snags should be of the largest available diameter, preferably over 20 inches at breast height (BDH). Snags and recruitment trees are particularly valuable to cavity-nesting birds, and are used by over 40 species. They need not be highly valuable commercial trees; in fact, large wolf trees with many branches are ideal because they are worth less at the mill or for export. Preferably, leave the least vigorous trees, so that they will die more rapidly. In riparian areas such trees should be located so that they shade the water surface, and should have the potential of falling into the stream channel to provide fish habitat, thus directly benefiting aquatic resources.

Uneven-aged stands have three or more age classes. These are managed by selectively harvesting individual trees or small groups of trees at periodic intervals or by allowing natural processes to occur over a very long time. This system is best suited to those areas where the dominant tree species are generally shade tolerant, since reproduction must occur in the partial shade of older trees. Ponderosa pine forests east of the Cascades, for example, can be either even- or uneven-aged in structure. Silvicultural systems that perpetuate uneven-aged stands have generally been more successful on the eastside. In low-elevation westside forests, wind-thrown trees, unwanted shrubs, severe stem and root rot, and tree species shifts to alder or maple have

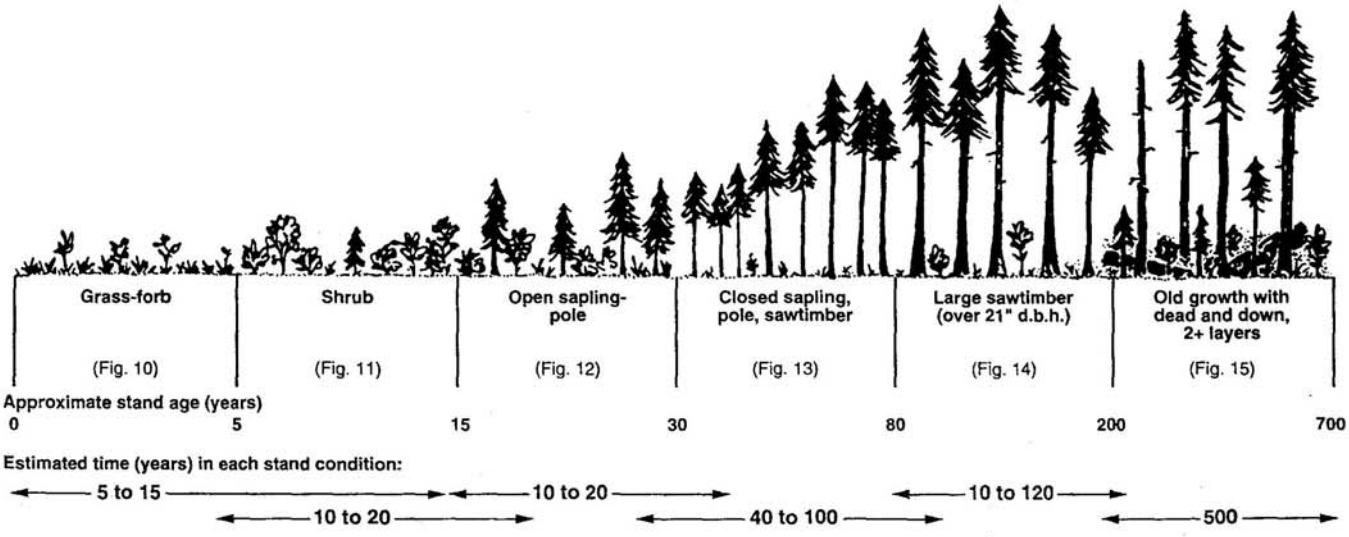


Figure 2. Stand conditions in Douglas-fir forests after even-aged harvesting. From Brown (1985).

rendered the system mostly unworkable. If poorly applied, the system can quickly lead to high-grading, the repeated harvesting of the best trees, leaving the poorer ones to regenerate the forest.

Vertical Development

Vertical development of tree and shrub species is affected by shade tolerance, stocking, site quality, and disturbance factors. Over time, competition for sunlight and soil nutrients influences the height of shrubs and trees. This difference eventually results in overtopping and the death of species that cannot compete. Many Neotropical migrants thrive when there is a greater diversity of plant species and growth forms (Figure 3; Table 2). If you wish to maintain diverse Neotropical migrant populations, use silvicultural systems that develop well-defined canopy layers from the tree canopy to the forest floor.

Management of Mature Stands

For mature stands west of the Cascades, use clearcut or green-tree retention systems to create diversity. On the eastside, use shelterwood, patch clearcut, or selective logging systems.

In the shelterwood method, about one-third of the trees are removed in the course of three entries carried out over a 5- to 10-year period. This results in approximately half sunlight and half shade on the forest floor. Allow the area to get "brushy," using herbicides sparingly.

Patch clearcuts can be used if the patches are kept to less than 10 acres. Analysis has shown that leaving large patches unharvested for interior bird species, and grouping harvest patches for early successional and edge bird species, can accommodate all birds and return the same cut of fiber. Consideration should be given to what other owners have done in your region. Locate patches so that habitat transitions occur between stand types. Patch clearcuts are often called for if you have predominantly shade-intolerant species such as red alder or lodgepole pine, or if bark beetle or root rot problems are severe.

The aggregated green-tree retention (AGTR) system is experimental, but it holds promise for Neotropical migrants. In this system, an undisturbed portion of the forest is retained as a kind of "island" in a harvest unit. This aggregate is maintained throughout the life of the next rotation to provide biological "legacies" for the future. Over time these areas should provide late successional habitats of increasing wildlife value. Generally, the size should be large enough to include the

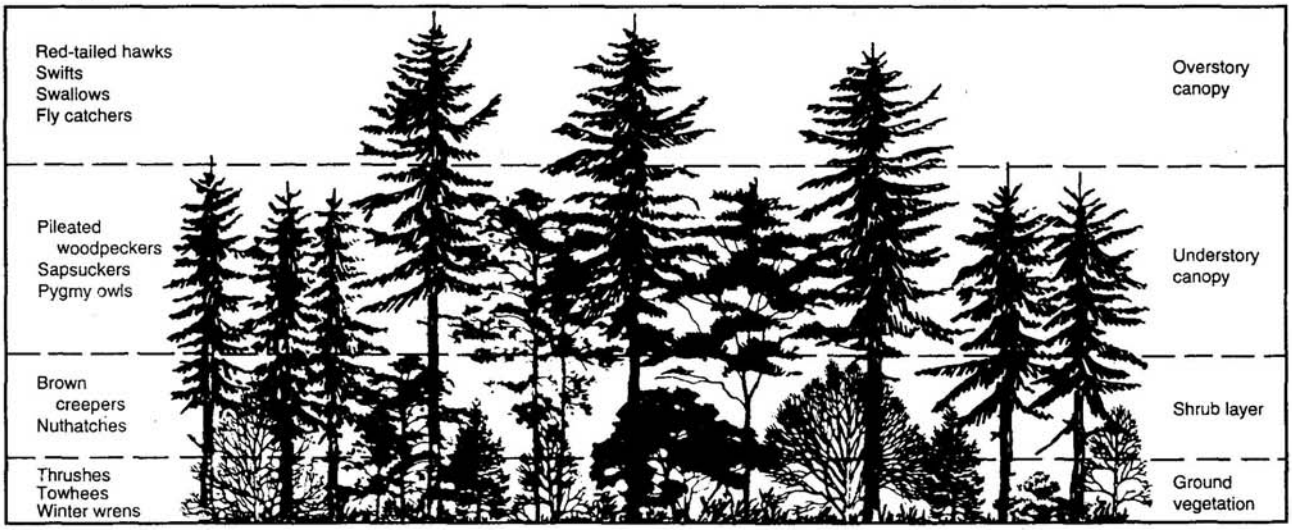


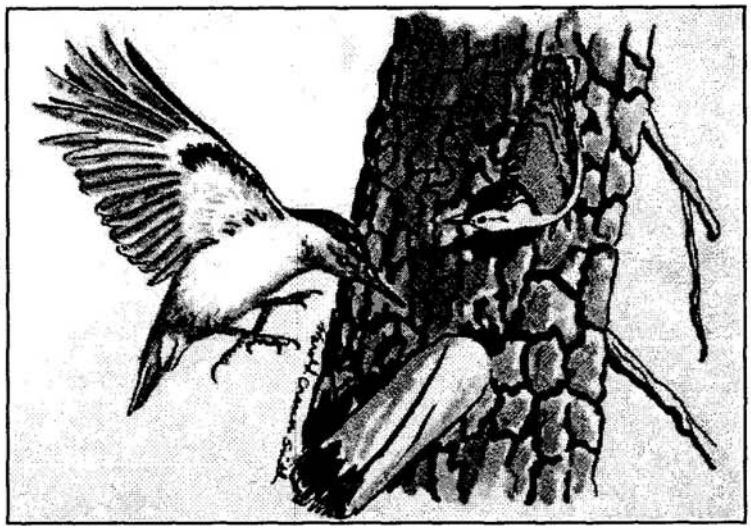
Figure 3. An example of the birds that utilize the vertical diversity in a mature Douglas-fir forest. From Brown (1985).

biological diversity of the existing stand. Multiple islands in midslope and riparian areas are desirable. These islands must provide enough undisturbed area to prevent displacement of wildlife. Because of limited trials and research, use of AGTR on the eastside is not well understood. However, the concept should still apply. Higher-elevation mixed conifer forests hold the most promise for this new technique.

In the selective logging system, more commonly applied on the eastside, trees that are the *oldest* in the stand, *not necessarily the largest,* are harvested at approximately 10-year intervals. Shrub management is important to maintain canopy-layer diversity and allow for adequate natural regeneration of the trees. Too many shrubs will hinder the natural regeneration of the trees; too few shrubs may result in harsh environments for young trees.

Management of Immature Stands

A common practice in immature stands is thinning. Some of the trees in the stand are removed to provide additional light and nutrients to those that remain. Thinning is a fundamental technique that promotes increased tree health and vigor, and can also create small openings in the forest canopy for light to reach the forest floor. Whenever light reaches the forest floor, new plant diversity is stimulated. *For timber management,* the smallest or most defective trees are cut to promote a healthier stand. However, this "low thinning" may be detrimental to some Neotropical migrants, especially those that use the mid-canopy regions. If your forest management goal is to increase Neotropical migrant habitats leave some dead standing trees and some nonmerchantable live trees that occupy the mid-canopy areas. Even small snags (less than 8 inch DBH) will have value for wildlife and should be retained during a thinning. It is a good idea to vary the leave-tree density as well. Small groups of leave trees will provide some protection from windthrow. Commercial thinning done during the winter will minimize the disturbance to Neotropical migrants.



White Breasted Nuthach

On the westside, some landowners thin repeatedly to maintain and develop multiple age and size classes in predominantly Douglas-fir stands. This approach is more likely to be successful on sites where root rot and soil compaction are not serious concerns. The long-term effects of this practice on biological diversity and soil properties are not known.

In eastside forests, multiple-entry thinning has been used by some landowners as a viable commercial harvest technique. This method allows them to adjust species composition for both habitat and economic reasons. A high degree of skill is required to implement this technique successfully.

Recommendations for Each Stand Type

If your goal is to provide for the broad needs of a variety of Neotropical migrant species, try to attain the best possible mix of the stand conditions discussed

below. *Take into account the habitat provided by land adjacent to yours.* As stands develop over time, their habitats change. And as these habitats change, so do the Neotropical migrant species.

Grass and Forb Type

If your property already contains some open land, you can maintain a healthy mixture of vegetation types by establishing grasses and forbs by seeding, periodic burning, grazing, or mowing. This kind of habitat can be created by making openings in existing stands, using small clearcut patches, and seeding the disturbed area with a grass or legume mix. On the eastside, forest-land grazing is common. However, grazing is sometimes incompatible with ground nesting Neotropical migrants and should be monitored carefully. Protection of riparian areas from grazing is desirable whenever possible.

Shrub Type

Shrubs provide many wildlife species with food, cover, and shelter. You can meet the cover needs of Neotropical migrants by leaving existing brush areas unplanted or by thinning the tree canopy to stimulate shrub growth. Desired shrubs often require direct sunlight. Shrubs can also be planted to create habitat, and specialized nurseries have appropriate planting stock. Try to plant and retain native species that produce berries. If herbicide use is necessary to control competing vegetation, consider leaving some areas untreated to retain shrub habitat. Leaving wider-than-required no-spray buffers along waterways and wetlands is also recommended. On the westside, consider cutting alder rather than spraying, when possible. Cut in summer after the alder is in full leaf to avoid resprouting. Alder can sprout even if it is less than 1 inch in diameter at the ground line during the dormant season. Be sure to cut below the lowest lateral branch.

Immature Second Growth Conifers

Thin these stands periodically to maintain a healthy, vigorous condition. Patch thinning is highly recommended in older stands to provide more light to the forest floor. Leave some standing dead and defective live trees as well as cavity trees or nesting trees. Unfortunately, wildlife diversity in these monetarily valuable stands is often low. Selective thinning helps maintain trees and shrubs in many canopy layers. Retain recruitment trees for the next generation of snags. On the eastside, favor shade-intolerant or intermediate shade-tolerant species such as western larch and ponderosa pine whenever possible.

Mature Second Growth Conifers

West of the Cascades, use a shelterwood system, patch clearcut, or aggregated green-tree retention system. Use the shelterwood system on the eastside. The selective logging system can be tried east of the Cascade crest. If you use this system, take into account tree vigor, species, location, and health, as well as age. Do not high-grade. Select trees to harvest based on their age, species, and location. Harvest trees that display insects, diseases — especially bark beetles, root and stem rots, and dwarf mistletoe. If possible, minimize the period of disruption by limiting silvicultural activities to small areas, and complete them in a short time. Simultaneous logging of adjacent drainages should be avoided. Retain snags whenever practical. Try to avoid logging between late February and mid-July in pine forests because of the increased likelihood of *Ips* (pine engraver) beetle attacks.

It is best to seek advice from a competent wildlife biologist and or forester before implementing silvicultural treatments to improve Neotropical migrant habitats.

Table 1.

Most common Neotropical migrants in forested and associated habitats of Washington & Oregon[2]

Species/Group	*Common nest site location*
Osprey, eagles, hawks, falcons, vultures	
golden eagle	snags or cliffs (platform nester)
turkey vulture	stumps, cliffs, caves
osprey	snags and trees near water (platform nester)
sharp-shinned hawk	conifers (platform nester)
Cooper's hawk	deciduous and coniferous trees (platform nester)
Swainson's hawk	deciduous trees atop cliffs
red-tailed hawk	trees (platform nester)
Northern goshawk	conifers (platform nester)
Northern harrier	ground, concealed by shrubs
merlin	deciduous trees atop cliffs
peregrine falcon	cliffs in slight depression on ground
American kestrel	abandoned cavities in trees and cliffs
Owls	
short-eared owl	ground, concealed by low growing vegetation
long-eared owl	abandoned nests of other birds (variable)
flammulated owl	abandoned woodpecker holes (cavity nester)
Pigeons and Doves	
band-tailed pigeon	most commonly in deciduous trees
mourning dove	most commonly in deciduous trees
Nighthawks, Poorwills	
common poorwill	ground in open woodlands
common nighthawk	stumps, or on ground in open and clear-cut areas
Swifts and hummingbirds	
black swift	cliffs behind waterfalls
Vaux's swift	larger, hollow trees
rufous hummingbird	riparian thickets
calliope hummingbird	montane woodlands
black-chinned hummingbird	open, riparian woodlands
broad-tailed hummingbird	open woodlands
Woodpecker, Sapsuckers	
Lewis's woodpecker	snags, deciduous trees in open woodlands (cavity nester)
red-naped sapsucker	coniferous trees (cavity nester)
red-breasted sapsucker	snags, deciduous trees (cavity nester)
Williamson's sapsucker	coniferous trees (cavity nester)
Kingfishers, Flickers	
belted kingfisher	burrows in banks along watercourses
Northern flicker	snags, trees in any woodlands (cavity nester)
Flycatchers	
ash-throated flycatcher	natural cavities in deciduous trees (cavity nester)
least flycatcher	deciduous trees or shrubs in mixed woodlands
gray flycatcher	shrubs in open, arid woodlands
cordilleran flycatcher	ground in dense woodlands
Pacific slope flycatcher	coniferous and mixed woodlands
olive-sided flycatcher	coniferous woodlands
western wood peewee	coniferous and mixed woodlands
dusky flycatcher	open woodlands
Hammond's flycatcher	dense, coniferous woodlands

Species/Group	*Common nest site location*
willow flycatcher	deciduous, riparian woodlands
Western kingbird	deciduous trees in riparian woodlands
Eastern kingbird	deciduous trees in open or riparian woodlands
Swallows	
purple martin	snags near water (cavity nester)
tree swallow	snags near water (cavity nester)
violet-green swallow	tree cavities near water (cavity nester)
Wrens	
house wren	open woodland thickets (cavity nester)
Kinglets and thrushes	
golden-crowned kinglet	coniferous woodlands
ruby-crowned kinglet	coniferous and mixed woodlands
western bluebird	open woodlands (cavity nester)
mountain bluebird	open areas of coniferous woods (cavity nester)
Townsend's solitaire	open, coniferous woodlands
Swainson's thrush	ground/shrubs in woodlands
veery	nests on ground in riparian thickets
hermit thrush	ground in woodlands
American robin	trees in all habitats
Gray catbird	dense, riparian thickets
Varied thrush	dense, coniferous woodlands
Waxwings and wrentits	
cedar waxwing	woodlands near water
wrentit	deciduous, riparian thickets (western Oregon)
Warblers and vireos	
Hutton's vireo	shrubs or trees in mixed woodlands
solitary vireo	coniferous or mixed woodlands
warbling vireo	deciduous or mixed woodlands
red-eyed vireo	tall, riparian woodlands
orange-crowned warbler	ground in riparian thickets and brushy uplands
Nashville warbler	ground in riparian thickets
yellow warbler	riparian thickets
yellow-rumped warbler	coniferous woodlands
black-throated gray warbler	open, mixed woodlands
Townsend's warbler	coniferous woodlands
hermit warbler	high in coniferous woodlands
MacGillivray's warbler	shrubs in riparian thickets
common yellowthroat	riparian thickets, especially willow
yellow-breasted chat	shrubs in riparian thickets; brushy hillsides in western Oregon
Wilson's warbler	shrubs in riparian thickets and coniferous woodlands
Northern waterthrush	banks of woodland streams
Tanagers and grosbeaks	
western tanager	coniferous woodlands
lazuli bunting	nests in open woodland thickets
black-headed grosbeak	deciduous, riparian woodlands
Sparrows, juncos, towhees	
chipping sparrow	high in open, coniferous woodlands
fox sparrow	low in dense woodland understory
song sparrow	low in riparian thickets
Lincoln's sparrow	low in riparian thickets
white-crowned sparrow	low in open, coniferous woodlands

Species/Group	*Common nest site location*
savannah sparrow	on ground in open meadows and marshy areas
Dark-eyed junco	low in open, coniferous woodlands
spotted towhee	ground in woodland riparian thickets
green-tailed towhee	ground in riparian scrub in open coniferous
Blackbirds	
Brewer's blackbird	riparian woodlands
brown-headed cowbird	nest parasite, edge habitat or open woodlands
red-winged blackbird	reeds all riparian habitats
yellow-headed blackbird	reeds in freshwater marshes
bobolink	ground in flooded meadows, tall grass
Western meadowlark	ground in meadows
Bullock's oriole	deciduous, riparian woodlands
Finches	
Cassin's finch	in coniferous woodlands
American goldfinch	shrubs in deciduous, riparian woodlands
purple finch	high coniferous woodlands
pine siskin	high coniferous woodlands
red crossbill	high coniferous woodlands

Table 2.

Neotropical migratory landbirds grouped by major habitats in coniferous forests of ***eastern*** *Washington and Oregon. (Source: Andelman, et al., 1994)*

Species	Riparian [1]	Clearcut and seedling/shrub [2]	Second growth [3]	Old growth [4]	Meadow [5]
Turkey vulture		x			
Swainson's hawk	x				
Northern harrier					x
Red-tailed hawk	x	x	x	x	x
Golden eagle		x		x	
Osprey	x				
Sharp-shinned hawk	x	x	x	x	
Cooper's hawk	x	x	x		
Northern goshawk				x	
Merlin	x	x			
American kestrel	x	x	x	x	x
Killdeer					x
Mourning dove	x	x	x	x	
Flammulated owl				x	
Short-eared owl					x
Long-eared owl	x		x	x	x
Common nighthawk	x	x	x	x	
Common poorwill		x	x	x	
Vaux's swift	x			x	
Black swift	x				
Broad-tailed hummingbird [a]				x	

Table 2. (Continued)

Species	Riparian [1]	Clearcut and [2] seedling/shrub	Second growth [3]	Old growth [4]	Meadow [5]
Black-chinned hummingbird	X	X			
Calliope hummingbird	X	X	X	X	X
Rufous hummingbird	X				X
Belted kingfisher	X				
Lewis's woodpecker	X	X		X	
Red-naped sapsucker	X		X	X	
Red-breasted sapsucker	X				
Williamson's sapsucker				X	
Northern flicker	X	X	X	X	
Olive-sided flycatcher		X	X	X	
Western wood-pewee	X		X	X	
Willow flycatcher	X				
Least flycatcher	X				
Hammond's flycatcher	X		X	X	
Dusky flycatcher	X	X	X	X	
Pacific-slope flycatcher	X				
Ash-throated flycatcher	X				
Gray flycatcher		X			
Cordilleran flycatcher			X	X	
Western kingbird	X				
Eastern kingbird	X				
Purple martin	X				
Tree swallow	X				X
Violet-green swallow	X		X	X	
House wren	X	X	X	X	
Golden-crowned kinglet			X	X	
Ruby-crowned kinglet			X	X	
Western bluebird		X	X	X	
Mountain bluebird		X		X	
Townsend's solitaire		X	X	X	
Veery	X				
Swainson's thrush	X				
American robin	X	X	X	X	X
Varied thrush				X	
Hermit thrush		X	X	X	
Gray catbird	X				
Cedar waxwing	X				
Solitary vireo	X		X	X	
Warbling vireo	X				
Red-eyed vireo	X				
Orange-crowned warbler	X				
Nashville warbler		X			
Yellow warbler	X				
Black-throated gray warbler	X				
MacGillivray's warbler	X	X			
Yellow-rumped warbler			X	X	
Townsend's warbler		X	X	X	
Northern waterthrush	X				

Table 2. (Continued)

Species	Riparian [1]	Clearcut and [2] seedling/shrub	Second growth [3]	Old growth [4]	Meadow [5]
Common yellowthroat	x				x
Wilson's warbler	x				
Yellow-breasted chat	x				
Western tanager	x		x	x	
Black-headed grosbeak	x				
Lazuli bunting	x	x			
Green-tailed towhee		x			
Spotted towhee	x	x			
Song sparrow [a]		x			
Savannah sparrow					x
Fox sparrow	x				
Lincoln's sparrow	x				x
White-crowned sparrow	x	x			
Chipping sparrow		x	x	x	
Dark-eyed junco		x	x	x	
Boblink					x
Red-winged blackbird	x				
Yellow-headed blackbird [a]	x				
Brewer's blackbird	x				x
Western meadowlark					x
Brown-headed cowbird	x	x			
Bullock's oriole	x				
Cassin's finch			x	x	
Red crossbill			x	x	
American goldfinch	x				

Table 2. footnotes

[a] Specific to this habitat type in Oregon (though may also occur in Washington).

[1] Woodlands, shrubby or herbaceous vegetation associated with streams, rivers, and occasionally with ponds or lakes.

[2] Clearcuts, clearings and shrubby openings (open canopy) within forested areas.

[3] Closed canopy, young forest (30-100 years)

[4] Closed canopy, mature forest (> 100 years)

[5] Wet meadows, excluding hay fields

Table 3.

Neotropical migrant landbirds grouped by major habitats in coniferous forests of ***western*** *Washington and Oregon. (Source: Andelman et al., 1994)*

Species	Riparian [1]	Clearcut and [2] seedling/shrub	Second growth [3]	Old growth [4]	Meadow [5]
Turkey vulture		x			
Swainson's hawk	x				
Northern harrier					x
Red-tailed hawk	x	x	x		x
Golden eagle		x			
Peregrine falcon		x			
Sharp-shinned hawk	x	x	x	x	

Table 3 (Continued)

Species	Riparian [1]	Clearcut and [2] seedling/shrub	Second growth [3]	Old growth [4]	Meadow [5]
Cooper's hawk	x	x	x	x	
Northern goshawk				x	
Merlin	x	x	x	x	
American kestrel	x	x			x
Killdeer					x
Band-tailed pigeon			x	x	
Mourning dove	x	x			
Short-eared owl					x
Long-eared owl	x				x
Common nighthawk	x	x			
Vaux's swift	x			x	
Black swift	x				
Black-chinned hummingbird	x				
Calliope hummingbird	x				x
Anna's hummingbird	x				
Rufous hummingbird	x	x	x	x	x
Belted kingfisher	x				
Lewis's woodpecker	x				
Red-naped sapsucker	x				
Red-breasted sapsucker	x		x	x	
Northern flicker	x	x	x	x	
Olive-sided flycatcher		x	x	x	
Western wood pewee	x		x	x	
Willow flycatcher	x	x			
Hammond's flycatcher	x		x	x	
Dusky flycatcher	x				
Pacific-slope flycatcher	x		x	x	
Ash-throated flycatcher	x				
Western kingbird	x				
Eastern kingbird	x				
Tree swallow					x
Violet-green swallow	x				
House wren	x	x			
Golden-crowned kinglet			x	x	
Mountain bluebird		x			
Townsend's solitaire		x			
Swainson's thrush	x	x	x	x	
American robin	x	x	x	x	x
Hermit thrush		x	x	x	
Cedar waxwing	x	x			
Solitary vireo	x		x	x	
Warbling vireo	x	x			
Red-eyed vireo	x				
Orange-crowned warbler	x	x			
Yellow warbler	x				
Black-throated gray warbler	x		x		
MacGillivray's warbler	x	x			
Yellow-rumped warbler			x	x	
Townsend's warbler			x	x	

Table 3 (Continued)

Species	Riparian [1]	Clearcut and [2] seedling/shrub	Second growth [3]	Old growth [4]	Meadow [5]
Northern waterthrush	X				
Common yellowthroat	X				X
Hermit warbler			X	X	
Wilson's warbler	X	X	X	X	
Yellow-breasted chat	X				
Western tanager	X		X	X	
Black-headed grosbeak	X				
Lazuli bunting	X				
Spotted towhee	X	X			
Savannah sparrow					X
Fox sparrow	X	X			
Lincoln's sparrow	X				X
White-crowned sparrow	X	X			
Dark-eyed junco		X	X	X	
Red-winged blackbird	X				
Brewer's blackbird	X				X
Western meadowlark					X
Brown-headed cowbird	X	X	X		
Bullock's oriole	X				
Purple finch [a]			X	X	
Pine siskin [a]		X	X	X	
American goldfinch	X	X			

[a] Specific to this habitat type in Oregon (though may also occur in Washington).

[1] Woodlands, shrubby or herbaceous vegetation associated with streams, rivers, and occasionally with ponds or lakes.

[2] Clearcuts, clearings and shrubby openings (open canopy) within forested areas.

[3] Closed canopy, young forest (30-100 years)

[4] Closed canopy, mature forest (> 100 years)

[5] Wet meadows, excluding hay fields

Checklist of things you can do to improve habitat for Neotropical migrant birds in your forest:

- *Maintain habitat diversity.* Retain or create a variety of tree and plant species, diameters, heights and spacings. Leave uncut patches, and vary thinning densities. Consider habitat on neighboring properties when planning your activities.
- *Protect riparian vegetation along waterways and wetlands.* Restrict harvesting, herbicide application, and grazing in these critical habitat areas. Restore riparian vegetation in areas where it has been removed or damaged.
- *Retain and create snags and wildlife reserve trees.* Preferably, select large diameter trees of little or no commercial value; including damaged, deformed, and large-limbed "wolf trees."
- *Establish native trees, shrubs, and seed* mixtures known to be beneficial to birds.
- *Protect mid to lower canopy level vegetation,* including berry-producing shrubs, during forest management activities.
- *Limit herbicide use.* Consider manual control of competing vegetation where practical. Leave untreated areas, especially those with berry-producing shrubs, if herbicide application is needed to control competing vegetation.

- *Install and maintain nest boxes as a short-term habitat enhancement* where preferred snag and reserve trees are limited or not available.
- *Limit forest management activities during breeding season.* Most Neotropical migrant birds breed during spring and early summer (April 1 - August 1).

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Glossary

Age structure	The variety of tree ages in a forest. The age structure can be even-aged or uneven-aged (see definitions below).
Aggregated green tree retention (AGTR)	A harvested unit in which some trees are left standing in clumps. This harvesting technique is different from clearcutting, and is intended to improve wildlife habitat and other ecosystem features in future stands.
Bark beetle	An insect that bores into and beneath tree bark to lay its eggs. The feeding trails (galleries) girdle the tree and may kill it. Specific types of bark beetles attack different tree species. Most bark beetles can kill weakened trees.
Canopy	The uppermost layer in a forest, formed collectively by the tree crowns.
Canopy gap	An opening in the forest canopy, often due to fallen trees. More light is able to reach the forest floor in a gap, thereby allowing increased growth of understory plants.
Clearcut	A harvest and regeneration technique removing all the trees (regardless of size) on an area in one operation. Clearcutting is commonly used with shade-intolerant species such as Douglas-fir or lodgepole pine, which require full sunlight to reproduce and grow well.

	Clearcutting produces an even-aged stand.
DBH	The tree diameter at breast height (4.5 feet above the ground on the uphill side).
Disturbance	A natural or human-caused event, such as a forest fire, disruptive wind storm, or insect infestation, that alters the structure and composition of an ecosystem.
Dwarf mistletoe	A parasite on trees that creates irregular branching patterns.
Ecotone (or edge)	A transition zone between two habitats.
Edge	When a large tract of forest land is broken up into smaller patches, edge is created. Edge is the area of transition between two different vegetation communities, such as forest and meadow.
Edge effect	The influence of a habitat edge on the behavior, distribution, and abundance of animals and plants.
Even-aged	A stand in which trees are essentially the same age (within 10 to 20 years).
Forest ecosystem	A plant community dominated by trees and other woody plants, where the plants interact with other living and nonliving components such as soil, water, air, animals, and microscopic organisms.
Fragmentation	The breaking up of larger areas of habitat into smaller patches.
Green tree retention	A harvest system that does not harvest all of the trees on a unit. Some of the trees are permanently retained on the site, in a clumped or dispersed manner, to improve wildlife habitat and other ecosystem attributes.
Habitat	The local environment in which an animal or plant naturally lives and develops.
High-grading	A harvesting technique that removes only the best trees to obtain high, short-term financial returns at the long-term expense of remaining stand growth potential. *See also* Selective logging.
Legacies	Biological features of a forest ecosystem still present after disturbance, such as green trees, decaying logs, surviving seeds, mycorrhizal fungi, soil organic matter, invertebrates, mammals, and so forth.
Neotropical migrants	Birds that nest in North America but spend the winter in the New World tropics (e.g., Mexico and Central and South America).
Niche	The particular role that an animal or plant fulfills in an area, including where it lives and what it does.
Passerine	Songbirds such as sparrows, finches, warblers, and flycatchers that belong to the Order Passeriformes.
Patch clearcut	A small clearcut.
Permanent residents	Birds that remain in Oregon and Washington all year long.

Glossary (Continued)

Planting stock	Seedling trees ready for planting.
Recruitment trees	Mature trees that are left on a unit after harvesting. These trees will eventually die and become snags, thereby providing wildlife habitat.
Riparian zone	The area along the banks of a river, stream, or lake. These areas often have distinct plant and animal communities.
Root rot	Fungal diseases that attack tree roots. Root rots can weaken and eventually kill trees.
Selective logging	A system of removing only desirable species of trees over a certain diameter, also known as diameter limit cutting.
Shelterwood	A system of harvesting trees in a series of two or more operations. New seedlings grow and become established in the partial shade protection of older trees that are left during the first harvest. Those older shade trees are subsequently removed. Harvests are usually 5 to 10 years apart, resulting in an even-aged stand.
Silviculture	The theory and practice of controlling forest establishment, composition, structure, and growth to achieve management objectives. Silviculture can be oriented toward timber production as well as providing wildlife habitat.
Snag	A dead tree that is still standing, as opposed to a fallen dead tree (log).
Stand	A recognizable area of forest that is relatively homogeneous and can be managed as a single unit. Stands are the basic management units of the forest.
Structural diversity	The vertical arrangement and spatial organization of plants and other features of a habitat.
Successional stage	A phase in the natural development of forest communities. Over time, favorable conditions are reached for the establishment of the next stage.
Summer residents	Birds that nest in Oregon and Washington but spend the winter elsewhere.
Thinning	Tree removal in a forest stand that reduces tree density and tree-to-tree competition. Thinning encourages increased growth of fewer, higher quality trees. Thinning systems include precommercial thinning, commercial thinning, low thinning, and crown thinning.
Uneven-aged	A stand that supports trees of several age classes (technically, more that two age classes).
Vertical diversity	The amount of complexity in vegetation from the ground to the top of the dominant vegetation.
Winter residents	Birds that spend the winter in Oregon and Washington but nest elsewhere.
Wolf tree	A low-value tree occupying more space in the forest than its economic value justifies. Usually older, larger, or more branchy than other trees in the stand.

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