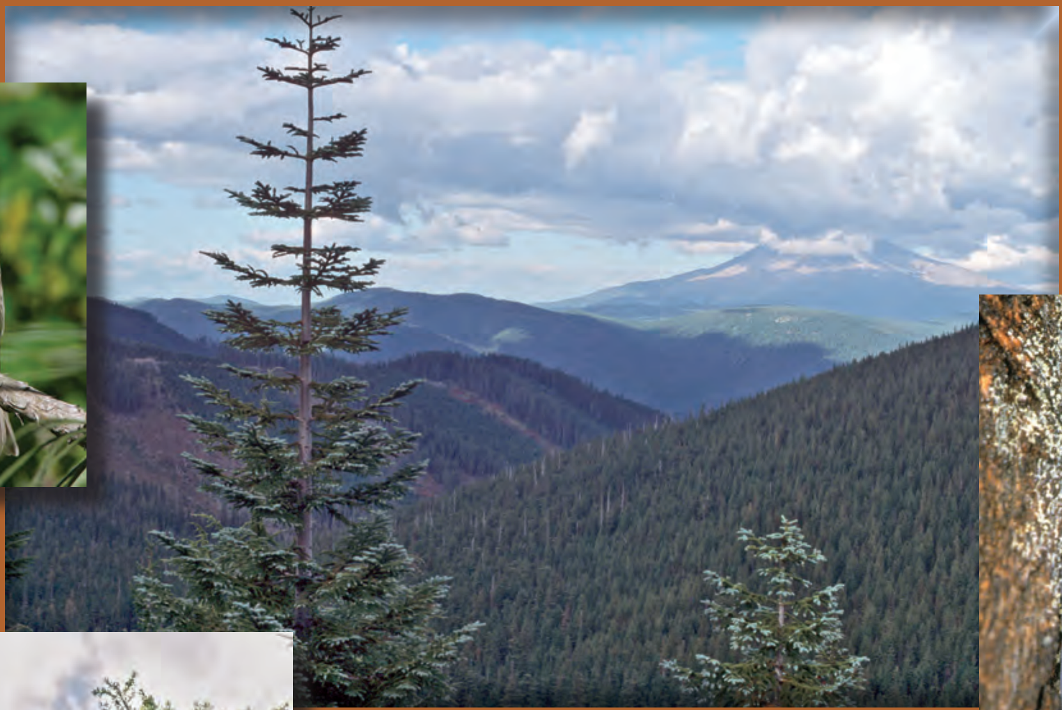
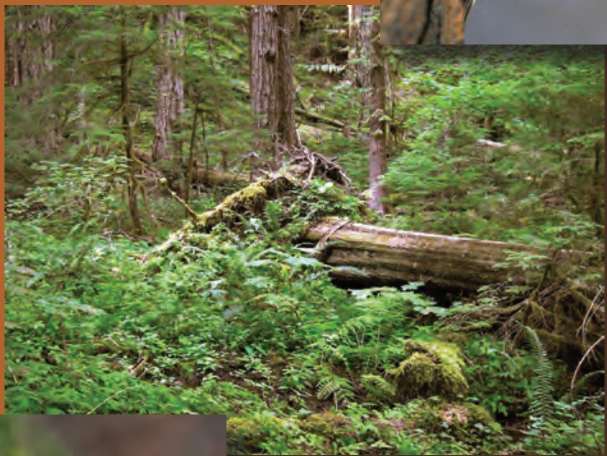
Habitat Conservation for Landbirds in the Coniferous Forests of Western Oregon and Washington





Version 2

Habitat Conservation for Landbirds in the Coniferous Forests of Western Oregon and Washington Version 2

Oregon-Washington Partners in Flight
www.orwapif.org

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Hammonds Flycatcher by Scott Streit
Brown Creeper by Michael Stubblefield
Pileated Woodpecker by Alan Wilson
Other images and cover design by Erik Ackerson

Executive Summary

This document has been prepared to stimulate and support a proactive approach to the conservation of landbirds in coniferous forests of western Oregon and Washington. It represents the collective efforts of numerous individuals from multiple agencies and organizations within the Oregon-Washington Chapter of Partners in Flight.

Recommendations included in this document are intended to guide planning efforts and the habitat management actions of land managers, direct expenditures of government and non-government organizations, and stimulate monitoring and research to support landbird conservation. The recommendations also are expected to be the biological foundation for developing and implementing integrated conservation strategies for multiple species at multiple geographic scales to ensure functional ecosystems as indicated by healthy populations of landbirds.

The Birds and the Forests

Temperate rain forests of the Pacific Northwest support the highest abundances of birds of any coniferous forest system in North America. Non-game landbirds comprise the largest portion of this bird community, but have been underrepresented in resource management plans. Additionally, many coniferous forest landbird species are experiencing population declines. In coniferous forests of western Oregon and Washington, 32 species have significant recent (1980-2006) and/or long-term (1966-2006) declining trends based on Breeding Bird Survey data, while only 16 species have significantly increasing trends.

Most coniferous forests in western Oregon and Washington are regularly altered by land management activities, primarily timber production and harvest. Traditional forest management practices over the last 50 years have included fire suppression, disease control, salvage logging, shorter rotations, clearcutting, slash burning, herbicide applications, and thinning. These and other practices have resulted in a reduction in the amount of late-successional forest, and a reduction in the range of bird habitat structural variability present in younger forests. Recent forest management practices, particularly on federal lands, have changed with a greater emphasis on "ecosystem management" in which maintaining ecological values and function is integrated with sustainable commodity production. Management prescriptions that increase structural diversity are being implemented, including green tree and snag retention to enhancing late-successional characteristics, and thinning and group selection cuts that create different sizes and shapes of forest patches and gaps. Implementation of these and other new management prescriptions coupled with the long-term landbird species declines emphasizes the need to develop conservation strategies for maintaining functional ecosystems for landbirds.

Goals and Process

The primary goal of this document is to promote long-term persistence of healthy populations of native landbirds in coniferous forests of western Oregon and Washington. To facilitate that goal, we describe the following steps in a process that emphasizes providing quantitative, prescriptive recommendations for the desired range of habitat types and habitat conditions needed for landbird conservation:

- identify habitats that are conservation priorities for landbirds
- identify the desired conditions for landbirds within the priority habitats
- identify species representative of the desired habitats and habitat attributes (i.e., focal species)
- supplement the focal species list with priority species that have been identified by primary bird conservation partners and would benefit from conservation of focal species
- establish measurable habitat objectives to achieve the desired habitat conditions based on the habitat requirements of the focal species
- opportunistically supplement the habitat objectives with focal species population objectives to be used as the metric for tracking bird conservation
- recommend conservation strategies that can be implemented to achieve the habitat objectives
- conduct monitoring to assess the habitat and focal species response to the implemented conservation strategies and progress towards the habitat and population objectives
- implement adaptive management as appropriate to adjust habitat management towards the trajectory of the biological objectives

Accomplishment of our primary goal through implementation of the process described above also should result in accomplishment of our secondary goal to help prevent listing of landbird species as threatened or endangered. When our vision of an ecosystem-driven conservation strategy is fully implemented at large geographic scales, the aggregated effect will be the creation of landscapes that should function to conserve landbird species and communities.

Focal Species

Our strategy for achieving functioning ecosystems for landbirds is described through the habitat requirements of 25 "focal species." By managing for a suite of species representative of important habitat components in a functioning coniferous forest ecosystem, many other species and elements of biodiversity also will be conserved. The following focal species were selected based on their degree of association with important habitat attributes in coniferous forests of western Oregon and Washington:

Photo by Alan Wilson

Forest Condition	Habitat Attribute	Focal Species
Old-growth/Mature	Large snags	Pileated Woodpecker
Old-growth/Mature	Large trees	Brown Creeper
Old-Growth/Mature	Deciduous canopy trees	Pacific-slope Flycatcher
Old Growth-Mature	Mid-story tree layers	Varied Thrush
Mature/Young	Closed canopy	Hermit/Townsend's Warbler
Mature/Young	Open mid-story	Hammond's Flycatcher
Mature/Young	Deciduous understory	Wilson's Warbler
Mature/Young	Forest floor complexity	Winter Wren
Young/Pole	Deciduous canopy trees	Black-throated Gray Warbler
Sapling/Seedling	Residual canopy tree	Olive-sided Flycatcher
Sapling/Seedling	Snags	Northern Flicker
Sapling/Seedling	Deciduous vegetation	Orange-crowned Warbler
Unique	Nectar-producing plants	Rufous Hummingbird
Unique	Mineral springs/seeps	Band-tailed Pigeon
Unique	Montane wet meadows	Lincoln's Sparrow
Unique	Alpine grasslands	American Pipit
Unique	Waterfalls	Black Swift
Unique	Large hollow snags	Vaux's Swift
Unique	Landscape mosaic forest	Blue (Sooty) Grouse
Klamath Mts. Mixed Forest	Pine-oak canopy/subcanopy trees	Purple Finch
Klamath Mts. Mixed Forest	Dense shrub understory	Nashville Warbler
Klamath Mts. Mixed Forest	Shrub-herbaceous interspersion	Hermit Thrush
Klamath Mts. Mixed Forest	Forest canopy edges	Western Tanager
Klamath Mts. Mixed Forest	Montane brushfields	Fox Sparrow
Klamath Mts. Mixed Forest	Post-fire	Lazuli Bunting

Biological Objectives and Conservation Strategies

Based on the habitat relationships of our focal species, biological objectives are recommended and conservation strategies to achieve them are identified. Simply stated, biological objectives are "***what we think the birds need***." They are **not regulatory,** nor do they represent the policies of any agency or organization. Establishing quantitative biological objectives serves several purposes:

- provides targets for designing management plans and benchmarks for measuring success of management actions
- helps formulate hypotheses for research, particularly when objectives are based on assumptions and/or professional opinion due to lack of data
- assists outreach to communicate to others what is needed to conserve landbirds
- provides a starting point for discussion of integration with broader ecosystem-based objectives

Biological objectives include site and landscape-level habitat objectives, and some population objectives. Habitat objectives are derived from current knowledge and professional judgment about bird-habitat relationships. Population objectives are primarily a direct translation of habitat objectives based on a species habitat-specific density. Additionally, regional habitat objectives are included for forest successional stages, forest cover in developing landscapes, and natural forest regeneration in post-wildfire habitat.

Conservation strategies are examples of management actions that may be used to support the biological objectives or enhance conservation relative to a habitat attribute or focal species. They are recommendations that can be institutionalized into management practices or implemented on an opportunistic basis within the broader context of ecosystem management.

This document emphasizes conservation efforts in areas where each species' abundance is greatest and presumably habitat is most suitable. To facilitate this at a regional scale, recommended management is prioritized for focal species and their associated habitat attributes by forest type, ecoregion, and elevation where appropriate. Highest regional priorities include two forest types and three ecoregions:

High Priority Forest Types

- low elevation Western Hemlock/Western Redcedar
- mixed-conifer forest in the Klamath Mountains ecoregion

High Priority Ecoregions

- Klamath Mountains
- Oregon Coast Range
- Olympic Peninsula

Photo by Bob Altman

Education and Implementation

Conservation of landbirds in the coniferous forests of western Oregon and Washington will require not only the development and implementation of a variety of biological objectives and conservation strategies, but also increased public awareness, commitment, and political support to ensure that resources are available to conduct the work. This means information must be communicated to the public to educate them about the benefits of bird conservation, and also communicated to land managers in a manner that is concise and understandable.

For the most effective translation of the information and recommendations of this document into education programs, it is suggested that teams of scientists and educators work together to develop outreach products such as bird-habitat conservation Decision Support Tools. To facilitate that, we provide two examples of Decision Support Tools—one for the focal species and habitat attributes of the mixed conifer and mixed conifer-hardwood forests of the Klamath Mountains ecoregion of southwest Oregon, and the other for regional landscape-level conservation and management for Pacific-slope Flycatcher.

Implementation of landbird conservation as described in this document will require conservation actions that are:

- integrated across focal species and habitat types and conditions
- implemented at several geographic and ecological scales
- coordinated among various landowners and land management agencies
- monitored and adjusted as new data warrant

All these actions will require careful consideration of numerous options to maximize conservation efforts, and the integration of diverse values and goals of land owners/managers with that of bird conservation. Implementation also will require a broad range of partnerships, extensive cooperation, considerable financial resources, and a strong scientific biological foundation within the context of multiple biological and non-biological goals and objectives. Biological objectives in this document should be used as the foundation for the bird conservation part of comprehensive, integrated, landscape designs for conservation of all natural resources.

Recommendations in this document include opportunities for participation at any level. This includes directing management actions for small landowners to provide habitat for a single species (e.g., managing for deciduous canopy trees and Black-throated Gray Warblers), and as the foundation for comprehensive, integrated complex multi-agency/organization, multi-species conservation within large-scale management units (e.g., watersheds, land management districts, ecoregions). At smaller scales, management actions should be ecologically appropriate based on site-specific conditions, and fit into the context of conservation across the landscape or region. At larger scales, management should emphasize functioning ecosystems with adequate representation of appropriate habitat attributes to support the entire landbird community.

This document has broad applicability to many other conservation planning efforts. This includes use of our recommendations in development of site-specific conservation plans such as State and private Habitat Conservation Plans, agency and inter-agency Management Plans, and local land-use planning strategies. Conversely, areas designated for conservation or management in other land management plans (e.g., Northwest Forest Plan) should be evaluated for potential support of landbird conservation as recommended in this document.

Monitoring, Research, and Adaptive Management

All conservation actions implemented on the basis of recommendations described in this document should include a monitoring and/or research component. This will be necessary not only to test the effectiveness of management actions, but also to evaluate assumptions upon which many of the biological objectives are based. When habitat management actions are undertaken as described in this document, monitoring and/or research programs should be designed and implemented to:

- test the effectiveness of the actions
- evaluate assumptions built into biological objectives
- direct adaptive management to achieve desired results

In addition to the need for validation of the biological objectives, there are three recurrent research themes throughout the document:

- focal species reproductive success and population viability in various forest conditions and from different forest management activities

Photo by Erik Ackerson

- area-requirements (i.e., patch size minimums) necessary for occupancy and population viability of area-sensitive (i.e., forest interior) focal species
- landscape-level assessments of habitat needs for some focal species

The direct outgrowth of monitoring and research conducted to support the recommendations in this document should be adaptive management. Monitoring and research are an integral part of the adaptive management component of our recommendations, and will function to increase our knowledge base and provide scientific data to revise biological objectives as necessary.

Future Versions

This document should be considered a “working document” with anticipated revisions and expansions as new information becomes available. Future versions may include more focal species and additional habitat and population objectives. As additional focal species are added and biological objectives are revised and updated, a more complete ecosystem management strategy will be continually formulated. Ultimately, we envision designated Landbird Conservation Areas identified on the regional landscape where integrated conservation for multiple species is being implemented as part of ecosystem management.

Acknowledgements

We would like to extend our appreciation and thanks to the many individuals who contributed their time and expertise in the development of this document and the previous version upon which it is based. Individuals providing a review of earlier drafts of Version 2.0 include B. Bresson, J. Buchanan, M. Green and E. Ackerson. A. Dayer prepared the chapter on Education. E. Ackerson prepared the layout and design. Funding for Version 2.0 was provided by the National Fish and Wildlife Foundation and the Gwladys & John Zurlo Charitable Foundation through grants administered by the Klamath Bird Observatory.

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Introduction to Landbird Conservation

Partners in Flight

Continental, regional, and local declines in North American landbird populations, first brought to public attention in the late 1980s (Robbins et al. 1989), have led to concern for the future of migratory and resident landbirds. Scientists and the concerned public recognized that a coordinated, cooperative, conservation initiative focusing on landbirds was needed to address the problem (Pashley et al. 2000). In late 1990, Partners in Flight (PIF; www.partnersinflight.org) was conceived as a voluntary, international coalition of government agencies, conservation groups, academic institutions, private organizations, and citizens dedicated to "keeping common birds common" and "reversing the downward trends of declining bird species" (Rich et al. 2004).

> ***"The primary goal of PIF landbird conservation planning is to promote long-term persistence of healthy populations of native landbirds."***

The Oregon-Washington chapter of PIF (OR-WA PIF; www.orwapif.org), formed in 1992, has been at the forefront of landbird conservation not only in the Pacific Northwest but also throughout North America. It produced the first regional document within PIF that prioritized landbird species for conservation based on a scoring system (Andelman and Stock 1994), and the first PIF chapter "Project Directory" to catalogue and describe existing monitoring projects (Altman 1994). OR-WA PIF partners have been actively engaged in every aspect of landbird conservation at regional, national, and international levels, providing leadership and participation on various committees and programs along with developing strong partnerships and projects in Canada, Mexico, and Central America, including an OR-WA PIF sister chapter in El Salvador.

The foundation of PIF's long-term strategy for bird conservation is a series of geographically-based landbird conservation plans, of which this document is one. The primary goal of PIF landbird conservation planning is to promote long-term persistence of healthy populations of native landbirds. This document is intended to facilitate that goal by stimulating conservation actions for landbirds, particularly for nonlisted and nongame landbirds which historically have been under-represented in conservation efforts, and many of which are exhibiting significant declines that may be possible to reverse if appropriate actions are taken now. Thus, implementation of the recommendations in this and other OR-WA PIF landbird conservation plans also supports efforts to reduce the need for future listings of bird species under the Endangered Species Act.

North American Bird Conservation Initiative

The North American Bird Conservation Initiative (NABCI; www.nabci-us.org) emerged in the late 1990s out of the disparate but extensive evolution of the four major bird conservation initiatives (waterfowl, waterbirds, shorebirds, landbirds) to facilitate coordinated implementation of "all-bird, all-habitat" conservation. It was established to provide a unifying theme for bird conservation, a forum for communication, and an avenue for integration among the bird conservation initiatives in North America. The purpose of NABCI is to *ensure the long-term health of North America's native bird populations by increasing the effectiveness of bird conservation initiatives, enhancing coordination among initiatives, and fostering greater cooperation among the continent's three national governments and their people*. The goal of NABCI is to *deliver the full spectrum of bird conservation through regionally-based biologically-driven, landscape-oriented partnerships*.

Bird Conservation Regions (BCRs) are the ecological units that have been identified through NABCI for the delivery and tracking of bird conservation. There are 67 BCRs within North America and Hawaii (NABCI 2000), including the Northern Pacific Rainforest Bird Conservation Region (BCR 5) which encompasses all of the geographic scope of this document (Figure 1).

Joint Ventures

Under the vision of NABCI, Joint Venture partnerships are being encouraged to play an integral role in the implementation of landbird conservation. Traditionally, Joint Venture partnerships focused on wetland and waterfowl conservation to implement the North American Waterfowl Management Plan. The success of their wetland/waterfowl conservation actions since the late 1980s, along with the need to support implementation of bird and habitat conservation for the other three major bird initiatives, resulted in expansion of the role for Joint Ventures to address "all-bird, all-habitat" conservation.

There are nearly two dozen Joint Venture partnerships within North America, including the Pacific Coast Joint Venture (PCJV; www.pcjv.org), which encompasses the geographic scope of this document. The primary way in which the PCJV partnership is advancing landbird conservation is through their position of Science Coordinator for Upland Birds and Habitats, and the development of habitat and population objectives for landbirds as part of their implementation plans (www.pcjv.org/home/implementation/). The PCJV partnership also is supporting landbird conservation through habitat protection activities, and project funding for planning, research, monitoring, and outreach.

"*This document is intended to support both the development of conservation or management plans and the implementation of on-the-ground habitat management activities that have the potential to benefit breeding bird populations in the coniferous forests of western Oregon and Washington.*"

Purpose of this Document

This document is intended to support both the development of conservation or management plans and the implementation of on-the-ground habitat management activities that have the potential to benefit breeding bird populations in the coniferous forests of western Oregon and Washington. The degree to which a land manager is willing or able to manage for bird habitat or bird populations is a decision based on many factors beyond the scope of the document. We assume users of this document already have an interest in managing for bird habitat or bird populations as one of several objectives that land managers must typically balance. However, it is not our purpose to discuss integration of bird conservation with other management objectives. Our objective is simply to provide those interested in bird conservation with information and recommendations on:

- the landbird species and habitat attributes (i.e., habitat conditions and/or habitat elements) that should be emphasized for conservation, and
- the quantitative, measurable objectives that are recommended to support conservation of those landbird species and habitat attributes.

Version 2.0

This document is an update of *Conservation Strategy for Landbirds in Coniferous Forests in Western Oregon and Washington* (Altman 1999), the original landbird conservation plan for westside coniferous forests. Among PIF bird conservation plans nationally, one of the unique features of Version 1.0 of the OR-WA PIF bird conservation plans was the quantitative and prescriptive objectives that were established for habitat attributes important to landbird species. One reason for doing this was to fill a gap, which exists in most conservation planning efforts (i.e., the absence of quantitative objectives), yet is something that most land managers want not only to direct their management but also to use for tracking progress towards conservation goals. We have received numerous reports which show the range of how the OR-WA PIF plans have been used—as focal species lists in environmental assessments (See: *Using the PIF Plans in Biological Evaluations*), as a guide to restoration efforts (See: *Using the PIF Plans to Guide Restoration Efforts*), and as a tool for ecoregional analyses to assess how alternatives in major forest plans meet the regional habitat objectives (See: *Assessing Alternatives in Forest Plans for Meeting PIF Plan Objectives*).

Photo by Erik Ackerson

Using the PIF Plans in Biological Evaluations

I use the table of focal species and habitat attributes they represent in Biological Evaluations. In the narrative, I discuss which species may be impacted (positively or negatively) by the project. I also correlate this information with Breeding Bird Survey data from nearby routes to show population trends and discuss long-term impacts to landbirds and habitat. I have found the Westside Coniferous Forest Plan to be very useful. *Kevin Sands, Tiller Ranger District, U.S. Forest Service.*

Since the development of Version 1.0 in the mid to late 1990s, considerable changes have occurred in the world of bird conservation, along with significant changes in the management and policy regarding coniferous forests in the Pacific Northwest. Regionally within coniferous forests, there has been noteworthy loss of private forest land, both industrial and nonindustrial, into development or speculative development; and significant changes in management of public forest lands based on changes in planning regulations. Internationally and nationally, we have seen the emergence of NABCI and BCRs, and the enhanced role of Joint Ventures in landbird conservation. Within PIF, there has been extensive emphasis on the geospatial design of landscapes for bird-habitat conservation through the publication of the Five Elements Process (Will et al. 2005). Additionally, the North American Landbird Conservation Plan (hereafter Continental Plan) was completed for the United States and Canada with the first attempt to establish continental population estimates and population objectives for landbird species (Rich et al. 2004). An updated version of this document, which included Mexico (hereafter Trinational Plan), further expanded the vision and connectivity necessary for migratory bird conservation (Berlanga et al. 2010).

Using the PIF Plans to Guide Restoration Efforts

The OR-WA PIF Bird Conservation Plans have allowed me to enhance my restoration work by providing specific, measurable targets at both coarse scales (habitat types) and fine scales (species). Your plans are a terrific compilation of the state of knowledge of what habitat elements are essential to contribute to the long-term persistence of landbird species. I really wish the same sort of information were available for non-avian species. The type of information present in the landbird conservation plans is pure gold to me. *Elaine Stewart, Natural Resource Scientist, Portland Metro.*

In this Version 2.0, we are not only updating the biological objectives for habitat attributes based on new data, but continuing to take leadership in being progressive and innovative in our approach to PIF landbird conservation by providing examples of habitat objectives at landscape scales and population objectives at several scales. Because the latter is relatively new, we opportunistically present these objectives for species and habitats where this work has been completed as part of PCJV or other planning. It is hoped that the presentation of quantitative biological objectives will not only stimulate conservation action on the ground, but also stimulate data collection and analyses to test the models and professional opinion used to develop the objectives.

Assessing Alternatives in Forest Plans for Meeting PIF Plan Objectives

In the Environmental Impact Statement for the Revision of the Resource Management Plans of the Western Oregon Bureau of Land Management Districts, we conducted analyses of different alternatives for forest management on the OR-WA PIF plan habitat objectives for the amount of late-successional forest needed for landbird conservation. The type of quantitative objectives presented in the PIF plans are just not available in other plans, and they allowed us to present a more meaningful and accurate assessment of different management scenarios on landbirds that we could not do for other taxa. *Chris Foster, Roseburg District, Bureau of Land Management.*

In Version 2.0 we also are recognizing the mixed conifer and mixed conifer-hardwood forests of the Klamath Mountains ecoregion of southwestern Oregon separately because the uniqueness of the floristic diversity and the convergence of different ecological zones results in noteworthy differences in bird-habitat relationships from the rest of western Oregon and Washington (Olson et al. 2001). This region supports the highest bird biodiversity in western Oregon and Washington, which has been attributed in particular to the diversity and abundance of hardwood trees (Hagar 2001).

Photo by Erik Ackerson

"We recommend that the biological objectives and conservation strategies described in this document be integrated with other conservation planning and implementation in coniferous forests of western Oregon and Washington to provide functioning ecosystems for the region's diverse array of landbird species."

Integration with Other Plans

This updated bird conservation plan is one of five original OR-WA PIF ecoregional plans for priority habitats and associated landbirds in Oregon and Washington (Altman, 1999a, Altman 2000a, 2000b, 2000c, Altman and Holmes 2000). These ecoregional plans can function independently for landbird-specific conservation, but also are intended to complement plans of the waterfowl, shorebird, and waterbird initiatives within the framework of NABCI. Ongoing efforts to integrate with these initiatives during program or project-level planning and implementation will help ensure that healthy populations of all native bird species continue to exist. We recommend that the biological objectives and conservation strategies described in this document be integrated with other conservation planning and implementation in coniferous forests of western Oregon and Washington to provide functioning ecosystems for the region's diverse array of landbird species.

Integration with the Northwest Forest Plan

The Northwest Forest Plan has guided forest management on federal lands for nearly two decades. The NWFP was designed as an ecosystem management plan to address biodiversity of late-successional forests through a variety of mechanisms. Integration of components of this OR-WA PIF bird conservation plan, which also is ecosystem-driven, with the NWFP presents a significant opportunity to advance landbird conservation in coniferous forests. **The greatest potential integration of recommendations in this document with the NWFP is our biological objectives for focal species associated with late-successional forests. For example, our fine filter, quantitative habitat objectives provide the prescriptive habitat conditions and metrics that can be used to guide habitat management and assess the coarse filter assumptions of conservation of biodiversity in the NWFP's designated late-successional reserves.**

PIF landbird conservation plans also are one of numerous recent planning efforts that address conservation of natural resources and ecosystems in the Pacific Northwest. This document is intended to supplement and support these other planning and conservation processes (e.g., Northwest Forest Plan [*See* above], Habitat Conservation Plans, State Wildlife Action Plans [*See* below], Ecoregional Plans of the Nature Conservancy, Pacific Coast Joint Venture Implementation Plans [*See* below]) and regulatory enactments (e.g., State Forest Practices Act, Endangered Species Act, Migratory Birds Treaty Act) in two particular ways:

- by addressing conservation towards a suite of landbird species representative of desired habitat conditions for birds in priority habitats; thus, species that are often not addressed in other plans, and
- by providing quantitative objectives for specific habitat attributes and populations of landbird species at site and landscape scales, which are rarely provided in other plans.

Integration with State Wildlife Action Plans

The States of Oregon and Washington recently completed Comprehensive Wildlife Conservation Strategies (aka State Wildlife Action Plans) as directed by Congress to proactively encourage the maintenance of healthy fish and wildlife populations and minimize the costly and controversial listing of species under the Federal Endangered Species Act. These plans provide a broad conceptual framework that identifies and prioritizes species and habitats for conservation and the qualitative actions that need to occur to support their conservation. **The greatest potential integration of recommendations in this document with the State Wildlife Action Plans is our prescriptive, quantitative habitat and population objectives that provide the "next step" for specifically directing conservation and management of species and habitats to support the qualitative, conceptual objectives in the State Wildlife Action Plans.**

Integration with Pacific Coast Joint Venture Implementation Plans

The PCJV partnership has prepared ecoregional Implementation Plans with an emphasis on science-based, quantitative habitat objectives that are directly linked to bird populations, and assess the habitat capacity of the Joint Venture area to contribute to continental bird population objectives (www.pcjv.org/home/implementation/). The biological objectives (i.e., habitat objectives and population objectives) established in these ecoregional plans provide PCJV partners with a numerical context within which to stimulate conservation action and gauge the regional perspective of their local conservation actions. **The greatest potential integration of recommendations in this document with the PCJV Implementation Plans is our prescriptive habitat objectives that describe the specific conditions needed to support species and habitat conservation, and thus provide the "how to" aspect of conservation that complements the "how much" objectives in the PCJV plans.**

Photo by Bob Altman

Photo by Erik Ackerson

Scope of Conservation

Geographic

The geographic scope of this document is coniferous forest in Oregon and Washington west of the crest of the Cascade Mountains (i.e., westside coniferous forest), and the variable zone approximately 2–10 miles east of the crest where similar westside forest conditions and types prevail (Figure 1). This boundary was selected because it is a relatively distinct range boundary for many landbird species. Species composition on the east-slope of the Cascade Mountains tends to have more habitat and bird species affinities with coniferous forests elsewhere in eastern Oregon and Washington (e.g., Ochoco Mountains, Blue Mountains, Okanogan Mountains) than with coniferous forests in western Oregon and Washington.

Ecoregions

Throughout the geographic scope of this document, there are many similarities in ecosystems, habitats, and land uses. However, noteworthy differences in environmental resources exist within several relatively distinct geographic areas. These "ecoregions" provide a finer-scale spatial framework for describing and assessing the conservation landscape. For the purposes of this document, we use Level III ecoregions of the U.S. Environmental Protection Agency (1996) (Figure 2), which is similar to the slightly finer-filtered ecoregions of Franklin and Dyrness (1973) (Table 1) used in Version 1.0 (Altman 1999).

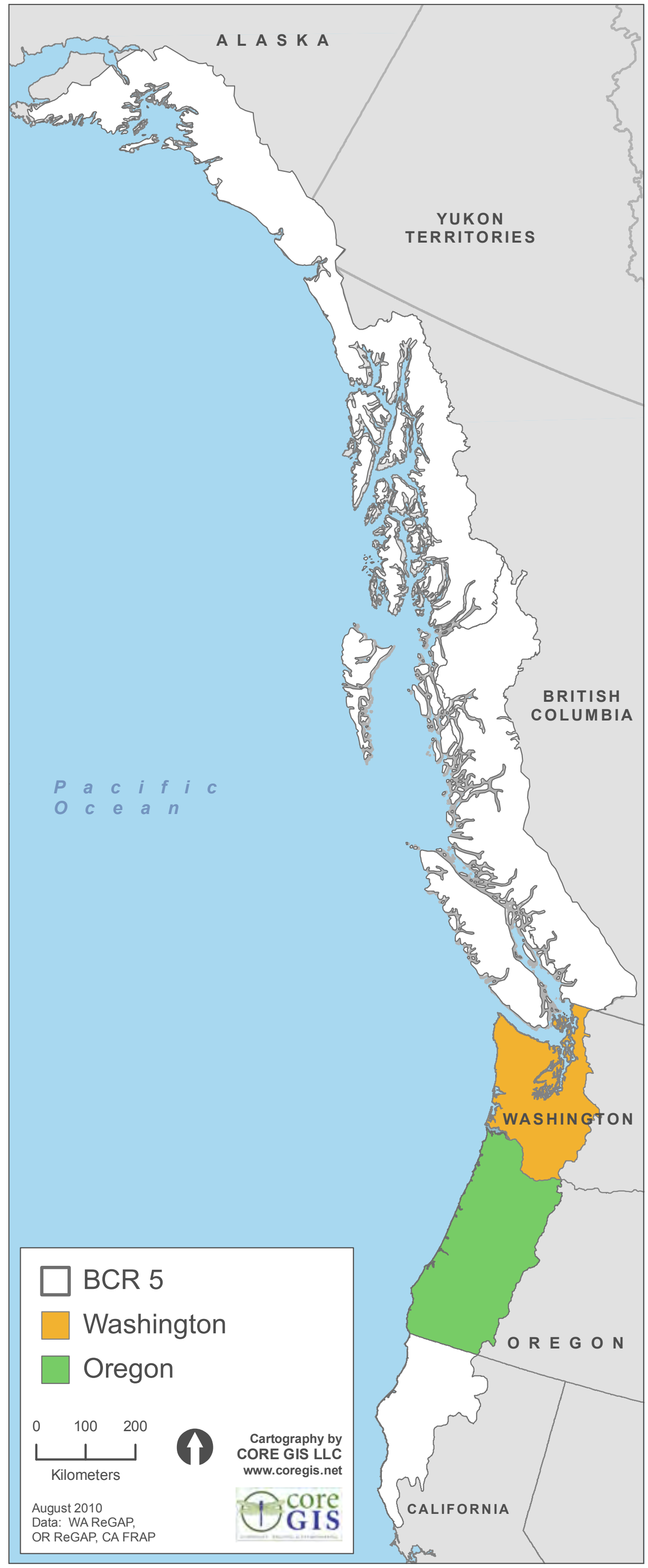

Figure 1. Northern Pacific Rainforest Bird Conservation Region (BCR 5) and the geographic scope of this document (Oregon and Washington).

Coniferous Forests

Coniferous forest, as defined in this document, includes all forest lands where the ecologically appropriate forest canopy is dominated by coniferous trees (i.e., generally >70% coniferous trees). This includes early successional habitat that is not currently dominated by coniferous trees (e.g., dominated by shrubs or small deciduous trees), but would meet that criteria in an older successional stage.

Unique Coniferous Forest Habitats

Within the vast landscape of coniferous forests in western Oregon and Washington, there are several unique non-forest habitats or forest inclusions important to landbirds such as alpine grasslands, waterfalls, wet meadows, and mineral springs that also are considered in this document because there are priority species associated with them. Some species are highly associated or obligate to these habitats such as American Pipit with alpine grasslands and Black Swift with waterfalls. Conversely, there are other habitats, such as wetlands, ponds, and lakes, within the coniferous forest landscape that we don't consider in this document because they are dominated by non-landbird species.

A forest landscape habitat not addressed in this document is riverine riparian forest with >30% deciduous/hardwood canopy closure. Within the coniferous forest landscape, these habitats generally occur at lower elevations or in the more arid montane environments of the Klamath Mountains ecoregion of southwestern

“This document does not directly address all landbird species, but instead uses ‘focal species’ to describe the biological objectives for the avian community.”

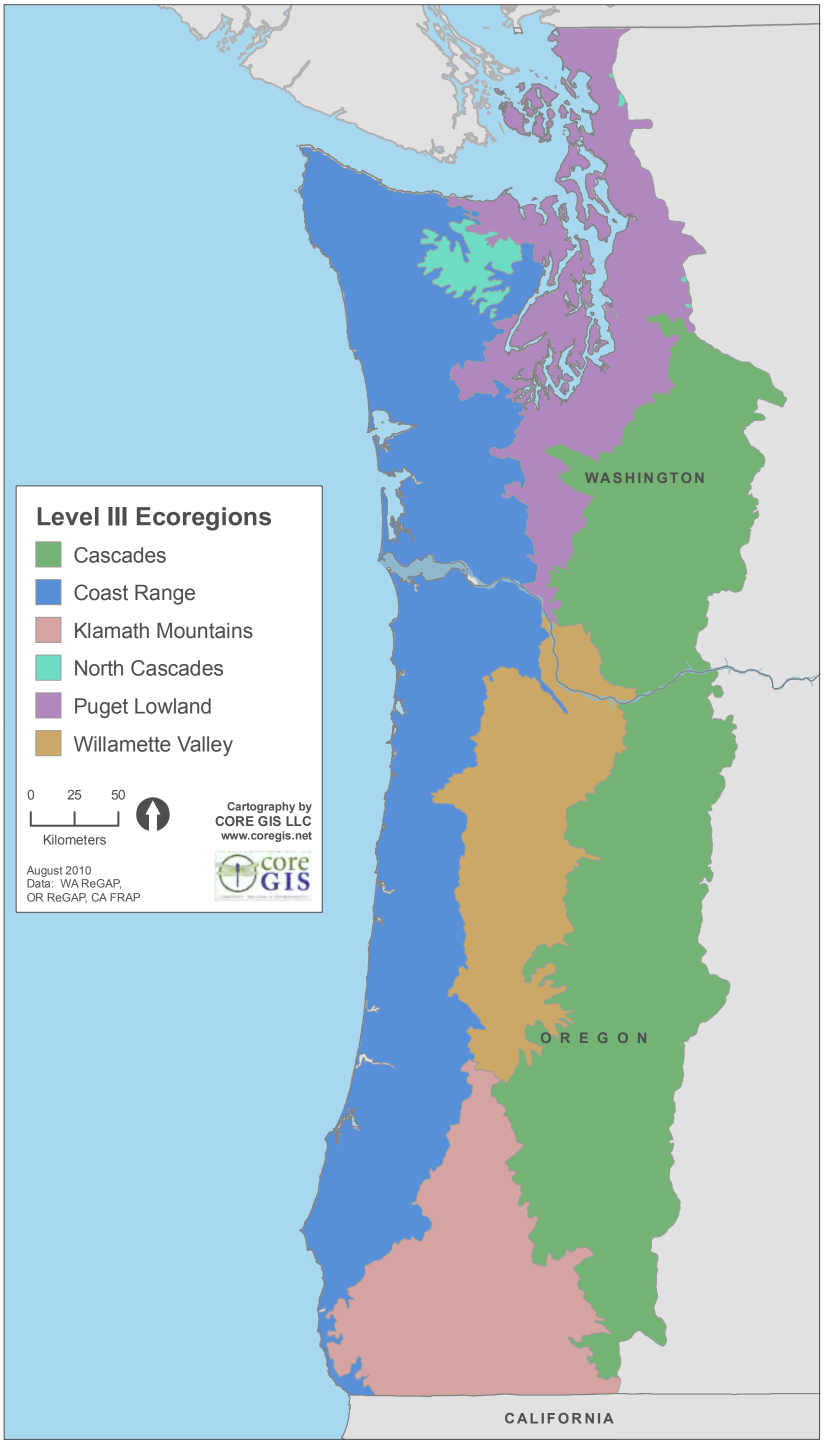

Figure 2. U.S. Environmental Protection Agency (1996) Level III Ecoregions.

Oregon and are addressed in *Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington* (Altman 2000a), because landbird species associations are generally different from adjacent coniferous forest, and most similar to species associations of deciduous riparian forests in lowland valleys. Conversely, riparian stringers of second and third order streams that extend into headwaters are considered a part of this conservation document because the deciduous composition is generally <30%, and the landbird species composition is similar to the adjacent upland coniferous forest (McGarigal and McComb 1992; Pearson and Manuwal 2001).

Urban/Residential Coniferous Forests

Within the geographic scope of this document, there are patches of coniferous forest that occur in urban and residential settings, particularly in the Puget Trough and Willamette Valley ecoregions. Although these may be relatively minimal in terms of habitat amount and/or conservation value to landbirds compared to the vast landscape of coniferous forest in western Oregon and Washington, we recognize their potential contribution to landbird conservation, and suggest the same level of consideration of the biological objectives and conservation strategies as recommended throughout the document for other coniferous forest. However, it also is important to recognize that these areas may have problematic conservation issues due to the relatively small size of the forest patches which excludes many species with larger area requirements (Donnelly and Marzluff 2004), the potential impacts of adjacent developed areas on bird populations such as increased predation and disturbance (Marzluff 2001), and the higher likelihood of future loss of many of these areas to development. Thus, conservation strategies as described herein should be vetted against these and other issues that occur in urban/residential forests before implementing the recommended conservation actions.

Breeding Birds

In this document, we emphasize the conservation of native landbird species that regularly breed in coniferous forests of western Oregon and Washington. Because breeding bird species occur in all the habitats and conditions that support non-breeding bird species, we are making the assumption that habitat management for breeding birds will likely support most, if not all, of the habitat needs of non-breeding birds in these forests.

Although we only address the conservation of landbirds during the breeding season, factors that operate outside the breeding season may adversely affect populations of these birds. This may be particularly true for migratory birds subject to habitat changes and other factors on their wintering grounds and/or during migration that may impact the abundance and health

Table 1. Comparison of ecoregion designations between Franklin and Dyrness (1973) and U.S. Environmental Protection Agency (1996).

Franklin and Dyrness (1973)	U.S.E.P.A (1996) Level III
Olympic Peninsula (WA)	Coast Range (OR and WA)
Coast Range (OR)	Coast Range (OR and WA)
Southern Cascades (WA)	Cascades (OR and WA)
Western Cascades (OR)	Cascades (OR and WA)
Klamath Mountains (OR)	Klamath Mountains (OR)
Northern Cascades (WA)	North Cascades (WA)
Puget Trough (WA)	Puget Lowlands (WA)
Willamette Valley (OR)	Willamette Valley (OR)

Photo by Erik Ackerson

of breeding populations. Although we cannot address the breadth of those issues here, we consider appropriate conservation actions on the breeding grounds a stewardship responsibility of a natural resource shared with many other countries and peoples (Altman and Hagar 2007). We encourage bird conservation partners to seek opportunities to develop international partnerships and projects to support conservation of our shared migratory landbirds (Berlanga et al. 2010).

This document does not directly address all landbird species, but instead uses "focal species" to describe the biological objectives for the avian community. Many species not emphasized are 'habitat generalists" that thrive in a wide range of forest conditions (e.g., American Robin), and thus are of less concern for conservation.

Four federally-listed or recently delisted species; Bald Eagle, Marbled Murrelet, Northern Spotted Owl, and Peregrine Falcon are not considered in this document because species-specific conservation strategies and/or recovery plans have already been established for these species. However, existing regulations/recommendations for management and conservation of these species has significance for landbird conservation. For example, designated areas for management and conservation of the Northern Spotted Owl and Marbled Murrelet are an important opportunity for the conservation of other late-successional forest landbird species.

Outside of our Scope

There are of course many other aspects to landbird conservation beyond habitat such as policy, education, and land protection, but in this document we only provide a cursory background of those components of landbird conservation. We also only provide limited geospatial recommendations for landbird conservation, usually at larger scales such as ecoregions. This spatially-explicit aspect of conservation has been a focus of other plans such as PCJV Strategic Plans, Ecoregional Plans of The Nature Conservancy, and State Wildlife Action Plans, although usually for broader conservation goals than landbirds. The identification of spatially-explicit conservation areas specifically for birds has been addressed to some extent through the Important Bird Areas programs of the American Bird Conservancy (www.abcbirds.org) and State Audubon chapters (www.oregoniba.org and http://wa.audubon.org/science_IBAWashington.html). We recommend that bird conservation partners seek spatially-explicit guidance for bird conservation from the aforementioned plans and others that provide these types of recommendations.

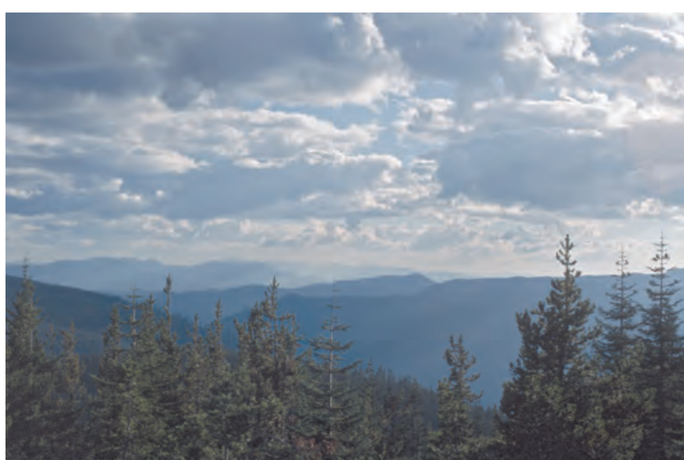

Photo by Erik Ackerson

The Process

Conceptual Approach

Numerous conceptual approaches for wildlife conservation have been proposed and implemented in recent decades. These approaches have focused on various elements such as single species, management indicator species, ecological guilds, management assemblages, and ecosystems (reviewed by Block et al. 1995). All the approaches by themselves have inherent practical or biological limitations. For example, the single-species approach is usually not cost effective or practical for many species, and a broad-based biodiversity approach can have conflicting objectives among the myriad of species involved—and can be ambiguous in terms of design and evaluation without reference to specific habitat requirements for individual species (Lambeck 1997). Salwasser (2001) suggests that a coarse filter (i.e., multiple species, landscapes, ecosystems) and fine-filter (i.e., species and their habitat needs) approach that is nested and overlapping is the most likely to provide effective wildlife conservation.

"…our conservation emphasis is on habitat and habitat attributes, and we use a suite of bird species and their relationships to those habitats and habitat attributes as the mechanism for achieving bird conservation."

Within PIF, species prioritization for conservation is driven by the quantitative scoring system of the Species Assessment Database (www.rmbo.org/pif/pifdb.html; [Panjabi et al. 2005]), which has been externally reviewed by Beissinger et al. (2000). Although the emphasis is on single-species conservation, there is an underlying assumption that conservation of priority species supports ecosystem management because other species will likely benefit from actions implemented to conserve priority species. However, it is unlikely that a suite of PIF priority species can represent the array of habitat features or conditions important for landbirds in a functioning ecosystem, in part because priority species often are a priority because they are "habitat specialists." Thus, conservation of an ecosystem or habitat type for birds is likely to be compromised because desired conditions for some/many habitat features or functional relationships would not be addressed if just focusing on priority species. Furthermore, the broader goals for conservation of biodiversity, increasingly desired as societal and ecological goals, cannot be achieved on a species by species basis (Franklin 1993).

Given the limitations of the priority species approach for ecosystem or habitat-level conservation and the recommendations of Salwasser (2001), we developed ***a multiple-scale approach for landbird conservation that emphasizes conservation of the coniferous forest ecosystem through appropriate representation of the habitat types and conditions important to birds as described through the habitat requirements of a suite of individual bird species most representative of those desired habitat types and conditions.*** Thus our conservation emphasis is on habitat and habitat attributes, and we use a suite of bird species and their relationships to those habitats and habitat attributes as the mechanism for achieving bird conservation. Two key components of this approach are:

- Adequate representation of the primary bird-habitat relationship categories within the coniferous forest ecosystem (e.g., forest type, successional stage)
- Adequate representation of the key desired habitat elements or attributes within the coniferous forest ecosystem (e.g., snags, canopy cover, shrub cover, tree size)

At the core of this approach is the use of focal species (Lambeck 1997). Our rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem for landbirds. Although conservation is directed towards focal species, establishment of conditions favorable to focal species also will likely benefit a wider group of species with similar habitat requirements (Lambeck 1997).

Our use of a suite of focal species provides an efficient and comprehensive way to address ecosystem conservation because it ensures that conservation is directed at the range of important habitat conditions within the ecosystem. Implementation of this multi-focal species approach should result in a high likelihood of maintaining key habitat attributes and providing functioning ecosystems for landbirds because the most important habitat attributes for landbirds are targeted for conservation. This approach also provides a comprehensive framework for dealing with priority species (current and future) because the component(s) of the habitat needed by those species are likely already addressed through our suite of focal species. It also provides the opportunity to include priority species either as focal species or as independently unique species, and include species-level recommendations for their conservation.

"Our use of a suite of focal species provides an efficient and comprehensive way to address ecosystem conservation because it ensures that conservation is directed at the range of important habitat conditions within the ecosystem."

Organizational Framework

Forest successional stage is used as the primary category to organize the document because it provides the most distinct separation of bird-habitat relationships in coniferous forests of western Oregon and Washington (Meslow and Wight 1975). However, it is widely recognized that successional stage alone can be an insufficient measure of wildlife habitat quality (Bunnell et al. 1997), because many wildlife species respond to specific habitat attributes that can occur in multiple successional stages such as canopy closure, presence of large trees and snags, understory development, structural heterogeneity, and a deciduous tree component. Additionally, intensively managed forests and efforts to implement multi-aged management complicates use of successional stage because the various structural features characteristic of "natural habitats" are managed for or against under different management objectives. Thus, we use successional stage as our coarse-filter organizational category, and use habitat attributes (See *Habitat Attributes*) within successional stages as our fine-filter organizational category. Finally, as described below, we use a suite of bird species to address conservation of the habitat attributes within successional stages, and also use populations of those bird species as one of the performance metrics for tracking progress towards objectives.

Habitat Attributes

We use the term habitat attribute to describe those habitat features, conditions, or elements that function as important life requisites for the focal species representing them. Our presentation of quantitative objectives for habitat attributes within the context of the appropriate successional stage provides land managers with descriptive and measurable targets to strive to achieve through management or natural succession.

Further, for some bird species, habitat relationships are not best described by successional stage and/or habitat attributes but by the composition and pattern of structural attributes or successional stages across the landscape. Since this strategy is designed to be an ecosystem planning tool, it also will be necessary to design and implement management at the landscape-level to support these species and ensure adequate representation of all the other species. Landscape planning will require addressing regional populations or sub-populations of birds that occur both within and across large landscapes. However, most of what we know about landbird ecology in coniferous forests exists at the scale of individual birds/pairs or small populations at the site-level (often referred to as stand-level in coniferous forests), and less is known about the relationships between landbird populations and habitat at the landscape scale (Marzluff et al. 2000). However, recognition of the importance of landscape-level considerations for forest bird conservation is receiving more recent attention (Aubry 2007), and herein we include some landscape-level objectives, based on emerging biological knowledge (e.g., Nott et al. 2005) and some professional judgment, to be tested in an effort to expand our knowledge of landbird biology and management toward the landscape scale.

> ***"…we use successional stage as our coarse-filter organizational category, and use habitat attributes within successional stages as our fine-filter organizational category."***

Components of the Process

The conservation planning process to support the conceptual approach described above includes the following components which are summarized in the following sections and presented in detail in subsequent chapters:

- identify habitats that are conservation priorities for landbirds
- identify the desired habitat attributes for landbirds
- identify species representative of the desired habitats and habitat attributes (i.e., focal species)
- supplement the focal species list with priority species that have been identified by primary bird conservation partners and would benefit from conservation of focal species
- establish measurable habitat objectives to achieve the desired habitat conditions based on the habitat requirements of the focal species
- supplement the habitat objectives with focal species population objectives to be used as the metric for tracking bird conservation
- recommend conservation strategies that can be implemented to achieve the habitat objectives,
- conduct monitoring to assess the habitat and focal species response to the implemented conservation strategies and progress towards the habitat and population objectives
- implement adaptive management as appropriate to adjust habitat management towards the trajectory of the biological objectives

Desired Habitat Attributes

We reviewed the scientific literature on bird-habitat relationships in westside coniferous forests to determine the range of important habitat attributes most associated with bird species habitat selection or use within the context of the ecologically desired conditions for these forests. We did not emphasize habitat attributes which may be ecologically important to the forest community or other taxa, but are not a primary habitat feature for landbirds (e.g., seeps for amphibians and downed logs for mammals).

Because there is considerable latitudinal and elevational variability in the geographic scope of this document, there also is variability in the habitat types and conditions and the bird species relationships with those habitat conditions. Thus, it is important to recognize that although bird species are generally responsive to the same habitat conditions throughout coniferous forests of western Oregon and Washington, there often is variation in response to the specific parameters of the habitat condition. Our characterization of bird-habitat relationships reflects primary tendencies that can be targeted for the greatest conservation value for those species and habitats. However, there are no absolutes in bird-habitat relationships and our characterizations should not replace local knowledge or data applicable for the conservation of our focal species and their associated habitats and habitat attributes.

Focal Species

The two primary goals for bird conservation under the PIF Initiative are 1) helping species at risk, and 2) keeping common birds common (Rich et al. 2004). Planning to meet these goals can be problematic because of the large number of landbird species and the need for conservation actions for both rare and common species. It is unrealistic in terms of cost and time to plan or implement species-specific conservation for so many species. Thus, the use of focal species (See*: Focal Species*) is an alternative approach widely used for conservation of biodiversity (Rempel 2007).

Focal Species

Although each bird species has evolved to occupy a unique ecological niche, there is significant overlap among many species in their basic habitat requirements. These areas of overlap provide an opportunity to efficiently capture the habitat needs of many bird species by directing conservation towards a few key species (i.e., focal species) associated with a suite of shared habitat requirements. The assumption is that **conservation directed towards the collective needs of a suite of focal species that represent the range of desired habitat conditions for birds in the habitat should also address the habitat needs of most if not all of the other bird species occurring in that habitat type**. Thus, our use of focal species is a "coarse filter" attempt to conserve biodiversity, a firmly entrenched objective of conservation.

After determining the important habitat attributes for landbirds as described above, we reviewed the scientific literature to determine the coniferous forest bird species that best met the following criteria as focal species for those attributes:

- regularly occurring breeding species throughout our geographic scope
- strongly associated with conifer forests such that it is the primary habitat for the species and they reach their highest breeding densities there
- strongly associated with an important habitat attribute within conifer forests such that they would demonstrate significant responses to management or restoration targeted at the habitat attribute
- readily monitored using standard techniques to be able to track progress towards objectives at multiple scales

When considering bird species suitable to meet these criteria, we first evaluated the appropriateness of any priority species identified by primary bird conservation partners. They were used as a focal species if we were confident they were a good representative relative to other potential focal species for a particular habitat attribute.

"Our premise throughout this document is that measurable, prescriptive targets for birds and associated habitat attributes are what is most needed by those working on-the-ground for landbird conservation."

Photo by Erik Ackerson

When more than one species would seemingly make a good focal species for a particular habitat attribute, we usually deferred to the species for which more knowledge exists about its life history and ecology to provide the source for setting biological objectives, or species that we had more national "responsibility" for based on their restricted distribution to the Pacific Northwest.

Although we tried to ensure the completeness of the geographic representation of each focal species, there is coniferous forest habitat in western Oregon and Washington where some focal species may not occur as breeding species. In these cases, we suggest using the habitat objectives presented for the focal species and using one of the species listed under "species to benefit" (Appendix A) for tracking population response or progress towards any population objective for the focal species.

We also identified some additional habitat attributes and focal species for the Klamath Mountains ecoregion of southwestern Oregon because of their uniqueness to that area. We suggest using these focal species to supplement the regional focal species and associated forest conditions and habitat elements as appropriate when planning or implementing conservation in southwestern Oregon.

Integration of Priority Species

Many PIF partner agencies and organizations have prioritized bird species for conservation based on factors such as small populations, limited distribution, declining population trends, threats to habitat, or dependence on the geographic area being considered. When using these lists of "priority" species to direct conservation, the emphasis is on single-species conservation with an underlying assumption that actions to conserve priority species supports some degree of habitat or ecosystem conservation because other species will likely benefit. However, the conservation of any particular feature or condition within the habitat or ecosystem is dependent on the chance that a priority species is associated with it. Thus, conservation using priority species is an opportunistic and often unbalanced approach for the conservation of habitats or ecosystems.

An assumption of our focal species approach is that the suite of focal species will cover the habitat requirements of priority bird species. However, some priority species are such unique ecological specialists that this is not always true. Some examples include Black Swift and waterfalls and Vaux's Swift and large hollow snags. Additionally, most agencies and organizations have historically used priority species; thus, there is established interest in tracking conservation of these species. In order to ensure our approach addressed these priority species, we included a priority species as a focal species with biological objectives if they met the focal species criteria described above. If not, we integrated them into the strategy where appropriate as species to benefit from conservation actions directed towards focal species.

Biological Objectives

Quantitative habitat and population objectives (collectively referred to as biological objectives) are the cornerstone of this document. Stated simply, they are "***what we think the birds need based on current knowledge.***" They are **not regulatory, nor do they represent the policies or recommendations of any agency or organization** (See*: Using our Quantitative Biological Objectives*). Our premise throughout this document is that measurable, prescriptive targets for birds and associated habitat attributes are what is most needed by those working on-the-ground for landbird conservation. Establishing quantitative biological objectives serves several purposes:

- They provide targets for designing management plans and benchmarks for measuring success of management actions
- They provide hypotheses for research, particularly when objectives are based on assumptions and/or expert opinion due to lack of data
- They are probably our best form of outreach to communicate to others what is needed to conserve landbirds
- They function as a starting point for discussion of integration with broader ecosystem-based objectives

"It is important to recognize that our biological objectives have been established solely for the promotion of landbird conservation. They are not tempered by societal or economic concerns or by the conservation concerns of other wildlife or natural resource values. Integration of those factors is important, but outside the scope of this document."

Using our Quantitative Biological Objectives

It is important to recognize that our biological objectives have been established solely for the promotion of landbird conservation. They are not tempered by societal or economic concerns or by the conservation concerns of other wildlife or natural resource values. Integration of those factors is important, but outside the scope of this document. It will be important for people historically steeped in regulatory enactments such as the Endangered Species Act or National Environmental Policy Act, to think outside the regulatory paradigm that associates quantitative objectives with compliance and consequences of non-compliance, and recognize the different purpose and value of the biological objectives presented herein. **Our quantitative biological objectives are what we think the birds need based on current knowledge and are intended to stimulate conservation action in the trajectory of an objective, not provide the expectation of a rigid threshold or benchmark with accompanying consequences. Furthermore, our biological objectives are based on the premise that a quantitative target is more likely to stimulate conservation action than a descriptive, qualitative target that does not provide any numerical context for the desired outcome or means of tracking progress towards it.** Simply stated, most land managers want to know the measurable parameters—how much, where, and by when—in order to plan and implement bird conservation actions in an effective and integrated manner with other objectives, and perhaps just as importantly to have a context within which to track their progress towards goals and objectives.

Because of variability in the type, quality, and amount of data on focal species, some biological objectives are based on empirical data and others are based on expert opinion. To indicate this degree of variability, we provide the rationale and/or assumptions for the biological objectives as part of the process. We always strived to use the "best science available," and in many cases, the biological objectives have been taken directly from the recommendations of others based on empirical data from studies. Where specific data are limited for a focal species, and the biological objectives are based more on expert opinion, these objectives become testable

"All the biological objectives presented in this document should be viewed as dynamic with an emphasis on the need for research, refinement, and improvement of the numerical objectives over time."

hypotheses for research. All the biological objectives presented in this document should be viewed as dynamic with an emphasis on the need for research, refinement, and improvement of the numerical objectives over time.

Habitat Objectives

Several types of habitat objectives at several different scales are presented in the document. At the scale of large landscapes such as ecoregions, quantitative habitat objectives are presented for representation of different amounts of habitat types or successional stages across the landscape. These are derived from expert opinion on adequate representation of successional stages relative to historic amounts and current and projected future land uses. We also present some smaller landscape-level habitat objectives based on the demographic monitoring of the Monitoring Avian Productivity and Survivorship (MAPS) program and species-specific ecological modeling for Pacific Northwest forests (Nott et al. 2005, Nott 2009).

At smaller scales (e.g., sites), prescriptive habitat objectives are presented as measurable targets for specific habitat attributes such as canopy cover, tree or snag size, and understory cover. These are derived from an evaluation of bird-habitat relationship data in the scientific literature and determination of the most appropriate targets. Three factors were paramount in setting these quantitative objectives for habitat conditions or attributes:

- means (rather than minimums) of available data were used because they more likely provide adequate conditions for maintaining populations
- a range of values were often used to represent the plasticity of a species' relationship with a habitat attribute and to acknowledge the historical range of variation that likely occurred for many habitat attributes
- optimal or high quality habitat was emphasized (to the degree of our knowledge) for self-sustaining populations in geographic areas most suitable for maintaining or providing that habitat

Unless otherwise indicated, data on population abundance or density are used to indicate habitat suitability. This assumes healthy, viable populations where species are most abundant, despite recognition that population density and associated habitat quality can in some cases be a misleading or inaccurate measure of population viability (Van Horne 1983). From a practical standpoint, this approach has been widely used because of the ease and cost effectiveness of collecting abundance or density data relative to demographic data, which is often unavailable. However, a consistent theme throughout this document is that use of habitat quality to represent population health is an assumption that will ultimately need to be validated with demographic data to determine relationships between habitat characteristics and population viability.

We emphasize setting habitat objectives for the most desirable habitat conditions for focal species in areas where those conditions are ecologically appropriate. Thus, throughout the habitat objectives we use the phrase "where ecologically appropriate" as a reminder that it is essential to consider the ecological appropriateness of the site to support the habitat attribute before initiating the management.

Finally, in the habitat objectives section, we provide quantitative targets not only for the habitat attribute the focal species is representing, but often for other habitat features the species is highly associated with. These additional habitat objectives are provided to recognize that the species conservation may include features beyond the habitat attribute they represent.

"We emphasize setting habitat objectives for the most desirable habitat conditions for focal species in areas where those conditions are ecologically appropriate."

Population Objectives

The PIF Continental Plan used range-wide Breeding Bird Survey (BBS) trend data to establish *ideal* (i.e., not based on potential or capacity to achieve it) population abundance objectives (i.e., maintain, increase by 50%, increase by 100%) for the highest continental priority bird species (i.e., Watch List species; Rich et al. 2004). The establishment of continental population objectives was based on the model of the North American Waterfowl Management Plan in which population objectives have proven to be a valuable tool for stimulating conservation actions and for measuring the success of those actions. The population objectives established in the PIF Continental Plan were viewed as a starting point to initiate dialogue on the value of population objectives, and to stimulate action towards conservation of priority bird species at the continental scale by setting measurable targets. The expectation was that regional and local assessments would be conducted to establish habitat-based population objectives at those scales that reflect the practical realities of the capacity of those areas to contribute towards the continental population objective.

There is inherent value in having quantitative objectives for bird populations as part of bird conservation. Some of these include:

- a marketing tool to emphasize the magnitude of the conservation needed
- a communication tool that is compelling and understandable for public outreach
- a management tool with measurable targets for planning and implementation
- a performance metric to track bird populations relative to habitat management actions conducted on their behalf

- an adaptive management tool for monitoring ecological response and assessing where changes need to occur
- the "bottom line" metric for the ultimate assessment of bird conservation
- support of the continental population objectives presented in the PIF Continental Plan (Rich et al. 2004)

Population objectives were set in two ways. Most were set as a direct translation of habitat objectives based on abundance indices or density estimates. A few were set based on some desired density of breeding pairs within a landscape.

Conservation Strategies

Conservation strategies as defined herein are examples of management actions that may be used to support the biological objectives or enhance conservation relative to a habitat attribute or focal species. They are recommendations that can be institutionalized into management practices or implemented on an opportunistic basis within the broader context of ecosystem management. Management actions recommended include only a few of the wide variety of options available. Land managers and biologists should consult with ecologists and scientists from other disciplines to ascertain appropriate conservation actions to prescribe for specific areas. These individuals also can be a valuable source of information for additional management actions to achieve the biological objectives.

"…most land managers want to know the measurable parameters—how much, where, and by when—in order to plan and implement bird conservation actions in an effective and integrated manner with other objectives, and perhaps just as importantly to have a context within which to track their progress towards goals and objectives."

"The population objectives established in the PIF Continental Plan were viewed as a starting point to initiate dialogue on the value of population objectives, and to stimulate action towards conservation of priority bird species at the continental scale by setting measurable targets. The expectation was that regional and local assessments would be conducted to establish habitat-based population objectives at those scales that reflect the practical realities of the capacity of those areas to contribute towards the continental population objective."

Monitoring and Adaptive Management

Finally, monitoring of habitat attributes and focal species will provide a means of assessing bird and habitat response to the implemented conservation strategies and tracking progress towards our biological objectives. Monitoring provides essential feedback for demonstrating adequacy of conservation efforts on the ground, and guides the adaptive management component (Irwin and Wigley 1993) that is inherent in this approach. Because bird monitoring is a cost-effective tool for measuring the ecological effects of habitat management (Alexander et al. 2007), it serves as a link between bird conservation and habitat management within the adaptive management framework. Standard bird monitoring methods are readily available (e.g., Ralph et al. 1993) for gathering the types of habitat and population data necessary to evaluate progress towards the biological objectives found in this document.

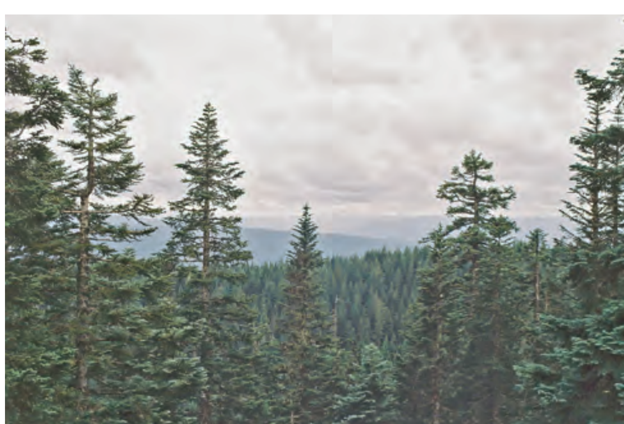

Photo by Erik Ackerson

The Forests

The temperate "rain forests" of western Oregon and Washington represent maximal development of temperate coniferous forests in terms of extent and size, and have produced some of the greatest biomass accumulations of any plant formations in the world (Franklin and Dyrness 1973). These forests are characterized by the dominance of conifer tree species, the large size and longevity of the trees, and the high productivity of the forests. They also have been some of the most intensively managed forests in the world.

A thorough description of the physical and environmental setting and the historic and current forest vegetation of western Oregon and Washington is beyond the scope of this document. The information presented below is a cursory overview of the principal features of the environment and vegetation with an emphasis on the habitat that is provided for landbirds.

Forest Types

Coniferous forests in western Oregon and Washington include five climax forest types or vegetation zones; the coastal Sitka spruce zone, the widespread low-elevation western hemlock/western redcedar zone, the mid-elevation Pacific silver fir zone which occurs primarily in the Cascade and Olympic Mountains, the subalpine mountain hemlock zone of the Cascade, Olympic, and Klamath Mountains, and the mixed-conifer zone of the Klamath/Siskiyou Mountains (Franklin and Dyrness 1973) (Table 2). Beyond these general broad-scale geographic characterizations, local forest types often depend on elevation, aspect, and/or rainfall amounts. The text below and Table 2 provide a general description of the characteristics of each of the five forest types.

Sitka Spruce Zone: This narrow zone along the Pacific coastline often is only a few miles wide. Most of the zone occurs below 150 m (500 ft) in elevation. It is characterized by a relatively mild climate with minimal fluctuations in moisture and temperature regimes, high rainfall amounts with frequent fog and low clouds, and dense, tall conifer trees with a limited hardwood component.

Western Hemlock Zone: This is the most extensive forest vegetation zone in western Oregon and Washington, and the most important in terms of timber production. Although it is called the western hemlock zone based on potential climax species, Douglas-fir forests dominate large areas, and western hemlock often does not become dominant or codominant until late successional stages. It can extend from sea level up to 900 m (3,000 ft) in elevation, but most of the zone occurs below 600 m (2,000 ft). A wet, mild, maritime climate and a dense, tall forest canopy characterize this zone. Because of its extent and accessibility, most of the western hemlock zone has been disturbed by logging, fire, or human development.

Pacific Silver Fir Zone: This mid-elevation zone between the western hemlock and subalpine mountain hemlock zones is transitional in terms of precipitation and temperature regimes. The climate is cooler and wetter than the western hemlock zone, and approximately half the precipitation occurs as snow with a significant winter snowpack. It generally occurs from 600–1,200 m (2,000–4,000 ft) in elevation, but can occur up to 1,350 m (4,500 ft). It is characterized by dense forests of tall conifers.

Table 2. Forest types and vegetation characteristics of coniferous forests in western Oregon and Washington.[a]

Forest Type	Elevation Range	Dominant Tree Species	Common Shrubs	Common Herbaceous Plants
Sitka Spruce	0–150 m (0–500 ft)	Sitka spruce, western hemlock, western redcedar, Douglas-fir	huckleberry, salmonberry, devils club	sword fern, Oregon oxalis, evergreen violet
Western Hemlock	0–900 m (0–3,000 ft)	Douglas-fir, western hemlock, western redcedar, red alder, big-leaf maple	salal, vine maple, huckleberry, oceanspray, rhododendron, Oregon grape, California hazel	vanillaleaf, sword fern, trillium, twinflower, evergreen violet
Pacific Silver Fir	600–1,200 m (2,000–4,000 ft)	Pacific silver fir, noble fir, western hemlock, Douglas-fir	Oregon grape, salal, vine maple, huckleberry	beargrass, twinflower, trillium, ladyfern, vanillaleaf
Mountain Hemlock	1,200–1,800 m (4,000–6,000 ft)	Mountain hemlock, subalpine fir, noble fir	huckleberry, Cascade azalea	beargrass, dwarf blackberry, one-sided wintergreen
Mixed-Conifer	300–1,800 m (1,000–6,000 ft)	Douglas-fir, grand fir, white fir, red fir, Pacific madrone, sugar pine, Ponderosa pine, Incense-cedar	vine maple, Pacific yew, manzanita, Oregon grape, Pachistima, huckleberry, dewberry, ceanothus	twinflower, vanillaleaf, whipplevine, beargrass

[a] Franklin and Dyrness (1973)

Mountain Hemlock Zone: This is the highest forested zone in western Oregon and Washington, extending from about 1,200 m (4,000 ft) to timberline in the Cascade Mountains and on the Olympic Peninsula. Mountain hemlock is dominant at lower elevations, and is replaced by forest patches of subalpine fir at higher elevations. It is the coolest and wettest forested zone in western Oregon and Washington. Most precipitation occurs as snow, and snowpacks and snow duration often last up to six months or more. It is characterized by short to medium tall conifers in dense forests and forest patches interspersed with shrublands, grass meadows, and debris chutes.

Mixed-Conifer Zone: This forest zone includes the ecologically complex region of the Klamath Mountains ecoregion of southwestern Oregon where environmental and floristic diversity make this perhaps the most biologically diverse region in the United States (Whittaker 1960). It includes mixed vegetation zones of Douglas-fir, true firs (e.g., grand fir, white fir, red fir), pines, and hardwoods including oaks and Pacific madrone. These forests occur from sea level to 1,800 m (6,000 ft) in elevation, and climate tends to be milder and drier than elsewhere in western Oregon and Washington.

Forest Succession

As stated earlier, we use successional stage as the primary organizational category for describing bird-habitat relationships. For purposes of this document, successional stage categories are coarse-level descriptions of habitat characteristics derived in part from forest succession patterns described by Oliver (1981). In reality, there is a gradient or continuum of habitat characteristics with undefined breakpoints, and successional stage is subject to site-specific conditions and management actions. Additionally, catastrophic events, either natural (e.g., wildfire) or anthropogenic (e.g., tree harvest) can not only reset the successional stage but also result in a mixing of successional stage features when attributes are retained as legacies from the previous stand.

Our emphasis in this document is not on a detailed description of the stages of forest development, but on describing the habitat conditions most important to landbird conservation within the general framework of successional stage. To facilitate that, we use five categories to characterize successional stage (Table 3), but also further lump those into three general successional stages:

- Early-successional refers to the seedling/sapling stage
- Mid-successional refers to the pole and young forest stages
- Late-successional refers to the mature and old-growth stages

The typical successional pattern in unmanaged forest, particularly in the western hemlock/western redcedar zone, begins with a dense layer of broad-leafed shrubs, followed by rapid growth of coniferous trees, and a relatively long period of dense patches of Douglas-fir until natural mortality begins to open up the forest and allow development of an understory. When the forest begins to open up, western hemlock invades to establish a subcanopy and eventually a multi-layered canopy with Douglas-fir. If succession proceeds without disturbance, western hemlock may replace Douglas-fir at 400–500 years. Douglas-fir is often the dominant (often sole dominant) tree species up to the old-growth successional stage in several vegetation zones, due to its propensity for rapid reproduction in open or early-successional conditions and its longevity.

Table 3. Successional stages and characteristics of coniferous forests in western Oregon and Washington.

Names	Age	Structural Characteristics	Tree Canopy	Tree Size	Unique Characteristics
Seedling/sapling grass-forb; stand initiation; regenerating	0 to 15–20 years	Variable: dominated by herbs and shrubs early with developing trees	Open; 0–30% tree cover	<10 feet tall	Even-aged cohort of new seedlings
Pole forest stem exclusion	15–20 to 30–40 years	Little to no understory vegetation (ground and shrub)	Dense closed canopy	<10 in dbh	Dominance of the initial cohort of trees to the exclusion of others
Young forest understory reinitiating	30–40 to 60–80 years	Development of understory herbs, shrubs, and shade tolerant trees	Mixed open and closed	10–21 in dbh	Thinned naturally or mechanically
Mature forest multi-layered	80–150 years	Moderate structural and compositional complexity with a moderately developed sub-canopy and shrub layer		21–32 in dbh	
Old-growth	>150 years	High level of structural and compositional diversity; replacement of long-lived pioneer species such as Douglas-fir with climax species such as western hemlock		>32 in dbh	High degree of decadence and an abundance of downed woody debris

The Birds

Douglas-fir forests, which dominate western Oregon and Washington, support the highest bird densities of any coniferous forest systems in North America (Weins 1975). Information on landbirds and their habitat relationships in the coniferous forests of western Oregon and Washington is relatively robust compared to most of Western North America. This is due in large part to extensive collateral work associated with late successional forest endangered species (i.e., Northern Spotted Owl, Marbled Murrelet), and the economic importance of the forests. Avian inventories, censusing, trend monitoring, and correlative associations with successional stage or habitat conditions have received the most emphasis. There are less data available on species relationships with habitat elements; demographic processes such as reproduction, mortality, and recruitment into the population; landscape issues such as patch size, distribution, and configuration; use of corridors; and fragmentation.

We considered over 100 breeding landbird species to be closely associated with habitats in the coniferous forests of western Oregon and Washington based on numerous sources (e.g., Johnson and O'Neil 2001). This does not include a number of other landbird species that may occur in these forests (particularly in riparian habitats), even occasionally as breeding species, but which are not considered to be regular components of the avifauna from a conservation perspective. Additionally, many other species may occur as migrants or wintering species only, but are not directly considered in this document.

There are no landbird species endemic to the coniferous forests of western Oregon and Washington, although several breeding species are relatively unique to the area (i.e., a high percent of their global population occurs in western Oregon and Washington). These include Chestnut-backed Chickadee, Hermit Warbler, Hutton's Vireo, Pacific-slope Flycatcher, Red-breasted Sapsucker, and Blue (Sooty) Grouse. No landbird species has been extirpated as a breeding species from westside coniferous forests.

Bird-Habitat Relationships

An essential component for establishing biological objectives and deciding appropriate management actions to support the biological objectives is an understanding of the relationships between landbird species and their habitat. The most recent synthesis of knowledge on landbird species and their habitat relationships is *Wildlife Habitats and Species Associations in Oregon and Washington* (Johnson and O'Neil 2001). There are other compendiums of bird-habitat information for the forests of western Oregon and Washington including Brown (1985), Altman and Hagar (2007) for young conifer forests, and two recent State bird books, Marshall et al. (2003) for Oregon and Wahl et al. (2005) for Washington. Herein, we use available data on landbird species-habitat relationships from these compendiums and numerous studies to support our selection of focal species and the setting of biological objectives.

"The principal conservation issue affecting breeding bird populations is forest management because of the extensive 'use' of the forests for a variety of human activities and commodity production."

Bird Conservation Issues

Landbird conservation in the coniferous forests of western Oregon and Washington faces numerous challenges, most either directly or indirectly arising from conflicts with human development or economic issues. The principal conservation issue affecting breeding bird populations is forest management because of the extensive "use" of the forests for a variety of human activities and commodity production. Other issues such as habitat loss to development, diseases, increased levels of predation, and wildfire also impact bird populations to varying degrees, but are generally secondary to the consequences of forest management. For many migratory species, issues occurring outside our geographic scope also are likely affecting their breeding populations, perhaps even more significantly than forest management on the breeding grounds.

Land Ownership

Because most land ownership in the coniferous forests of western Oregon and Washington is large areas of public lands or industrial forest lands, a significant part of landbird conservation is addressing issues within the context of policy, planning, and regulations. This habitat-based landbird conservation strategy does not include the political-based strategies needed to address these issues. However, it does provide potential language in the form of our biological objectives that could be used in developing the policy/regulations that will be necessary to support landbird conservation.

Declining Landbird Populations

At the core of our concern for landbirds in coniferous forests of western Oregon and Washington are the population declines being experienced by many species. The BBS (Robbins et al. 1986) is the primary source of population trend information for North American landbirds (www.mbr-pwrc.usgs.gov/bbs/). There is no standard analyses of BBS data specifically for the geographic scope of this document, but three scales of BBS analyses provide insights into population trends for landbird species for all or large parts of our geographic scope (Table 4). These include two BBS physiographic regions, the Cascade Mountains and Southern Pacific Rainforests, and the Northern Pacific Rainforest Bird Conservation Region. All these analyses include some areas outside our boundaries (e.g., Willamette Valley and Puget Lowlands are part of the Southern Pacific Rainforests; east-slope of the Cascades is part of the Cascade

"Among landbird species regularly associated with coniferous forests of western Oregon and Washington, 32 species are experiencing significant (p <0.10) recent (1980–2006) and/or long-term (1966–2006) declining population trends based on a relatively high confidence of BBS data…"

Mountains; and western British Columbia, southeast Alaska, and northwestern California are part of the Northern Pacific Rainforest Bird Conservation Region).

Among landbird species regularly associated with coniferous forests of western Oregon and Washington, 32 species are experiencing significant (p <0.10) recent (1980–2006) and/or long-term (1966–2006) declining population trends based on a relatively high confidence of BBS data for at least one of the three BBS analysis regions described above (Sauer et al. 2007) (Table 4). Additionally, there are likely some species that are not adequately addressed by the BBS such as owls and birds with a limited distribution or small population (Altman and Bart 2001) that also are experiencing population declines. Conversely, only 16 species are experiencing significantly increasing population trends (Table 4). Two species, Song Sparrow and White-crowned Sparrow, have significant trends in both directions (i.e., declining and increasing) in different BBS analysis regions.

"An underlying premise of this document is that forest management can have a direct and significant influence on bird populations. Consequently, manipulation of forest conditions as part of forest management can be designed and implemented to achieve bird conservation objectives."

An examination of species population trends between the regional analyses indicates noteworthy geographic differences. There are 22 species with significantly declining long-term or recent trends in the Southern Pacific Rainforest BBS region, but only 8 species in the Cascade Mountains BBS region (Table 4). Conversely, there are 6 species in the Southern Pacific Rainforest BBS region with significantly increasing long-term or recent trends, and 10 species in the Cascade Mountains BBS region. These differences suggest a negative factor(s) specific to or primarily occurring in coastal forests (i.e., the Southern Pacific Rainforest BBS region). Coastal forests that comprise the Southern Pacific Rainforest are lower elevation

"…only 16 species are experiencing significantly increasing population trends."

and in greater private ownership than in the Cascade Mountains, and likely have been more impacted by human development and forest management than forests in the Cascade Mountains, and loss of habitat is likely to be a more significant factor than in the Cascade Mountains, where there is extensive public ownership.

Photo by Erik Ackerson

Forest Loss and Conversion

The amount of forested landscape in western Oregon and Washington has changed little in the last 75 years. For example, comparisons with forest inventories in western Oregon and Washington in the 1930s indicate that greater than 90% of the forest land remains as forest (Campbell et al. 2002). Where permanent loss and conversion of coniferous forest habitat has occurred, most has been at low elevations due to growth and expansion of urban, residential, and agricultural areas.

Although the loss of coniferous forest has not been substantial, the representation of late-successional forest has been greatly reduced. Mature and old-growth forest covered approximately 50% of the forested landscape in the Pacific Northwest prior to World War II, but now occupy less than 20%, and often occur in relatively small and isolated patches within a mosaic of younger forest (Bolsinger and Waddell 1993). Forest harvest practices that truncate succession at 40–70 years have resulted in a landscape dominated by early- and mid-successional forest (Bunnell et al. 1997). These changes have had significant impact on landbird species highly associated with late-successional forests, including endangered status for Northern Spotted-owl and Marbled Murrelet.

Table 4. Coniferous forest landbird species with significant population trends based on analyses of Breeding Bird Survey data (1966-2007) within the area encompassed by the coniferous forests of western Oregon and Washington.

Species	Significantly Declining Trends [1]			Significantly Increasing Trends [1]		
	Bird Conservation Region 5 [2]	Southern Pacific Rainforest BBS Region [3]	Cascade Mountains BBS Region [4]	Bird Conservation Region 5 [2]	Southern Pacific Rainforest BBS Region [3]	Cascade Mountains BBS Region [4]
American Goldfinch	L R	L R [5]				
American Robin	L R					
Band-tailed Pigeon	L R					
Black-headed Grosbeak						L R
Black-throated Gray Warbler		R				
Blue Grouse	L R					
Brown Creeper		R	L			
Brown-headed Cowbird	L R					
Bushtit		L R				
Cassin's Vireo						L R
Cedar Waxwing					L R	
Chipping Sparrow		L R				
Chestnut-backed Chickadee		L R				
Common Nighthawk			R			
Common Raven				L	L R	L R
Common Yellowthroat					L R	
Dark-eyed Junco	L R					
Fox Sparrow	L R		L			
Golden-crowned Kinglet		L R				
Gray Jay			R			
Hairy Woodpecker	R					
Hammond's Flycatcher				L R		L R
Hermit Thrush		L R				
House Finch				R		
MacGillivray's Warbler	L R	L R	L			
Mountain Quail				L		
Nashville Warbler		R				
Northern Flicker						L R
Olive-sided Flycatcher	L R	L R				
Orange-crowned Warbler	L R	L R				
Pacific-slope Flycatcher	R	L R	L R			
Pine Siskin	L R	L R				
Purple Finch	L R	L R				
Red Crossbill	L R					
Red-breasted Nuthatch					L R	
Rufous Hummingbird	L R	L	L			
Song Sparrow	L R	L R				L R
Spotted Towhee						L
Steller's Jay					L R	
Swainson's Thrush		L				
Turkey Vulture				R	R	
Varied Thrush		R	R			
Warbling Vireo						L R
Western Tanager				R		R

Table 4. Coniferous forest landbird species with significant population trends based on analyses of Breeding Bird Survey data (1966-2007) within the area encompassed by the coniferous forests of western Oregon and Washington. — Continued

Species	Significantly Declining Trends [1]			Significantly Increasing Trends [1]		
	Bird Conservation Region 5 [2]	Southern Pacific Rainforest BBS Region [3]	Cascade Mountains BBS Region [4]	Bird Conservation Region 5 [2]	Southern Pacific Rainforest BBS Region [3]	Cascade Mountains BBS Region [4]
Willow Flycatcher	L R	L				
Wilson's Warbler	L R	L R	L R			
Wrentit		R				
Yellow Warbler	L					

[1] Species with significantly declining or increasing trends (p ≤0.10) and a relatively high degree of confidence (Sauer et al., 2008).

[2] Bird Conservation Region 5 = a NABCI ecological unit which includes northwestern California; western Oregon, Washington, and British Columbia; and southeast and southcoastal Alaska.

[3] Southern Pacific Rainforest BBS Region = a BBS physiographic province which includes northwestern California and coastal western Oregon and Washington (excludes Cascades Mountains).

[4] Cascade Mountains BBS Region = a BBS physiographic province which includes the Cascade Mountains in northern California, Oregon, and Washington.

[5] L = significant (p ≤0.10) long-term (1966-2007) population trend; R = significant (p ≤0.10) recent (1980-2007) population trend.

"Current forest management on most public lands focuses on 'ecosystem management' in which maintaining ecological functions and biological diversity is integrated with sustainable commodity production."

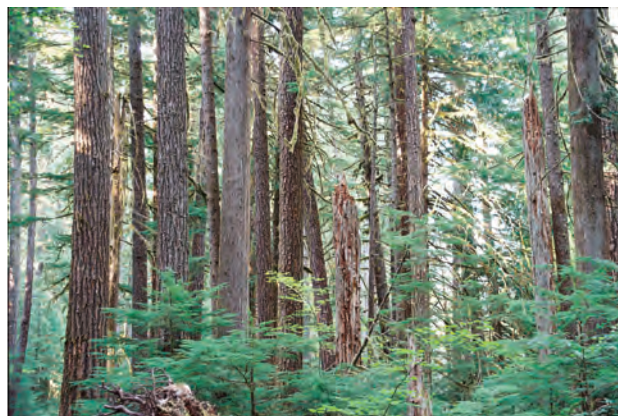

Photo by Erik Ackerson

Forest Management

An underlying premise of this document is that forest management can have a direct and significant influence on bird populations. Consequently, manipulation of forest conditions as part of forest management can be designed and implemented to achieve bird conservation objectives (Busing and Garman, 2002; Lehmkuhl et al. 2002). However, it is not our intent to describe all the potential forest management activities that could be conducted to achieve the desired habitat conditions for birds. Those need to be determined locally by assessing the most ecologically appropriate management at each site. However, to assist land managers, the document offers some basic forest management activities that are widely accepted for achieving particular habitat attributes.

There is an extensive body of literature on forest management in the Pacific Northwest that we will not attempt to summarize here. Simply stated, in the past 50–100 years, coniferous forests in western Oregon and Washington have been substantially altered by a variety of forest management activities, but especially timber harvest and subsequent replanting and management for wood production. Prior to management of these forests for timber extraction, patterns and dynamics of the forested landscape were shaped by natural disturbances such as fire, wind, floods, volcanic eruptions, insects, and disease (Pickett and White 1985), and small-scale disturbances (e.g., fire) initiated by Native Americans. Human-induced disturbances, particularly timber harvesting, now influence most of the physical changes in these forests, and the changes have altered habitat for forest birds in a manner different from natural disturbances. In particular, there has been simplification of forest structure and composition at the site-level and fragmentation of formerly contiguous forest patches at the landscape level (Noss 1999).

Traditional forest management on public and private lands in most of western Oregon and Washington into the 1980s was designed to maximize timber production (Franklin 1989). Relatively high growth rates have allowed for intensive management and short rotation periods between harvests (e.g., 40–60 years). Traditional logging practices were dominated by clearcutting; broadcast burning to remove slash and prepare for planting; replanting with Douglas-fir seedlings; herbicide applications, fertilization, and pest control to ensure rapid development; pre-commercial thinning at 10–15 years post-harvest to remove competitive deciduous trees and less vigorous conifers; and commercial thinning at 20–35 years post-harvest to reduce competition for the target crop of trees (Swanson and Franklin 1992). This occurred across the landscape either in small, staggered patches or in large, continuous areas. Thus, much of the current forest landscape remnant is a mosaic of varying even-aged forest patches. Even-aged management results in simplified forest structure and reduced habitat heterogeneity and patchiness from

Photos by Erik Ackerson

Table 5. Forest successional stages and associated habitat attributes and focal species for landbird conservation in coniferous forests in western Oregon and Washington.

Forest Stage	Habitat Attribute	Focal Species
Old-Growth/Mature Forest (Multi-Layered/Late-Successional)	Large snags	Pileated Woodpecker
	Large trees	Brown Creeper
	Deciduous canopy/sub-canopy trees	Pacific-slope Flycatcher
	Mid-story tree layers	Varied Thrush
Mature/Young Forest (Multi-Layered/ Understory Reinitiating)	Closed canopy	Hermit Warbler
	Open mid-story	Hammond’s Flycatcher
	Deciduous understory	Wilson’s Warbler
	Forest floor complexity	Winter Wren
Young/Pole Forest (Understory Reinitiating/ Stem Exclusion)	Deciduous canopy trees	Black-throated Gray Warbler
Sapling/Seedling Forest (Stand Initiation/Early Successional)	Residual canopy trees	Olive-sided Flycatcher
	Snags	Northern Flicker
	Deciduous shrub layer	Orange-crowned Warbler
Unique Forest Habitats or Conditions	Mineral springs	Band-tailed Pigeon
	Wet meadows	Lincoln’s Sparrow
	Alpine grasslands	American Pipit
	Waterfalls	Black Swift
	Nectar-producing plants	Rufous Hummingbird
	Large hollow snags	Vaux’s Swift
	Landscape mosaic forest	Blue (Sooty) Grouse
Klamath Mountains Mixed Conifer/Mixed Conifer-Hardwood Forests	Pine-oak canopy/subcanopy trees	Purple Finch
	Dense shrub understory	Nashville Warbler
	Shrub-herb interspersion understory	Hermit Thrush
	Forest canopy edges	Western Tanager
	Montane brushfields	Fox Sparrow
	Post-wildfire	Lazuli Bunting

that of naturally regenerated forests. Additionally, shorter rotation lengths are insufficient for development of structural characteristics associated with mature or old-growth forests. Moreover, structural features such as snags and merchantable downed logs are often removed from harvested forest patches due to logistic or safety factors. The early-successional stage (shrub-dominated) of natural forest succession is also truncated under traditional logging practices to establish a tree crop as quickly as possible.

Forest management in the predominately mixed conifer forest of the Klamath Mountains ecoregion of southwestern Oregon has included some of the traditional clearcutting practices of elsewhere in western Oregon and Washington, but also more selective cutting practices such as thinning and partial cuts. Harvest rotations tend to be longer due to slower growth rates, and the resultant forests tend to have more variable structure than managed forests elsewhere in western Oregon and Washington.

Current forest management on most public lands focuses on “ecosystem management” in which maintaining ecological functions and biological diversity is integrated with sustainable commodity production (Hansen et al. 1995). This change has often been referred to as “New Forestry” (Franklin 1989) or “Ecological Forestry” (Johnson and Franklin 2009). The basis for this type of forest management is an attempt to 1) use disturbance patterns and habitat heterogeneity that occur in unmanaged forests as a guide for timber harvest patterns and retention, and 2) accelerate re-establishment of older forest conditions and structural elements such as snags, down logs, and vertical heterogeneity.

Recent changes in silvicultural practices primarily on public lands include attempts to foster variability in forest structure through more selective cutting, and variable-density green-tree and snag retention to provide a “legacy” of structural complexity through stand development (Franklin 1989). Selective cutting includes group selection cuts of various sizes that create patches or

"*Although fragmentation has been widely implicated in declines of several bird species in eastern and midwestern deciduous forests, there is no direct evidence of broad-scale adverse affects in western forests, including western Oregon and Washington.*"

gaps in an otherwise unharvested forest matrix. However, "green-tree retention," "structural retention," or "variable retention" is becoming the predominant silvicultural practice on federal lands since the Northwest Forest Plan mandated that a minimum of 15% of the trees in a harvest unit be retained (USDA and USDI 1994). Green-tree retention provides features thought to be important to late-successional forest species, supports biological diversity goals, and may be viewed by the public more positively than clearcutting. An attempt to provide empirical data to evaluate consequences of green-tree retention is the U.S. Forest Service sponsored Demonstration of Ecosystem Management Options (DEMO) study (Aubry et al. 1999, Halpern et al. 1999).

In addition to green-tree retention, a traditional forest management practice, thinning, also is being promoted as an ecological management tool for enhancing structural diversity and accelerating development of old forest conditions. In particular, variable-density thinning has been promoted to create the spatial heterogeneity that mimics natural conditions (Carey et al. 1996). When variable-density thinning is combined with legacy retention from the original forest, understory planting to enhance structural and compositional diversity, and decadence management (i.e., snags and downed logs), there is the potential for developing the complex forest conditions that occur in unmanaged forests. There has been a significant amount of literature on the use and types of thinning for ecological objectives (e.g., Harrington and Tappeiner 2007), including its potential use in creating bird habitat, which has been summarized in Altman and Hagar (2007). A summary table on landbird species response to thinning from Altman and Hagar (2007) has been updated in Appendix B.

Landbird responses to forest management practices are complex, species-specific, and dependent upon many environmental and ecological factors. Summaries of the effects of forest management on birds in coniferous forests of western Oregon and Washington have been synthesized by Hagar et al. (1995), Bunnell et al. (1997), and Sallabanks et al. (2001). Meslow and Wight (1975) identify and describe four areas of concern for forest birds associated with traditional production forests: 1) shortening of the grass-forb-shrub stage, 2) effect of an even-aged Douglas-fir monoculture, 3) elimination of snags, and 4) elimination of old-growth forest. Tools developed to monitor and/or predict bird response to habitat change resulting from forest management include risk ratings (Lehmkuhl and Ruggiero 1991), sensitivity indices (Hansen et al. 1993), viability assessments (Thomas et al. 1993, Holthausen et al. 1995), and versatility indices (Thomas 1979, Brown 1985, Chambers 1996).

Forest Fragmentation

Forest fragmentation, the breaking up of a forest tract, involves both reduction of contiguous forest area (McGarigal and McComb 1995), and the isolation of forest patches (Harris 1984). This has the potential to primarily affect species that: 1) are forest-interior specialists, 2) have large home ranges or habitat-area requirements, 3) require connective corridors for movement, or 4) are vulnerable to indirect impacts associated with increased edges (e.g., changes in abundance or composition of predators, parasites, and food supply). In coniferous forests of western Oregon and Washington, forest fragmentation has been widely regarded as the reduction and isolation of patches of older forest surrounded by younger forest managed for timber production (Bunnell et al. 1999). However, forest fragmentation does occur naturally and should not be interpreted solely in terms of negative impacts (Franklin et al. 2002).

Although fragmentation has been widely implicated in declines of several bird species in eastern and midwestern deciduous forests (Whitcomb et al. 1981, Robinson et al. 1995, Thompson et al. 2002), there is no direct evidence of broad-scale adverse affects in western forests (Hejl 1994, Schieck et al. 1995, Bunnell et al. 1997), including western Oregon and Washington (Manuwal and Manuwal 2002). Reasons for this may be due to landscape-level effects such as 1) differences in land-use practices in the landscape matrix of western forests versus eastern forests, and 2) the natural heterogeneity and variability of western forests in which forest bird species evolved prior to forest management (Hansen et al. 1991). The landscape around fragmented forests in the East is agricultural and urban (unsuitable for a forest dwelling bird), while in the West it is often still forest, just differently-aged. Thus, in western forest landscapes, especially coniferous forests of western Oregon and Washington (Manuwal and Manuwal 2002), there is less contrast between intervening land-uses of fragmented patches, and potentially suitable habitat if characteristics of unfragmented forests are retained in harvested forest. The latter often occurs in naturally fragmented landscapes and can occur in managed forest landscapes with certain types of harvest.

In a landscape-level analysis in the Oregon Coast Range, McGarigal and McComb (1995) reported that more bird species exhibited a positive relationship (i.e., abundance increased) with fragmented distribution of habitat. They did not identify any species that completely avoided edges created by fragmentation, and identified only five species (Gray Jay, Brown Creeper, Winter Wren, Varied Thrush, and Chestnut-backed Chickadee) that were less abundant along edges than in the forest interior. Relatively few species exhibited negative responses (i.e., abundance decreased) to forest fragmentation measures in Douglas-fir forests in northwestern California, and those that did were primarily wide-ranging species such as Pileated Woodpecker, Ruffed Grouse, and Spotted Owl (Rosenberg and Raphael 1986). In the western Washington Cascades, community-level bird species richness and abundance varied little in differing degrees of fragmented forest, although individual species did exhibit differences (Manuwal and Manuwal 2002). Although evidence documenting broad-scale negative effects of fragmentation in forests of western Oregon and Washington is absent, it is possible that effects have yet to manifest themselves or have yet to be properly investigated

> "*Fire suppression probably has had less effect on bird communities in moister coastal and high elevation coniferous forests because the fire-return interval is beyond the time frame of effective fire suppression. The effects of fire suppression on bird communities are probably more pronounced in the drier habitats of the Klamath Mountains ecoregion of southwestern Oregon because the fire-return interval has been lengthened by effective fire suppression.*"

Photo by Erik Ackerson

(Bunnell et al. 1997). Additionally, several studies have reported relatively consistent negative species responses to fragmentation, and some local declines in nesting success due to predation where fragmentation has occurred (George and Brand 2002).

One of the outcomes and potentially adverse effects of forest fragmentation on birds is a higher ratio of edge to interior habitat (Primack 1998), and thus increased rates of parasitism and predation associated with those edges (Cavitt and Martin 2002). The latter may occur as a result of opening up forests,which may allow access for parasitic and predator species to occupy habitats previously not available to them. Parasitism by Brown-headed Cowbirds seems likely to have little effect in wet coastal forests (reviewed by Schieck et al. 1995), except potentially at low elevations at the interface of forests and agricultural lands (Chambers et al. 1999). Likewise there is a lack of compelling broad-scale evidence of negative edge effects and fragmentation on increase predation rates in western forests. However, some studies have reported local decreases in nest success due to nest predation where fragmentation has occurred. In redwood forests of northwestern California, George and Brand (2002) reported significantly negative effects on nest success for Swainson's Thrush, and in the Oregon Cascades, Vega (1993) reported significantly increased nest predation rates on shrub-nesting birds in green-tree retention harvest units than in clearcuts. Steller's Jays also were more abundant in green-tree retention units than in clearcuts, and Vega (1993) speculated that retained green-trees might provide strategic perch sites for avian predators like Steller's Jay.

The other principal potential consequence of forest fragmentation on bird species is reduction in patch size, particularly for late-successional forests (McGarigal and McComb 1999). Species that require patches of contiguous forest habitat much larger than their territory to maintain a presence or a viable population are referred to as forest-interior or area-sensitive species. There is a growing body of evidence to support this status during the breeding season for several bird species in late-successional forests, including seven species in at least three of the eight studies reviewed by George and Brand (2002): Brown Creeper, Chestnut-backed Chickadee, Golden-crowned Kinglet, Pileated Woodpecker, Red-breasted Nuthatch, Varied Thrush, and Winter Wren. Additionally, demographic monitoring and landscape analyses strongly suggest area-sensitivity for Pacific-slope Flycatcher (Nott et al. 2005). However, other studies report opposite effects for some species such as Brown Creeper (Mayrhofer 2006), and it has been speculated that the type of habitat at the edge of the patch may play a role in bird species use of different forest patch sizes (Mayrhofer 2006).

Fire

The ecological persistence of coniferous forest birds was facilitated by fire,which historically played a role in maintaining a mosaic of seral stages or habitat structures (e.g., snags) in forests of the Pacific Northwest (Huff et al. 2005). The moist climate of most of western Oregon and Washington results in a fire regime characterized by long fire return intervals and high severity fires. At lower elevations and in dryer areas, westside coniferous forests are associated with mixed-severity fire regimes that are characterized by shorter fire return intervals. The most fire-prone ecoregion within the scope of western Oregon and Washington coniferous forests is the Klamath Mountains.

Photo by Erik Ackerson

Drawing generalizations about the effects of fire suppression on birds is difficult given the inherent variability within and among the different forest types (Huff et al. 2005). Fire suppression in the 20th Century may have changed forest structure and landscape composition in the coniferous forests of Oregon and Washington at several spatial scales. Fire suppression probably has had less effect on bird communities in moister coastal and high elevation coniferous forests because the fire-return interval is beyond the time frame of effective fire suppression. The effects of fire suppression on bird communities are probably more pronounced in the drier habitats of the Klamath Mountains ecoregion of southwestern Oregon because the fire-return interval has been lengthened by effective fire suppression. Here, forest composition and structural characteristics maintained by recurring fires have changed as a result of fire suppression, and the heterogeneity of forest characteristics has likely been reduced at the landscape scale.

Fire management tools that are designed to restore forest conditions associated with historical fire regimes might serve as tools for bird conservation. Huff et al. (2005) suggest that a series of research questions regarding the natural characteristics of fire regimes and how bird populations respond to fire, fire suppression, and fuels treatments, be addressed to provide critical information for the application of fire management towards effective bird conservation.

Photo courtesy of Olympic National Park

Climate Change

The science of predicting effects of climate change on vegetation or habitat type, let alone bird populations, is in its infancy. It is a model-driven exercise highly dependent on the parameters and the input data of the model. The modeled effects of climate change on forests in the region are variable; however, it is generally felt that the cool, wet climate of Pacific Northwest forests make the region less vulnerable to climate change than warmer drier regions (Smith 2004). Furthermore, forest birds are predicted to fare better in a changing climate than birds in other habitats (North American Bird Conservation Initiative 2010). It is generally recognized that where climate change effects are most likely to occur (i.e., within the geographic scope of this document) is at lower elevations in the ecotones between conifer forest and deciduous forest or non-forest, in the higher elevations between coniferous forest and alpine habitats, and in drier ecoregions such as the Klamath Mountains.

Herein, we make no attempt to address the issue of climate change relative to the setting of biological objectives. Most focal species habitat relationships are relatively static and changes in land cover will likely result in changes in the distribution and abundance of those species. Among the preliminary recommendations for conservation actions that consider the potential for impacts from climate change on landbird conservation is the protection of corridors where birds can make incremental changes in distribution following likely routes of change in vegetation (Peters 1992).

"Among the preliminary recommendations for conservation actions that consider the potential for impacts from climate change on landbird conservation is the protection of corridors where birds can make incremental changes in distribution following likely routes of change in vegetation."

For those interested in further information on this topic, there is a significant and growing body of information on climate change and birds. The international PIF web page (www.partnersinflight.org/climate_change) provides a bibliography of articles on this topic, and two web pages on research and predictive modeling on climate change and birds in the Pacific Northwest are American Bird Conservancy (www.abcbirds.org/climate_change/statepage.htm) and Institute for Bird Populations (www.birdpop.org/climate.htm). Perhaps, the most thorough assessment of the science and implications of climate change on forests is Brown (2008).

"Although suitable habitat is essential for bird conservation, habitat conservation does not necessarily equate to bird conservation. Habitat conservation efforts still require a litmus test assessment of bird populations, the ultimate measure and currency of bird conservation."

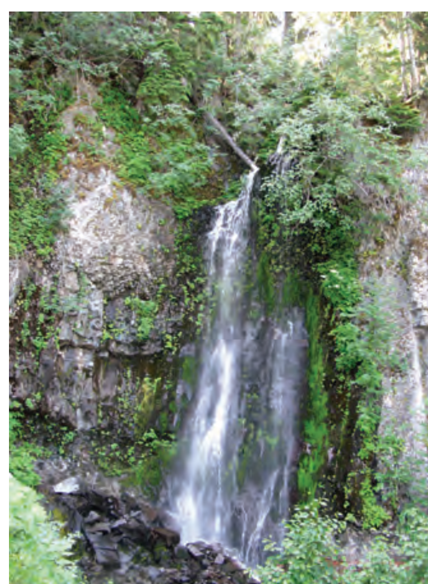

Photo by Bob Altman

Focal Species

A list of 19 focal species and the habitat attributes and forest stages they represent throughout western Oregon and Washington is presented in Table 6. This includes seven focal species with an obligate or near-obligate relationship to some unique forest habitat attribute or condition. Because of the uniqueness of the mixed-conifer/hardwood forests in the Klamath Mountains ecoregion of southwestern Oregon, we also recognize six focal species for forest and habitat conditions for that geographic area. However, we still recommend use of the 12 regional focal species in southwestern Oregon if the habitat attributes they represent are locally applicable (e.g., snags, forest floor complexity).

Priority Species

There are 38 priority landbird species identified by primary bird conservation partners that are regularly breeding species in coniferous forests of western Oregon and Washington (Table 7). This includes 15 of our 25 focal species. Although we do not provide biological objectives for priority species like we do for focal species, the remaining 23 priority species in Table 7 that are not focal species are recognized where they are likely to directly benefit from conservation directed towards focal species (Appendix A). Additionally, priority species in Appendix A should be considered as potential surrogate species for focal species when the focal species is not appropriate for a site due to range, habitat type, elevation, etc.

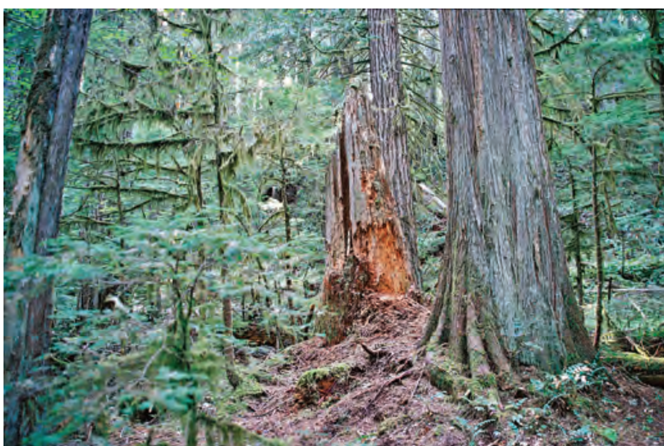

Photo by Erik Ackerson

Population Estimates

Population size is an important metric in assessments of a species conservation status and its response to natural or anthropogenic changes in its habitat. Within PIF, the Species Assessment Database includes population size as one of several factors considered in the prioritization of species (Panjabi et al. 2005). Although suitable habitat is essential for bird conservation, habitat conservation does not necessarily equate to bird conservation. Habitat conservation efforts still require a litmus test assessment of bird populations, the ultimate measure and currency of bird conservation. This concept is currently receiving increasing emphasis among bird conservation partners as a means of quantitatively accounting for the response of bird populations to investments in habitat conservation.

Population estimates have been developed for all bird species in North America at the continental level by the four bird conservation initiatives. Population estimates for North American landbirds have been published in the PIF Continental Plan (Rich et al. 2004). These estimates were derived from a process described in Blancher et al. (2007) using relative abundance counts from BBS data from the 1990s. The population estimates were further "stepped-down" to smaller geographic scales (i.e., states, BCRs, state/BCR polygons) to provide a starting point for dialogue on the setting of regional population objectives through regional assessments (Rosenberg 2004). Although this "top-down" approach does not account for the known disproportionate sampling of habitats by the BBS, it does illustrate differences in the relative degrees of magnitude among species populations, and provides a point of discussion for initiating the dialogue on the impacts of actions on landbird populations. Examples of population estimates using the process stepped-down from the continental population estimates is provided for our focal species in Table 7.

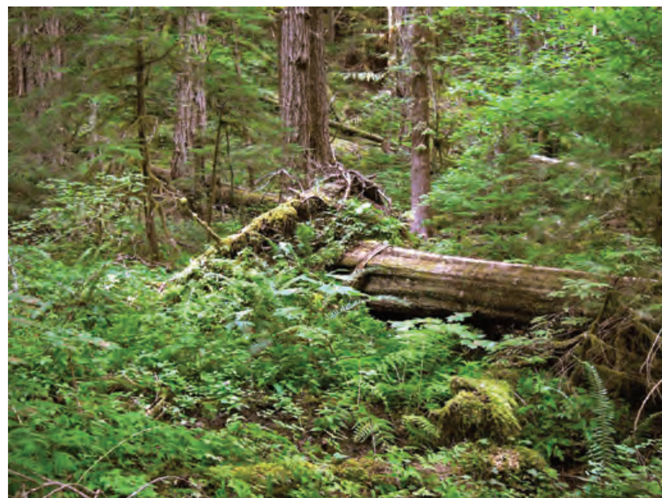

Photo by Erik Ackerson

Bird conservation partners, especially Joint Venture partnerships, are taking leadership in regional assessments to set quantitative habitat and bird population objectives for bird conservation. The principal components of this "bottom-up" process are regional geospatial data (e.g., GAP) on the amount and distribution of land cover types (i.e., habitat types for birds), and local and regional data on the degree of occurrence of bird species in the habitat (i.e., bird densities by habitat type or condition). For the latter, OR-WA PIF has created a database of studies that provide bird density estimates along with other pertinent data on the location, habitat, effort, and source of the information. These data in conjunction with geospatial data can be used to calculate estimates of bird population size at various scales.

Photo by Bob Altman

Table 6. Regularly breeding landbird species in western Oregon and Washington that have been designated as priority bird species by primary bird conservation partners. [1]

Species	USFWS BCC [3]	USFS/BLM Sensitive [4]	ODFW Strategy [5]	WDFW Strategy [6]	PIF SAD [7]	PIF CPLAN [8]	WATCH LIST [9]
Band-tailed Pigeon [2]			X		RC, RS	SCI	
Black Swift	X	X - OR	X		RC, RS		Yellow
Black-throated Gray Warbler					RS	SCI	
Blue (Sooty) Grouse					RC, RS	SCI	Red
Cassin's Vireo					RC		
Chestnut-backed Chickadee					RS	SCI	
Cooper's Hawk					RC		
Dusky Flycatcher					RC		
Flammulated Owl	X	X - OR				SCI	Yellow
Fox Sparrow						SCI	
Golden-crowned Kinglet					RC, RS		
Hermit Warbler					RS	SCI	Yellow
Hutton's Vireo					RS		
MacGillivary's Warbler					RS		
Mountain Quail		X - WA		X		SCI	Yellow
Northern Goshawk	X		X	X			
Northern Pygmy-owl					RS		
Northern Saw-whet Owl					RS		
Olive-sided Flycatcher	X		X		RC, RS	SCI	Yellow
Orange-crowned Warbler					RS		
Pacific-slope Flycatcher					RS	SCI	
Pileated Woodpecker				X			
Purple Finch					RC		
Purple Martin		X - OR		X			
Red-breasted Sapsucker					RC, RS	SCI	
Red Crossbill					RC, RS		
Ruffed Grouse					RC		
Rufous Hummingbird	X				RS	SCI	
Spotted Towhee					RS		
Steller's Jay					RS	SCI	
Townsend's Warbler					RS		
Varied Thrush					RS	SCI	Yellow
Vaux's Swift				X	RS		
Western Bluebird				X			
White-headed Woodpecker	X	X - OR	X			SCI	Yellow
Willow Flycatcher					RC, RS	SCI	
Winter Wren						SCI	
Wrentit						SCI	Yellow

[1] This list does not include listed or recently delisted species, and species that are irregular or peripheral breeders in coniferous forests of western Oregon and Washington.

[2] Shaded species also are focal species within this conservation strategy.

[3] USFWS BCC = U.S. Fish and Wildlife Service Birds of Conservation Concern (http://www.fws.gov/migratorybirds/reports/bcc2002.pdf). The area encompassed by this list is BCR 5 which includes more than western Oregon and Washington.

[4] USFS/BLM Sensitive Species (http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/). The area encompassed by this list is Oregon and Washington.

[5] ODFW Strategy = Oregon Department of Fish and Wildlife "Strategy" species for one or more of the western Oregon ecoregions as identified in the Comprehensive Wildlife Conservation Strategy (i.e., The Oregon Conservation Strategy) (http://www.dfw.state.or.us/conservationstrategy/contents.asp)

[6] WDFW Strategy = Washington Department of Fish and Wildlife "Strategy" species for one or more of the western Washington ecoregions as identified in the Comprehensive Wildlife Conservation Strategy (http://wdfw.wa.gov/wlm/cwcs/cwcs.htm).

[7] PIF SAD = Partners in Flight Species Assessment Database (www.rmbo.org/pif/jsp/BCRmap.asp): RC = Regional Concern; RS = Regional Stewardship. The area encompassed by this list is BCR 5 which includes more than western Oregon and Washington.

[8] PIF CPLAN = Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004) (http://www.partnersinflight.org/cont_plan/default.htm): SCI = Species of Continental Importance for the Pacific Avifaunal Biome.

[9] WATCH LIST = National Audubon/American Bird Conservancy Continental Watch List 2007; Red = Highest Priority; Yellow = Second Priority (http://web1.audubon.org/science/species/watchlist/) and www.abcbirds.org/abcprograms/science/watchlist/index.html.

Table 7. Population estimates of focal species in the Oregon and Washington portions of BCR 5 (i.e., western Oregon and western Washington) stepped-down from Partners in Flight continental population estimates.[1]

Species	Oregon			Washington			OR-WA	Continental	
	Pop Est[2]	DQ[3]	%[4]	Pop Est	DQ	%	% pop	Pop Estimate	DQ
Pileated Woodpecker	11,000	1	1.2	6,000	1	0.6	1.8	930,000	0
Brown Creeper	200,000	1	3.8	110,000	1	2.0	5.8	5,400,000	0
Pacific-slope Flycatcher	1,000,000	1	11.7	900,000	1	10.3	22.0	8,300,000	0
Varied Thrush	400,000	2	1.4	400,000	2	1.4	2.8	30,000,000	1
Hermit Warbler	1,200,000	1	51.1	140,000	3	5.9	57.0	2,400,000	0
Hammond's Flycatcher	300,000	1	2.4	150,000	2	1.2	3.6	13,000,000	0
Wilson's Warbler	1,000,000	2	2.8	600,000	1	1.8	4.6	40,000,000	2
Winter Wren	400,000	1	1.1	500,000	1	1.3	2.4	40,000,000	2
Black-throated Gray Warbler	300,000	1	11.3	300,000	1	8.6	19.9	2,900,000	0
Olive-sided Flycatcher	30,000	1	2.3	12,000	1	1.0	3.3	1,200,000	1
Northern Flicker	98,000	0	0.6	30,000	1	0.2	0.8	15,000,000	1
Orange-crowned Warbler	440,000	0	0.6	400,000	2	0.5	1.1	80,000,000	1
Rufous Hummingbird	700,000	1	10.6	500,000	1	8.3	18.9	7,000,000	1
American Pipit	0			0				20,000,000	2
Lincoln's Sparrow	9,000	3	0.0	3,000	4	0.0	0.00	40,000,000	1
American Dipper	19,000	2	3.0	19,000	2	3.0	6.0	600,000	2
Black Swift	0			3,000	3	1.9	1.9	150,000	2
Band-tailed Pigeon	140,000	1	3.6	160,000	2	4.1	7.7	4,000,000	2
Blue (Sooty) Grouse	40,000	2	1.5	70,000	2	2.8	4.3	3,000,000	2
Purple Finch [5]	90,000	1	2.9	90,000	1	3.1	6.0	3,000,000	1
Nashville Warbler [5]	400,000	2	1.2	20,000	3	0.1	1.3	34,000,000	0
Hermit Thrush [5]	300,000	1	0.6	120,000	3	0.2	0.8	60,000,000	1
Western Tanager [5]	310,000	0	3.5	170,000	1	2.0	5.5	8,900,000	0
Green-tailed Towhee [5]	4,000	3	0.1	0			0.1	4,100,000	0
Lazuli Bunting [5]	100,000	2	4.2	5,000	3	0.2	4.4	2,300,000	0

[1] http://www.rmbo.org/pif_db/laped/

[2] Pop est = population estimate (heavily rounded)

[3] DQ = Data quality. Lower numbers equal higher quality and quantity of data and higher numbers indicate some combination of low sample size, high variance in the BBS counts, or an otherwise poorly sampled species.

[4] % = percent of the population. Estimates of percent population are likely more accurate than population estimates which are heavily rounded, whereas percent populations are not (P. Blancher pers. comm.).

[5] The population estimates for focal species in the mixed-conifer forests of the Klamath Mountains ecoregion of southwestern Oregon are population estimates for all of western Oregon or western Washington not just southwestern Oregon because the Partners in Flight database does not have population estimates at that scale.

Biological Objectives and Habitat Conservation Strategies

Two types of landbird biological objectives (i.e., habitat and population) are presented at several scales. First, regional habitat objectives are presented for the desired proportions of forest successional stages at large landscape scales, for the amount of forest cover in urban/residential forests in developing landscapes, and for the amount of natural forest regeneration in post-wildfire habitat. These objectives are presented to recognize the biodiversity provided by these habitats across the landscape of coniferous forests of western Oregon and Washington, and to support the diversity of landbird species that occur within these ecological niches. Secondly, habitat objectives are presented for focal species and their associated habitat attributes at landscape and site scales to provide the desired array of forest conditions and structural components to support landbird diversity. Finally, population objectives are presented as the ultimate bird conservation metric to assess focal species status relative to the habitat objectives.

Regional Habitat Objectives

The following habitat objectives are provided to assist bird conservation partners with regional or unique forest land management responsibilities or mandates.

Late-Successional Forest

- **Maintain all existing late-successional (mature and old-growth) forest patches.**
- **Maintain >30% of large landscape units (e.g., Level 3 or 4 ecoregions, multiple watersheds) as late-successional forest with >30% of the late-successional forest as old-growth.**
- **Where existing late-successional forest comprises <30% of the large landscape units, initiate actions to meet that goal by first attempting to increase net size of existing late-successional forest patches; and patches designated as future late-successional forest should have a minimum patch size of 50 ha (125 ac) with minimum edge to interior ratio.**
- **Late-successional forest should have or be managed for the ecologically appropriate range of variability in habitat attributes as described in this document for focal species in old-growth/mature forests.**

Assumptions/Data Sources: Old-growth forest comprised approximately 49% of the total forest area in California, Oregon, and Washington in the 1930s compared to 18% in the early 1990s (Bolsinger and Waddell 1993). The large landscape, regional goal of 30% late-successional forest represents the need for an increased representation of this successional stage that is reasonably achievable. The term late-successional forest as used here is not synonomous with Late Successional Reserves (LSR) in the NWFP unless the current condition in the LSR is actually late-successional forest (i.e., not an earlier successional stage that is being managed to enhance development of late-successional characteristics). Minimum patch size of 125 acres is subjective based on the professional experience of several individuals.

Early and Mid-Successional Forest

- **Outside of late-successional forest and designated late-successional forest (i.e., LSRs in the NWFP), maintain >25% of the remaining area of each large landscape (e.g., Level 3 or 4 ecoregions, multiple watersheds) in each of these three successional stages: young forest (understory reinitiation), pole forest (stem exclusion), and early-successional forest (stand initiation).**
- **Early and mid-successional forest should have or be managed for the ecologically appropriate range of variability in habitat conditions (most readily achieved through natural regeneration – see *Naturally Regenerated Early-Successional Forest*) as described in this document for young forest, pole forest, and early-successional forest.**

Assumptions/Data Sources: Maintaining a diversity of native landbird species over large landscapes is ecologically appropriate from an historical perspective, and a desirable goal for biodiversity and ecological resiliency in coniferous forests of western Oregon and Washington. Landbirds often are associated with successional stages in coniferous forests, so the initial step to achieve this goal would be to provide some relatively equal mix of successional stages. The objectives above are intended to provide a coarse framework for maintaining successional stage diversity across large landscapes with minimum thresholds and flexible targets for each successional stage. The objectives are not intended for levels smaller than ecoregion or large landscapes of multiple watersheds, but could be used as guidelines for smaller scales (e.g., watersheds) where intensive management often precludes representation of late-successional forest. Specific structural habitat components within each of the successional stages also will be necessary to meet landbird biodiversity goals, and these attributes are the focus of species habitat objectives described throughout the remainder of this document.

Naturally Regenerated Early-Successional Forest

Early-successional forest includes all forest in the early post-disturbance stage prior to the dominance of tree canopies. However, there are great differences in the value of early-successional forests to birds depending on the type of disturbance and the post-disturbance management or lack thereof. Intensive management that maximizes removal of timber volume and minimizes retention of biological legacies (e.g., snags, down wood, deciduous trees and shrubs), followed by dense tree planting and control of deciduous vegetation simplifies early-successional habitat and reduces its value to bird species, especially focal or priority species. Intensive management also truncates the period of time as early-successional habitat, further reducing the value of these sites to birds that depend on this successional stage. **To meet bird conservation objectives, it is important to maintain landscapes with representative amounts of well-distributed naturally regenerated early-successional forests with biological legacies maintained through disturbance events.**

"… species-specific habitat objectives are provided to assist bird conservation partners interested in focal species conservation beyond the objectives for the habitat attribute they represent in our ecosystem-based conservation strategy."

Residential/Urban Forest Cover in Developing Landscapes

- **In developing suburban and exurban areas within a coniferous forest landscape, maintain >27% forest cover for each 100 ha (250 ac) developed with at least one area of >60% forest cover, and maintain the forest cover in patches >21 ha (51 ac) with some at least one patch >42 ha (101 ac).**
- **Within the context of forest cover in developing landscapes, maintain/provide the ecologically appropriate range of variability in habitat conditions as described in this document for the appropriate focal species.**

Assumptions/Data Sources: These recommendations are based on research in the Seattle metropolitan area assessing the ability of urban/residential landscapes to support regional bird diversity. The recommendation for percent forest cover is from the work of Blewett and Marzluff (2005) which indicated that 27% per 100 ha was the minimum forest cover needed to maintain the presence of the nine regularly occurring cavity-nesting bird species, provided that their snag requirements were met. However, for some species such as Brown Creeper, Chestnut-backed Chickadee, Hairy Woodpecker, and Pileated Woodpecker, higher densities were associated with forest cover amounts greater than 60%. The recommendation for size of forest patches is from the work of Donnelly and Marzluff (2004) which indicated that species such as Brown Creeper, Golden-crowned Kinglet, and Hutton's Vireo were mostly present in forest patches >21 ha (51 ac) but mostly absent in forest patches smaller than this. For some species such as Hermit Warbler and Varied Thrush, forest patches >42 ha (101 ac) were necessary for their occurrence.

Natural Forest Regeneration in Post-Wildfire Habitat

- **Maintain >50% of post-wildfire habitat as naturally regenerating forest.**
- **Where salvage logging is occurring, maintain post-wildfire growth of deciduous shrub and tree vegetation as described below in the habitat objectives for Klamath Mountains Ecoregion Post-Wildfire focal species Lazuli Bunting.**

Assumptions/Data Sources: Natural forest regeneration after wildfires is an historical ecological process under which landbirds evolved. Fire suppression and aggressive timber salvage policies have reduced the extent of this habitat across the landscape. Where wildfires have occurred, there is significant pressure to conduct salvage logging to extract merchantable lumber. There is a need to maintain some of this naturally occurring habitat to enhance biodiversity, and to function as control sites to promote understanding of bird use of this habitat for developing management prescriptions where salvage logging is occurring. The recommendation for >50% as naturally regenerating forest is based on the professional judgment of several individuals as a compromise between economic and biological goals.

Biological Objectives for Focal Species and Habitat Attributes

In the following sections, biological objectives and habitat conservation strategies are described for each focal species and associated habitat attribute within the forest successional stages presented in Table 5. Preceding these, there is a brief overview of management issues related to the conservation of each habitat attribute. Assumptions and data sources upon which the biological objectives are based are stated, along with suggestions for research or monitoring to address information needs and provide data to refine and update biological objectives. Examples of priority species expected to benefit from management for each focal species is presented in Appendix A, although conservation of priority species is not dependent upon or synonymous with conservation of focal species.

It is important to note that the habitat objectives for each focal species are mostly specific to the habitat attribute that a particular species is representing. However, we also include some habitat objectives for a focal species beyond the habitat attribute they represent if there are other important habitat attributes for that focal species' conservation. For example, we specify riparian buffer widths and patch sizes for several species, canopy cover for Olive-sided Flycatcher and Varied Thrush, and tree size and type for Hermit Warbler. These species-specific habitat objectives are provided to assist bird conservation partners interested in focal species conservation beyond the objectives for the habitat attribute they represent in our ecosystem-based conservation strategy.

Old-Growth/Mature Forest

Amid the mosaic of land ownerships, forest types, habitat conditions, and forest management practices, there is clearly a need to maintain some coniferous forest in western Oregon and Washington as late-successional (i.e., old-growth and mature) (Hayes et al. 1997). Timber extraction on federal forest land has been substantially reduced from previous levels, and federal lands are likely to play the primary role in providing habitat for species associated with late-successional forest (Bunnell et al. 1997).

Several non-listed landbird species are highly associated with late-successional forests. These species may be associated with complexity of the forest (i.e., multiple habitat attributes) or with a single habitat attribute. We considered the following habitat attributes most important for landbirds in late-successional forests: large snags, large trees, deciduous canopy/subcanopy trees, and the structural diversity of mid-story tree layers.

Old-Growth/Mature Forest

Photo by Erik Ackerson

Photo by Alan Wilson

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: LARGE SNAGS
Focal Species: PILEATED WOODPECKER (*Dryocopus pileatus*)

Habitat Issue

Many species of birds use or are dependent upon snags (i.e., dead trees) as both nesting (Mannan et al. 1980, Lundquist and Mariani 1991) and foraging (Mannan et al. 1980, Weikel and Hayes 1999) substrates. In unmanaged late-successional forests there is a regular supply of dying and dead trees due to natural processes. Large diameter snags are more abundant in old-growth than mature forest (Spies and Franklin 1991), and large snags harbor more insects and insect larvae than small diameter snags (Cline 1977). Large snags are generally unavailable under intensive forest management practices such as clearcut logging, repeated harvest entries, and rotation ages <80 years (Mannan et al. 1980, Cline et al. 1980). This is primarily because 1) cost-effective extraction of wood and shorter rotation ages preclude development of snags, particularly large snags, and 2) existing snags in harvest units are typically removed if they are considered operational safety hazards. Where snag management policies are implemented on intensively managed lands, created or retained snags are generally <50 cm (20 in) dbh because large snags (e.g., >65 cm [25 in] dbh) require more than 80 years to develop (Cline et al. 1980) and are not available from the cohort of trees in the harvest unit. Snags originating from the current cohort of trees in intensively managed forests are usually too small to provide adequate nesting sites for many species of cavity-nesting birds (Zarnowitz and Manuwal 1985, Nelson 1988). Thus, recommendations for large snags are unlikely to be achieved in intensively managed forests unless legacy snags and recruitment snags (large live trees) are maintained through rotations.

Habitat Objectives

- **Landscapes: At small landscape scales (e.g., watersheds, townships, sections) provide**
  - **>40% of the area as suitable nesting habitat (forest >60 years old with adequate snags as described below), and >30% of the suitable nesting habitat should be late-successional forest**
- **Sites: Where ecologically appropriate in forests >60 years old provide**
  - **>70% canopy closure and >70% conifer species canopy trees**
  - **≥2 nest snags/ha (0.7/ac) >80 cm (32 in) dbh of decay class 2 (mostly hard)**
  - **≥15 foraging snags/ha (6/ac) (mix of hard and soft snags) in the following size classes:**
    - **25–50 cm (10–20 in) dbh = ≥9/ha (3.6/ac)**
    - **50–75 cm (20–30 in) dbh = ≥4/ha (1.6/ac)**
    - **>75 cm (>30 in) dbh = ≥2/ha (0.7/ac) (may include the nest snag)**
- **Sites: Maintain a 2 ha (5 ac) no-harvest buffer around known nest or roost sites.**

Population Objectives

- Landscapes: The density of breeding pairs should be an average of at least one pair per 600 ha (1,500 ac) within the landscape that is suitable habitat (i.e., forest >60 years old with adequate snags as described above).

Assumptions/Data Sources: Late-successional forest is generally sufficient to provide suitable large snag habitat conditions. Forests <60 years old are generally not

Old-Growth/Mature Forest—*Continued*

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: LARGE SNAGS
Focal Species: PILEATED WOODPECKER (*Dryocopus pileatus*)

sufficient to provide suitable large snags unless significant large tree or snag retention has occurred from previous harvests/disturbance. The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional plus approximately 10% of the young forest [i.e., >60 years old]). The canopy closure objective is based on Hartwig et al. (2006) and Raley and Aubry (2006). Data used for the site-level biological objectives for snag sizes and amounts are based on several studies including Nelson (1988), Mannan et al. (1980), Mellen et al. (1992), Aubry and Raley (2002), Hartwig et al. (2002, 2004, 2006), and Raley and Aubry (2006). The population density objective is based on mean density data and presented as a check to see if created or maintained suitable habitat is supporting populations.

Habitat Conservation Strategies

- In forests managed for wood products, extend rotation ages to >80 years to provide potential snags of sufficient size, and retain these snags and recruit replacement snags (large live trees) at each harvest entry.
- Retain all large live trees with defective or dying conditions such as broken tops, fungal conks, and insect infestations.
- If snags have not been retained (or are insufficient in number), create snags through blasting tops, girdling, inoculation with heart rot, or other effective methods if size of trees meets species requirements.
- Retain known or suitable nesting and roosting snags from all harvest and salvage activities and restrict access for fuelwood cutters.
- Avoid use of pesticides near retained snags (Washington Department of Fish and Wildlife 1995).
- During harvest operations, retain large logs and stumps in various stages of decay for foraging sites.

Habitat Information Needs

- Are there thresholds for the proportion or distribution of varying aged habitat patches within a Pileated Woodpecker's territory?

Photo by Erik Ackerson

Photo by Michael Stubblefield

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: LARGE TREES
Focal Species: BROWN CREEPER (*Certhia americana*)

Habitat Issue

Large trees add vertical structure and complexity to forests. Large trees with deeply fissured bark such as Douglas-fir or scaly bark such as western redcedar increase surface area for bark foraging birds (Mariani and Manuwal 1990, Weikel and Hayes 1999). Late-successional forest is generally sufficient to provide suitable large tree habitat conditions. Forests managed for production of wood products <60 years old are generally not sufficient to provide suitable large tree habitat conditions unless significant large tree retention has occurred from previous harvests or natural disturbances. Large trees are generally unavailable under intensive forest management practices such as clearcut logging, repeated harvest entries, and rotation ages <80 years where cost-effective extraction of wood and shorter rotation ages preclude development of large trees. Where green-tree retention policies are implemented on intensively managed lands, the initial retained trees are generally <50 cm (20 in) dbh because large trees require more than 80 years to develop (Cline et al. 1980). However, retention of those trees through the following rotation may allow the trees to achieve size and height characteristics of late-successional trees.

Habitat Objectives

- **Landscapes: At small landscape scales (e.g., watersheds, townships, sections), provide ≥3 blocks of late-successional forest >30 ha (75 ac) or one block >85 ha (210 ac) per square mile with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in forests >60 years old provide**
  - **canopy closure >70%**
  - **≥15 trees/ha (6/ac) >50 cm (20 in) dbh**
  - **≥3 trees/ha (1.2/ac) >70 cm (24 in) dbh**
  - **most or all of the trees should be Douglas-fir**
- **Sites: Riparian buffer zones within harvest units should be >30 m (100 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional plus approximately 10% of the young forest [i.e., >60 years old]), and presented in patch size thresholds for this area-sensitive species. Patch size of 30 ha (75 ac) is based on an upwardly adjusted patch size minimum (i.e., 20 ha) for winter wren, another species considered a forest interior species, in Douglas-fir dominated forests in northwestern California (Rosenberg and Raphael 1986). The objective for canopy closure is based on Banks et al. (1995; 60%) and Doyon et al. (2000; 80%). The objective for a minimum of 15 trees/ha (/ac) >50 cm (20 in) dbh is a 50% increase over the minimum for suitability (10/ha) (Hansen and Hounihan 1996). The 50cm dbh is a frequently used cutoff point for separating large and small trees. The 70 cm (28 in) dbh is the approximate mean of nest tree dbh from several studies (e.g., Lundquist and Mariani 1991, Mariani 1987, Nelson 1988). Data indicate that Brown Creepers are absent or occur in limited abundance in green-tree retention units with 15% and 40% retention (Mayrhofer 2006), and are not present in young green-tree retention harvest units with <12 trees/ha (5/ac) >30 cm (12 in) dbh, but are present and in proportional abundance as density of large trees is increased (Vega 1993). The objective for riparian buffer width is based on Pearson and Manual (2001).

Habitat Conservation Strategies

- Maintain late-successional forests in the largest tracts possible to reduce amount of edge and fragmentation.
- Small patches of late-successional forest or light or moderately thinned forest dominated by large trees can be suitable for foraging only if extensive areas of late-successional forest are adjacent (Mayrhofer 2006).
- Retain or create snags (essential for nesting) within late-successional forest that are of earlier decay classes with bark remaining rather than older snags without bark.
- In forests managed for production of wood products, extend rotation age to >80 years to allow for development of large trees and snags, and retain these trees and snags and recruit replacements at each harvest entry.

Photo by Erik Ackerson

- In conjunction with extended rotations in forests managed for wood products, and where physically practical (e.g., not on steep slopes), conduct early and frequent thinning to accelerate individual tree growth and faster development of large trees.
- In harvest units of forests managed for wood products, retained trees should be clumped (retention aggregates), and should be primarily Douglas-fir with an emphasis on trees with deep fissures or furrows in the bark to provide more surface area and complexity of micro habitats for foraging (Van Pelt 2007).

Habitat Information Needs

- What are the relationships between the size of late-successional forest patches and Brown Creeper occupancy and population viability?
- At the landscape-level does patch size, configuration, or proportional occurrence in the landscape affect Brown Creeper reproductive success?
- In forests managed for wood products, do riparian buffer zones or logged patches provide Brown Creeper nesting habitat if suitable large trees are retained? If so, are there limiting factors such as buffer width, patch size, or tree density?
- Are Brown Creeper populations in young forest (<80 years old) contributing to species persistence (i.e., are they reproductively viable?).
- Is there a minimum density of Brown Creeper foraging sites (i.e., large trees) per territory? If so, is there a threshold of the spatial extent of foraging sites that cannot be exceeded for acceptable levels of energetic sustainability in winter? Does this vary by elevation or forest type?


Photo by Bob Altman


Photo by Jim Livaudais

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: DECIDUOUS CANOPY/SUBCANOPY TREES
Focal Species: PACIFIC-SLOPE FLYCATCHER (*Empidonax difficilis*)

Habitat Issue

Some landbird species in multi-layered late-successional coniferous forests are associated with deciduous trees for foraging or nesting. Deciduous trees provide ecological diversity and foliage-hatched insects different from that of conifers. Late-successional forest may or may not be sufficient to provide deciduous canopy/subcanopy tree habitat conditions, depending on the site. In coniferous forests without management of competing vegetation, particularly in wet sites, deciduous trees may contribute significantly to the tree canopy. However, intensive management of forests for production of conifer tree species limits habitat for species associated with deciduous trees. Additionally, there is economic incentive to convert hardwoods to softwoods, particularly on lands managed intensively for timber production.

Habitat Objectives

- **Landscapes: Within landscapes >1,000 ha (2,500 ac), maintain**
  - **approximately 90% as late-successional coniferous forest that includes a high percent of unfragmented core areas of densely canopied forest and patches of thinly canopied forest interspersed with patches of mixed coniferous-deciduous forest and deciduous forest (includes riparian habitat) (2-10%) with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in forests >40 years old provide**
  - **>20% deciduous canopy cover, particularly where associated with riparian zone or wet site deciduous trees especially red alder.**
- **Sites: In harvest units with deciduous tree site potential, retain all deciduous canopy trees near the riparian zone (i.e., within one tree length of outer boundary of existing riparian buffer) to expand potential suitable nesting and foraging habitat.**
- **Sites: Riparian buffer zones within harvest units should be >40 m (130 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level objectives are from Nott et al. (2005) and Nott (2009). The objective for >20% deciduous canopy cover was subjectively developed based on collective experience of several individuals. The objective for presence of red alder canopy/subcanopy trees is based on Leu (2000). The objective for riparian buffer width is based on Hagar (1999) to support approximately one-half the abundance in adjacent unlogged sites, and is supported by Nott et al. (2005).

Habitat Conservation Strategies

- In forests managed for wood products with an existing deciduous canopy component, extend rotation age to >80 years to allow for development of canopy and sub-canopy gaps for suitable foraging habitat.
- Conduct conifer tree thinning where there is potential for understory development of deciduous trees, particularly in wet sites. Conduct thinning early in forest development (<20 years-old) to enhance competitive opportunities for deciduous trees, and minimize short-term effect of reduced canopy closure and suitability of habitat.
- Where deciduous trees have been retained from earlier successional stages, ensure release of these trees by thinning of conifers shading them out.

- If deciduous trees have not been retained from earlier successional stages and the site is suitable, conduct thinning in scattered patches (variable-spaced) to open-up the canopy and allow for understory development of deciduous trees adjacent to the closed-canopy conifer dominated forest.
- Conduct repeated thinning as necessary in conjunction with a longer rotation to maintain a deciduous canopy component for a longer period of time.
- When conducting thinning activities, minimize mechanical impact on shrub cover to maintain this desired feature.

Habitat Information Needs

- What is Pacific-slope Flycatcher reproductive success in late-successional forests where red alder is absent or limited?
- What are the habitat type and condition thresholds for Pacific-slope Flycatcher occupancy and population viability in riparian buffer zones?

Photo by Bob Altman

Photo by Steve Dowlan

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: MID-STORY TREE LAYERS
Focal Species: VARIED THRUSH (*Ixoreus naevius*)

Habitat Issue

Tree layering in the mid-story of late-successional coniferous forests provides structural complexity and dense foliage. These layers tend to reduce understory shrub development, but can provide extensive forest floor debris from the organic matter associated with multiple tree layers, particularly if a deciduous tree component exists. Late-successional forest is generally sufficient to provide suitable mid-story tree layer habitat conditions, and the litter layer in old-growth forest is deeper than in mature or younger forests (Spies and Franklin 1991). Even-aged management for timber production limits tree layering by precluding multiple age- or size classes of trees. Forests <60 years old are generally not sufficient to provide suitable mid-story tree layers unless significant variable sized tree retention has occurred from previous disturbances.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watersheds, townships, sections), provide ≥3 blocks of late-successional forest >30 ha (75 ac) or one block >85 ha (210 ac) per square mile with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in forests >60 years old provide**
  - **multiple tree layers with mixed species (deciduous and coniferous) composition**
  - **berry-producing trees and shrubs**
  - **high canopy closure (>70%)**
  - **>30% deciduous cover in the sub-canopy and understory for a dense leaf litter layer**
- **Sites: Riparian buffer zones within harvest units should be >70 m (230 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional plus approximately 10% of the young forest [i.e., >60 years old]), and presented in patch size thresholds for this area-sensitive species (McGarigal and McComb 1995, George and Brand 2002). The minimum patch size of 30 ha (75 ac) is based on an upwardly adjusted patch size minimum (i.e., 20 ha) for winter wren, another likely forest interior species in Douglas-fir dominated forests in northwestern California (Rosenberg and Raphael 1986),

Old-Growth/Mature Forest—*Continued*

Forest Stage: OLD GROWTH/MATURE FOREST
Habitat Attribute: MID-STORY TREE LAYERS
Focal Species: VARIED THRUSH (*Ixoreus naevius*)

and the approximate doubling of minimum patch size for occupancy (16 ha [40 ac]) in redwood forests in northwestern California (Hurt 1996). The site-level habitat objective for multiple tree layers and berry-producing shrubs is based on Carey et al. (1991) and Gilbert and Allwine (1991). The site-level habitat objectives for >70% canopy cover and >30% deciduous cover in the subcanopy and understory was subjectively developed based on collective experience of several individuals. The site-level habitat objective for riparian buffer width is based on Hagar (1999).

Habitat Conservation Strategies

- Maintain late-successional forest patches in the largest tracts possible to reduce the amount of edge and fragmentation.
- In forests managed for wood products, extend rotation age to >80 years to allow for development of a multi-layered canopy and sub-canopy.
- Retain volunteer regeneration of hardwoods.
- Conduct light to moderate thinning from below early in forest development to enhance survival of suppressed and intermediate trees and layered development earlier in mid-successional stages. This should include thinning in variable densities (spacing), variable intensities (amount), variable size classes (layering), and variable species to promote faster growth for some trees and reduced growth for others (McComb et al. 1993).
- During regeneration, plant mixtures of tree species and incorporate small gaps in the planting prescription to enhance compositional and structural diversity in the mid-story (Carey and Curtis 1996).
- As necessary, conduct thinning in conjunction with underplanting of a diversity of species to increase tree layering and species diversity.
- Because the time frame of understory response to commercial thinning is <10 years (Alaback and Herman 1988), repeated thinnings may be necessary to advance understory development into sub-canopy layers through longer periods of commercial rotation.
- Retain and/or plant ecologically appropriate native berry and fruit producing shrubs (huckleberry, elderberry) in the understory preferentially over other deciduous trees and shrubs.

Habitat Information Needs

- Data are needed on all aspects of Varied Thrush nesting ecology.
- Are Varied Thrush populations in younger forests (<80 years) contributing to species persistence (i.e., are they reproductively viable)?
- Are there site-level thresholds of patch size for Varied Thrush successful reproduction to occur?
- Are riparian management zones within harvest units suitable habitat to support successfully reproducing populations of Varied Thrush? How much area is necessary?

Mature/Young Forest

Forests in the mature/young successional stage can be highly diverse in terms of habitat conditions provided for landbirds depending on previous management/disturbances. They also represent a link between early and late successional forests; providing marginal to good habitat for many species highly associated with both these successional stages. Additionally, it is within the young/mature forest stages where tree harvest usually occurs; thus, the presence of mature/young forest on the landscape can be abruptly changed, with concomitant consequences for landbird species.

Many of the landbird species highly associated with mature/young forests are among the most common species in Pacific Northwest forests (e.g., Hermit Warbler, Wilson's Warbler, Winter Wren). The habitat attributes these species are associated with often can occur throughout the range of habitat conditions in these forests. Other species such as Hammond's Flycatcher require more specialized habitat attributes to support populations. We considered the following habitat attributes most important for landbirds in mature/young forests: closed canopy, open mid-story, deciduous understory, and forest floor complexity.

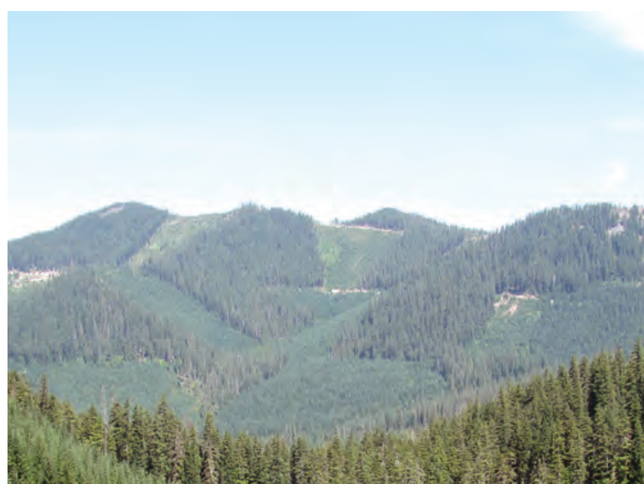

Photo by Bob Altman

Mature/Young Forest

Photo by Bob Altman

Photo by Glen Tepke

Forest Stage: MATURE/YOUNG FOREST
Habitat Attribute: CLOSED CANOPY
Focal Species: HERMIT/TOWNSEND'S WARBLER (*Dendroica occidentalis/ townsendii*)

Habitat Issue

Canopy closure and high canopy foliage volume is generally available throughout development of young forests. However, thinning is being extensively used to move forest patches out of the young closed-canopy stage and accelerate development of conditions found in late-successional forests. Although thinning in young (20–50 year-old) forests can promote development of large crowns and high foliage volume on dominant and codominant trees, extensive thinning can render a site unsuitable for species requiring a closed canopy until the crown achieves canopy closure again.

Habitat Objectives

- **Landscapes: At small landscape-levels (e.g., watersheds, townships, sections), provide >55% of the area as suitable nesting habitat (forest >40 years old with adequate canopy cover as described below), and >25% of the suitable habitat should be young forest.**
- **Sites: Where ecologically appropriate in forests >30 years old provide**
  - **average tree dbh >30 cm (12 in)**
  - **>90% canopy closure**
  - **a dominance of Douglas-fir trees**
- **Sites: Riparian buffer zones within harvest units should be >70 m (230 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional forest plus >25% young forest). The site-level habitat objectives for trees are based on several studies including Morrison (1982), Vega (1993), Hagar et al. (1996), and Pearson (1997). The site-level habitat objective for riparian buffer width is based on Hagar (1999).

Habitat Conservation Strategies

- In forests managed for wood products, extend rotation ages to lengthen the period of time that the forest is available as suitable habitat.
- Conduct light to moderate thinning early in forest development (<30 years-old) to promote development of large crowns to increase habitat suitability later in forest development.

Habitat Information Needs

- Are there differences in Hermit/Townsend's Warbler nesting and pairing success in varying aged forests >20 years old that are based on age or forest structure?
- Are there differences in Hermit/Townsend's Warbler reproductive success and habitat relationships on ridge tops and benches where high densities often occur (S. Pearson, pers. comm.)?

Photo by Bob Altman

Photo by Scott Streit

Forest Stage: MATURE/YOUNG FOREST
Habitat Attribute: OPEN MID-STORY
Focal Species: HAMMOND'S FLYCATCHER (*Empidonax hammondii*)

Habitat Issue

Some forest aerial predators require open areas beneath the forest canopy for adequate foraging space, because a low tree density allows clear flight paths to capture flying prey. Openings and reduced stem density occur naturally in the canopy and sub-canopy of late-successional forests where natural mortality occurs. Tree density in closed-canopy forests is high in the younger stages until natural mortality occurs due to competition. In forests managed for wood products, silvicultural prescriptions that include thinning of trees reduce tree density and can create an open mid-story.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watershed, township, section), provide ≥6 blocks of late-successional and young forest >20 ha (50 ac) or one block >120 ha (300 ac) per square mile with site-level habitat conditions as described below.**
- **Landscapes: Within large landscapes (i.e., >1,000 ha [2,500 ac]) maintain large core areas of unfragmented coniferous forest including**
  - **80–90% of the area in high canopy cover (i.e., >80%) of coniferous forest**
  - **10–20% of the area in early successional habitat**
  - **<1% cover of deciduous forest habitat in drier upland habitats (i.e., with low stream density).**
- **Sites: Where ecologically appropriate in forests >40 years old provide**
  - **forest patches >15 ha (42 ac)**
  - **canopy closure >50%**
  - **a relative stem density of 0.2 to 0.3 to maintain an open mid-story (Relative stem density is the ratio of actual stem density to the maximum density available).**
- **Sites: Riparian buffer zones within harvest units should be >70 m (230 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional plus approximately 10% of the young forest [i.e., >60 years old]), and presented in patch size thresholds for this area-sensitive species. The square mile landscape objective is based on minimum patch size, and the desired condition of at least 30% of subprovinces in late-successional and 25% in young forest conditions. The large landscape habitat objective is from Nott et al. (2005) and Nott (2009), and is recommended to maintain high reproductive success. The patch size of 15 ha (42 ac) is based on data (i.e., minimum of 15 ha) from work conducted in Douglas-fir/tanoak forests of northwestern California (Sakai and Noon 1991), and data (10–15 ha to support breeding) from Nott (2009). The site-level habitat objective for relative stem density is from Hagar et al. (1996). The site-level objective for >50% canopy cover is adjusted based on data (i.e., >40%) from southwestern Oregon (Alexander 1999). The site-level habitat objective for riparian buffer width is based on Hagar (1999) and supported by Nott (2009).

Habitat Conservation Strategies

- Conduct light to moderate single-layered thinning from below to reduce the density of trees and open-up the area below canopy foliage, but do not encourage layered understory development characteristics of variable-spaced and variable-layered thinning.
- Conduct habitat management in areas without an extensive riparian or deciduous tree component.

Habitat Information Needs

- How do various thinning regimes affect Hammonds Flycatcher reproductive success?
- Are there differences in prey (flying insects) abundance and availability for Hammond's Flycatcher in thinned forest versus unmanaged mature forest?
- Are riparian management zones within harvest units suitable habitat to support successfully reproducing populations of Hammond's Flycatcher? What size area is necessary?

Photo by Erik Ackerson

Photo by Barth Schorre

Forest Stage: MATURE/YOUNG FOREST
Habitat Attribute: DECIDUOUS UNDERSTORY
Focal Species: WILSON'S WARBLER (*Wilsonia pusilla*)

Habitat Issue

Understory vegetation is a significant component of the floristic and structural diversity of coniferous forests (Halpern and Spies 1995). Some landbirds are associated with deciduous shrubs and trees in the understory of late-successional forests (Chambers 1996, Hagar 2004). Deciduous vegetation increases structural heterogeneity and vegetative diversity in the understory (Hagar 2007). In unmanaged late-successional forest, natural openings in the canopy due to mortality and tree-fall gaps provide opportunities for development of a deciduous understory. In forests managed for wood products, deciduous vegetation has been traditionally managed against because of competition with commercially planted conifers. A dense close-canopied conifer forest precludes development of an understory which excludes some bird species and reduces overall biodiversity (Hagar 2007).

Habitat Objectives

- **Landscapes: Within landscapes >1,000 ha (2,500 ac) maintain a complex heterogeneity of habitat types and conditions including**
  - **>60% of the area in contiguous deciduous or mixed deciduous-coniferous forest**
  - **>4% of the area in early successional habitat in corridor-type strips or complex shapes (i.e., not uniform in shape) to maximize edge.**
- **Sites: Where ecologically appropriate in forests >40 years old provide**
  - **>40% understory cover of deciduous shrubs and small trees (<10 ft)**
  - **>25% of the shrub cover as western sword fern or bracken fern**
- **Sites: Riparian buffer zones within harvest units should be >30 m (100 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above**

Assumptions/Data Sources: The landscape-level habitat objective is from Nott et al. (2005) and Nott (2009),which emphasizes requirements for reproductive success and post-breeding dispersal habitat. The site-level habitat objective for >40% deciduous shrub-layer cover is based on the occupancy of habitat for foraging Wilson's Warblers (Hagar 2004). The site-level objective for >25% of the shrub cover as western sword fern or bracken fern is a quantitative representation of the subjective observations of the importance of this plant as a foraging and nesting substrate (Chambers 1996, Hagar 2004, Manuwal and Palazotto 2004). The site-level habitat objective for riparian buffer width is based on Hagar (1999).

Continued

Mature/Young Forest—*Continued*

Forest Stage: MATURE/YOUNG FOREST
Habitat Attribute: DECIDUOUS UNDERSTORY
Focal Species: WILSON'S WARBLER (*Wilsonia pusilla*)

Habitat Conservation Strategies

- In forests managed for wood products, extend rotation age to >60 years in conjunction with thinning as described below to lengthen suitability of the habitat for a longer period of time.
- If understory deciduous vegetation has not been maintained through earlier successional stages, conduct moderate to heavy variable-density thinning to create canopy openings and small gaps (<1 ha [2 ac]) to promote understory shrub development.
- Small patch (0.2 ha [0.5 ac]) group selection cuts, rather than green-tree retention or modified clearcuts, may provide habitat since these cuts have the overall least impact on important habitat features in the unharvested understory (Chambers 1996).
- If patches of understory deciduous vegetation have been maintained through earlier successional stages, conduct thinning as necessary to prevent conifers from competing and shading out deciduous understory.
- Because the time frame of understory response to commercial thinning is <10 years (Alaback and Herman 1988), repeated thinnings may be necessary to advance understory development.
- During thinning, activities should be carefully designed and logging systems tailored to site-specific conditions to minimize understory disturbance and site productivity (e.g., road systems and skid trails, type of harvest and equipment), especially tall shrub cover (Hagar 2004).
- In harvest units, retain intact patches of forest with understories rather than dispersed trees or aggregate clumps of trees with treated understories.
- Discontinue use of herbicides for deciduous tree and shrub control for species associated with a deciduous understory.

Habitat Information Needs

- What are the habitat components (e.g., species composition, structure) in a deciduous understory important to Wilson's Warbler abundance and reproductive success?
- Are riparian management zones within harvest units suitable habitat to support successfully reproducing populations of Wilson's Warbler? What size area is necessary?
- Are there site-level thresholds of patch size for Wilson's Warbler occupancy and population viability?

Photo by Bob Altman

Photo by Michael Stubblefield

Forest Stage: MATURE/YOUNG FOREST
Habitat Attribute: FOREST FLOOR COMPLEXITY
Focal Species: WINTER WREN (*Troglodytes troglodytes*)

Habitat Issue

Some landbirds, that forage or nest on the forest floor or low understory of late-successional forests, are associated with the complex vegetative structure and habitat attributes unique to older forests (e.g., large down logs, dense vegetation). The understory and forest floor is more complex in unmanaged forests. In unmanaged forests, the litter layer is deeper in old-growth than in mature or younger forests (Spies and Franklin 1991). In intensively managed forests, forest floor components such as downed logs and litter layer are limited or unavailable.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watershed, township, section), provide an average**

of ≥2 blocks of late-successional forest >30 ha (75 ac) or one block >60 ha (150 ac) per square mile with site-level habitat conditions as described below.

- **Landscapes: Within landscapes >150 ha (375 ac), maintain >10% of the area as mixed forest or deciduous forest (includes riparian areas) with site-level conditions as described below.**
- **Sites: Where ecologically appropriate in forests >60 years old provide**
  - **an average of 10 down logs/ha (4/ac) with a dbh >61 cm (24 in) in decay classes 3–5 (i.e., softer down logs) and >15.2 m (50 ft) long (decay class 3–5)**
  - **shrub cover (woody or ferns) >60% and fern cover >20% within 3 m (9 ft) of the ground**
  - **tree trunk surface area for foraging with a mean dbh >40 cm (16 in)**
- **Sites: Riparian buffer zones within harvest units should be >40 m (130 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The ecoregional objective for an emphasis on riparian areas in the Klamath Mountains is based on Barrows (1986). The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional plus approximately 10% of the young forest [i.e., >60 years old]), and presented in patch size thresholds (minimum 30 ha [75 ac]) for this area-sensitive species based on upwardly adjusted data (i.e., a minimum of 20 ha) from a study in Douglas-fir dominated forests of northwestern California (Rosenberg and Raphael 1986). The landscape-level habitat objective for mixed or deciduous forest is from Nott et al. (2005). Site-level habitat objectives for down logs, tree dbh, and deciduous cover were subjectively developed by several individuals based on knowledge of habitat attributes in late-successional forests. The site-level habitat objective for riparian buffer width is based on Hagar (1999) to support approximately one-half the abundance in adjacent unlogged habitat.

Habitat Conservation Strategies

- Maintain forests in the largest possible tracts to reduce the amount of edge and fragmentation.
- Retain down woody debris during forest management, and supplement where necessary by felling trees to create this attribute.
- Retain root wads where they occur.
- Create and retain slash piles of varying sizes at each harvest entry.
- Conduct light, variable-spaced thinning to enhance understory development rather than uniform thinning because variable-spaced thinning reduces the negative effects of reduced overstory canopy closure by maintaining some areas with high canopy closure.
- Harvest entries should be carefully designed and logging systems tailored to site-specific conditions to minimize understory disturbance and site productivity.
- Within the Klamath Mountains, provide site-level habitat conditions as described above within or adjacent to riparian areas.

Habitat Information Needs

- What are the relationships between Winter Wren reproductive success and patch size/fragmentation?
- What are the mechanisms (e.g., microclimate) by which edge effects and fragmentation influence habitat components (e.g., mossy vegetation) and abundance and reproductive success of Winter Wren?
- Do riparian management zones within harvest units provide enough suitable habitat to support successfully reproducing populations of Winter Wren? What size is necessary?

Young/Pole Forest

Young, pole forests are structurally simple and characterized by an even-aged, single-layered, closed-canopy with little or no understory development. Where understory vegetation exists, it is generally low growing and dominated by one or two shade-tolerant species (e.g., western sword fern). The age of these forests may range from sapling trees with high foliage ratios that have just attained canopy closure, to large pole trees that are densely stocked and have low foliage ratios and a high degree of canopy lift.

Young, pole forests are relatively depauperate in landbird species composition and richness (Hansen et al. 1991, Manuwal and Pearson 1997). Most species abundant in this stage also are relatively abundant in older closed-canopy forests (Hansen et al. 1995). However, one species, Black-throated Gray Warbler can be highly associated with this forest stage if there are deciduous canopy trees present. Conservation actions to maintain this habitat attribute through the stem exclusion/pole forest stage also will benefit species associated with deciduous canopy trees in older forest stages.

Photo by Erik Ackerson


Photo by Erik Ackerson


Photo by Greg Lavaty

Forest Stage: YOUNG/POLE FOREST
Habitat Attribute: DECIDUOUS CANOPY TREES
Focal Species: BLACK-THROATED GRAY WARBLER (*Dendroica nigrens*)

Habitat Issue

Some landbird species in coniferous forests are associated with deciduous trees for foraging or nesting. Deciduous trees provide ecological diversity, fruits and foliage insects different from that of conifers, a higher density of cavities than conifers (Gumtow-Farrior 1991). In coniferous forests without management of competing deciduous vegetation, particularly at wet sites, deciduous trees may contribute significantly to the forest canopy. Intensive management of forests for production of conifer tree species limits habitat for species associated with deciduous trees. Additionally, there is economic incentive to convert hardwoods to softwoods, particularly on lands managed intensively for timber production.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watersheds, townships, sections), provide >30% of the area as young/pole forest with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in forests >30 years old provide**
  - **>20% canopy cover of deciduous trees.**
- **Sites: Riparian buffer zones within harvest units should be >55 m (180 ft) wide to provide suitable habitat, and should meet site-level habitat conditions described above.**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional and the remainder in mid and early-successional). There have been no species-specific studies on Black-throated Gray Warbler in this region, so the site-level habitat objective for >20% deciduous canopy cover was subjectively developed based on collective experience of several individuals. The site-level habitat objective for riparian buffer width is based on the mean from Pearson and Manuwal (2001).

Habitat Conservation Strategies

- Where deciduous trees occur, ensure persistence of these trees by thinning of conifers shading them out.
- If deciduous trees are not present, conduct thinning to open-up the canopy and allow for development of deciduous trees where ecologically appropriate (e.g., wet sites). Thinning should occur in patches and be variable-spaced rather than uniform to minimize negative effects of reduced overstory canopy closure by maintaining some areas with high canopy closure.
- Under long rotations, conduct repeat thinning as necessary to maintain a deciduous canopy component and lengthen the suitability of the habitat for a longer period of time.

Habitat Information Needs

- Are there thresholds of deciduous tree cover for Black-throated Gray Warbler occupancy and population viability?
- Almost all aspects of Black-throated Gray Warbler breeding biology are poorly known (Guzy and Lowther 1997) so additional information on habitat relationships would be valuable.

Sapling/Seedling Forest

Early successional habitat can be highly diverse in terms of structure and species composition. Natural or human-induced early-successional forests are characterized by grasses and forbs for the first 2–3 years, followed by a shrub layer of tall herbaceous vegetation and woody vegetation such as deciduous shrubs and trees and conifer saplings. This condition exists until conifer trees approach crown closure and understory vegetation is reduced due to competition and shading.

Some landbird species reach maximum abundance in the stand initiation stage of early-successional forests. Species highly associated with this forest condition are often dependent upon some habitat attribute(s) that is either naturally occurring or can be provided through management. Management actions initiated at the early-successional stage (e.g., green-tree, snag, and hardwood retention; clumped thinning to create broken canopies) will benefit species associated with these habitat attributes in older forests by increasing heterogeneity and providing structural features that are characteristic of older forests. Structural and compositional attributes that we deemed most important for landbirds in the stand initiation/early-successional stage are residual canopy trees, snags, and deciduous shrub-layer vegetation.

Sapling/Seedling Forest

Photo by Bob Altman

Photo by Daniel Lebbin

Forest Stage: SAPLING/SEEDLING FOREST (EARLY-SUCCESSIONAL)
Habitat Attribute: RESIDUAL CANOPY TREES
Focal Species: OLIVE-SIDED FLYCATCHER (*Contopus cooperi*)

Habitat Issue

Several landbird species are positively associated with the presence of large green-trees within early-successional forest (Vega 1993, Chambers 1996). Traditional even-aged management using clearcut harvesting does not provide habitat for these species or other species associated with late-successional forests that may use early-successional forest if the habitat attribute is available. Retention of large trees within harvest units increases structural heterogeneity within the developing forest, and provides a legacy of structure that may provide habitat (primarily foraging and dispersal) for some species associated with late-successional conditions. Green-trees that are retained in early-successional habitat will become future snags, thus also benefiting snag dependent species in older forest conditions.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watersheds, townships, sections), provide >30% of the area as early-successional forest with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in early-successional forests >20 ha (50 ac) provide**
  - **>3 1-ha (2.5 ac) areas (aggregate clumps) with 10–30 trees/ha (4–12/ac) >12 m (40 ft) high, and within the early successional habitat, not adjacent to the forest edge**
  - **remainder of the harvest unit should average 3–5 trees/ha (1–2/ac) >12 m (40 ft) high, dispersed relatively equally throughout the harvest unit (dispersed trees)**
  - **retained large trees should be >50% hemlocks or true firs to provide preferred nest trees, and have ≥25% foliage volume for nesting substrates.**
  - **retain suppressed or understory plantation trees in the harvest unit (>13 ha [5/ac]) 3–12 m (10–40 ft) high**
- **Sites: In thinned sites, maintain 10–50% canopy cover with some areas 10–20% canopy cover.**
- **Sites: In post-fire habitat, maintain >40% as unsalvaged, and where salvage is occurring, retain all trees and snags >51 cm (21 in) dbh and >50% of those 27–50 cm (12–20 in) dbh.**

Continued

Sapling/Seedling Forest—*Continued*

Forest Stage: SAPLING/SEEDLING FOREST (EARLY-SUCCESSIONAL)
Habitat Attribute: RESIDUAL CANOPY TREES
Focal Species: OLIVE-SIDED FLYCATCHER (*Contopus cooperi*)

Population Objectives

- **The density of breeding pairs should be an average of one pair/24 ha (60 ac) within the landscape that is suitable habitat (i.e., early successional with habitat conditions described above).**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional and the remainder in mid and early-successional). The site-level habitat objectives are based on three years of data from western Oregon (Altman 1999b). The site-level habitat objectives for retained large trees are based on approximately 1/5 of retained trees in a harvest unit being in small clumps and the remainder in dispersed trees. The population density objective is based on mean density data and presented as a check to see if created or maintained suitable habitat is supporting populations.

Habitat Conservation Strategies

- In addition to green-tree retention, seed tree, shelterwood, or group selection cuts may be used to meet the biological objectives.
- In reforestation areas, include at least 10% hemlock or true fir seedlings, and retain these trees through thinnings and harvest.
- Retain residual clumps of older forest in association with retained green-trees to increase edge and reduce the likelihood that retained trees will be lost to windtrow.
- Retain large trees in association with retained large snags where snags can serve as guard and foraging perches.
- Maintain retained large canopy trees through forest development and recruit replacement green-trees at each harvest entry.

Habitat Information Needs

- Are there differences in Olive-sided Flycatcher reproductive success in harvest units with green-tree retention and late-successional habitats with large canopy openings?
- Examine prey availability and selection by Olive-sided Flycatchers relative to nesting success to ascertain whether food resources limit productivity (Altman and Sallabanks 2000).


Photo by Erik Ackerson


Photo by Tom Grey

Forest Stage: SAPLING/SEEDLING FOREST (EARLY-SUCCESSIONAL)
Habitat Attribute: SNAGS
Focal Species: NORTHERN FLICKER (*Colaptes auratus*)

Habitat Issue

The presence of snags in early-succcessional habitats is directly related to use of the site by cavity-nesting birds (Schreiber and deCalesta 1992). Intensive, efficient forest management practices for extraction of wood products (e.g., clearcutting) have reduced the availability of snags within early-successional forest. Snags are typically removed for economic, safety, or logistivc concerns (Neitro et al. 1985). Further, expansion of non-native competitors (e.g., European Starling) into lowland forested clearings has likely adversely impacted some cavity-nesting bird populations in these areas. During the last 20 years, guidance and management strategies for the conservation of cavity-nesting birds have been developed. Implementation of these strategies (e.g., retention and creation of snags) has improved the status of some cavity-nesters in some early-successional forest habitats.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watersheds, townships, sections), provide >30% of the area as early-successional forest with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in early-successional forests provide**
  - **>3 snags/ha (1 snag/ac) ≥61 cm (24 in) dbh and >12 m (40 ft) in height and in decay classes 2–3 (soft with moderate bark remaining)**
  - **>7 snags/ha (3 snags/ac) 40–61 cm (16–24 in) dbh and >12 m (40 ft) in height**
  - **>10 snags/ha (4 snags/ac) 10–30 cm (4–12 in) dbh**

Population Objectives

- **The density of breeding pairs should be an average of one pair/32 ha (80 ac) within the landscape that is suitable habitat (early successional with habitat conditions described above).**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional and the remainder in mid and early-successional). The population density objective is a check to see if created or maintained suitable habitat is supporting populations and is based on a territory size of 16 ha (40 ac) (Brown 1985) and an assumption of 50% occupancy of suitable habitat. Snag size objectives are based on Deal and Setterington (2000) and Brett (1997) and the collective experience of several people.

Habitat Conservation Strategies

- Retain large dying and defective trees (e.g., broken tops, fungal conks, insect infestations) where they occur.
- If snags have not been retained (or insufficient in number), create snags within the existing forest through blasting tops, inoculation with heart rot, or other suitable methods if size of trees meets species requirements.
- Retain known or suitable nesting snags from all harvest and salvage activities and restrict access for fuelwood cutters.
- Clearings and snags created from forest fires should be left to succeed naturally where possible (Washington Department of Fish and Wildlife 1995).
- In harvest units, implement green-tree retention for long-term snag management.

Habitat Information Needs

- Are there factors other than snag availability that limit Northern Flickers in early-successional habitat?
- Are there thresholds of snag densities or configurations (e.g., aggregated versus dispersed) that limit Northern Flicker presence, abundance, or nest success?

Photo by Bob Altman

Photo by To Grey

Forest Stage: SAPLING/SEEDLING FOREST (EARLY-SUCCESSIONAL)
Habitat Attribute: DECIDUOUS SHRUB LAYER
Focal Species: ORANGE-CROWNED WARBLER (*Vermivora celata*)

Habitat Issue

Many landbirds are positively associated with deciduous shrubs and trees in early-successional habitats (Morrison 1981). Deciduous vegetation increases structural heterogeneity and vegetative diversity of early-successional habitats (Morrison and Meslow 1983). In forests managed for wood products, deciduous vegetation has been traditionally managed against because of competition with commercially planted conifers. A dense growth of young conifer trees limits overall biodiversity. Some bird species highly associated with deciduous vegetation in early-successional habitats such as Orange-crowned Warbler, Rufous Hummingbird, and MacGillivray's Warbler have significantly declining populations in western Oregon and

Sapling/Seedling Forest—*Continued*

Forest Stage: SAPLING/SEEDLING FOREST (EARLY-SUCCESSIONAL)
Habitat Attribute: DECIDUOUS SHRUB LAYER
Focal Species: ORANGE-CROWNED WARBLER (*Vermivora celata*)

Washington. The main features of deciduous vegetation in early-successional habitats are cover in the shrub layer (e.g., ferns, salal, salmonberry, Oregon grape, rhododendron), and cover, height, and distribution of deciduous trees such as red alder and big leaf maple.

Habitat Objectives

- **Landscapes: Within small landscapes (e.g., watersheds, townships, sections), provide >30% of the area as early-successional forest with site-level habitat conditions as described below.**
- **Sites: Where ecologically appropriate in early-successional forest provide**
  - **>30% cover of the area in deciduous shrubs and small trees (<15 ft tall).**

Assumptions/Data Sources: The landscape-level habitat objective is calculated from the regional habitat objective for percent of large landscapes in different successional stages (i.e., >30% late-successional and the remainder in mid and early-successional). The site-level habitat objective for >30% deciduous shrub cover was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Allow early-successional habitat to regenerate naturally where there is the potential for a structurally complex and well-developed deciduous component of shrubs and trees.
- Maintain deciduous vegetation in areas where conifer seedlings are not planted or difficult to establish such as along logging roads and landings; on unstable, steep slopes; and in moist depressions, gullies, and stream courses.
- **Where vegetation management is conducted, use selective control of deciduous vegetation (e.g., immediately adjacent to conifer seedlings) by manual thinning or limited herbicide application.**
- **Where vegetation management is conducted, retain small, untreated patchily distributed plots (e.g., 0.1 ha, [Marcot 1984]; 10 X 20 m, Morrison [1982]) of deciduous vegetation throughout the conifer plantation.**
- **Lengthen time in early-successional condition by planting a lower density of conifers in conjunction with limited or no competing vegetation management.**
- **Conduct non-uniform (i.e., patchily) thinning and pruning of conifers in later stages of early-successional and into the pole stage to maintain a deciduous shrub component, particularly on rich, moist sites, to enhance and prolong suitability of the habitat.**
- **Discontinue use of herbicides for deciduous tree and shrub control.**
- **Harvest entries should be carefully designed and logging systems tailored to site-specific conditions to minimize ground disturbance and site productivity.**

Habitat Information Needs

- What are the effects of deciduous vegetation type, patch size, and other factors on reproductive success of Orange-crowned Warblers?
- What are the effects of different types of vegetation management on reproductive success of Orange-crowned Warblers?

Unique Forest Habitats

Several unique habitats or habitat attributes occur within the coniferous forests of western Oregon and Washington. Often, priority landbird species are associated with these habitats because their uniqueness results in a degree of habitat specialization and hence the vulnerability of the species to changes in the habitat or habitat attribute. In this document, we use the phrase *unique forest habitats* to capture a range of desired habitat conditions important for several priority landbird species.

There is extensive variability in the type of unique forest habitats we are emphasizing for landbird conservation. Some are characterized as small and occurring in scattered locations (e.g., mineral springs), are associated with a particular forest condition (e.g., large hollow snags), receive limited direct human impact (e.g., alpine grasslands), or their occurrence and condition is often controlled by natural factors such as climate, water tables, etc. (e.g., waterfalls). Some are widespread and occur in many forest conditions or landscapes (e.g., nectar-producing plants), and others are the result of the juxtaposition of multiple forest habitats (e.g., landscape mosaic forest).

For many of these unique forest habitats or the focal species associated with them, less is known about the species populations or associations with the habitat type or attribute than for our other focal species. Although we provide specific biological objectives for each species depending on our knowledge and understanding of their habitat relationships, these objectives may or may not represent the "essential" conservation attribute like they do for our focal species.

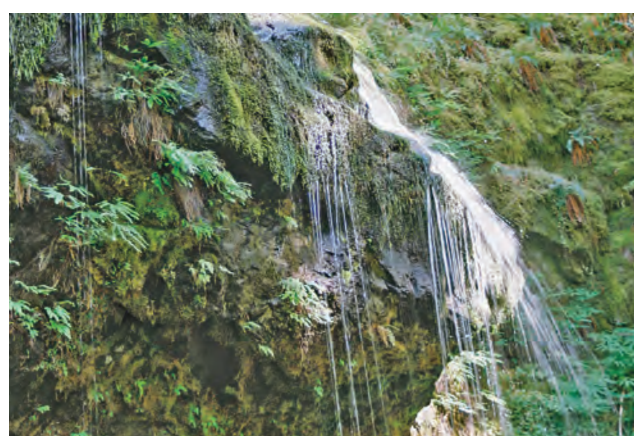

Photo by Erik Ackerson

Unique Forest Habitats

Photo by Erik Ackerson

Photo by Matt Lee

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: NECTAR-PRODUCING PLANTS
Focal Species: RUFOUS HUMMINGBIRD (*Selasphorus rufus*)

Habitat Issue

Cover and productivity of flowering plants are influenced by the characteristics of the forest overstory. Light-enriched areas can produce greater biomass of flowering plants (Bunnell 1990). Many deciduous trees, shrubs, and herbaceous plants produce flowers and nectar. In forests managed for wood products, especially in early-successional habitats, deciduous vegetation is often managed against because of competition with commercially planted conifers or inadvertently degraded/destroyed as a result of management activities. Rufous Hummingbirds are highly associated with nectar produced by flowering plants, and their territory size is dependent on the presence and abundance of nectar-producing flowers (Horvath 1963).

Habitat Objectives

- **Sites: Where ecologically appropriate in any forest stage or condition provide >20% of the shrub/herbaceous understory cover as nectar-producing plants (e.g., salmonberry, rhododendron, currant).**

Assumptions/Data Sources: The habitat objective for >20% cover as nectar-producing plants is subjective based on the collective experiences of several individuals.

Habitat Conservation Strategies

- Allow unmanaged early-successional habitat to regenerate naturally, particularly where there is the potential for a well-developed deciduous component of flower (nectar) producing plants.
- Retain and/or plant flower (nectar) producing shrubs and trees such as salmonberry, currant, and snowbrush, and herbaceous plants such as penstemenon, columbine, and paintbrush.
- Maintain deciduous vegetation in areas where conifer seedlings are not planted or difficult to establish such as along logging roads and landings: on unstable, steep slopes; and in moist depressions, gullies, and stream courses.
- Where vegetation management is conducted, use selective control of deciduous vegetation (e.g., immediately adjacent to conifer seedlings) by manual thinning or limited herbicide application.
- Where vegetation management is being conducted, retain small, untreated patchily distributed plots (e.g., 0.1 ha, Marcot [1984]; 10 x 20 m, Morrison [1982]) of deciduous vegetation throughout the conifer plantation.
- Discontinue use of herbicides for deciduous tree and shrub control for species associated with early-successional deciduous shrub-layer vegetation.
- Lengthen time in early-successional condition by planting a lower density of conifers in conjunction with limited or no competing vegetation management.
- Harvest entries should be carefully designed and logging systems tailored to site-specific conditions to minimize ground disturbance and site productivity.
- Beneath transmission powerlines where vegetation is maintained at shrub/sapling heights, selectively retain flower and nectar producing shrubs and trees.

Habitat Information Needs

- Are there degrees of Rufous Hummingbird use/selection of particular nectar-producing plant species?
- Are there thresholds of patch size, distribution, or number of nectar-producing plants for Rufous Hummingbird occurrence or population viability?

Photo by Erik Ackerson

Photo by Gary Kramer - U.S. Fish & Wildlife

Photo by Bob Altman

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: MINERAL SPRINGS/SEEPS
Focal Species: BAND-TAILED PIGEON (*Columba fasciata*)

Habitat Issue

Mineral springs/seeps are a small and rare feature of the coniferous forest landscapes of western Oregon and Washington. However, they provide an essential habitat resource (i.e., calcium) for nesting Band-tailed Pigeons, and their distribution and abundance may affect reproductive performance by constraining the distribution of suitable nesting sites (Leonard 1998).

Habitat Objectives

- **Sites: Maintain a 2 ha (5 ac) no harvest buffer around all mineral springs/seeps.**
- **Sites: Maintain an herbicide no spray zone around patches >0.2 ha (0.5 ac) with >75% cover of primary foraging plants such as cascara, elderberry, wild cherry, madrone, or huckleberry.**
- **Sites: Maintain 10–50% shrub cover including some fruit, berry, or mast producing shrubs.**

Assumptions/Data Sources: The 2 ha (5 ac) no-harvest buffer area around mineral springs is a subjective judgment to provide protection to these essential sites for Band-tailed Pigeons. The objective for shrub cover is subjective based on the collective experiences of several individuals.

Habitat Conservation Strategies

- Maintain forest cover around mineral springs/seeps.
- Avoid forest management around mineral sites during the breeding season (late April to mid October).
- Replant and maintain berry, fruit, and mast producing shrubs and trees, especially near mineral sources.
- Discourage use of herbicides that eliminate berry, fruit, and mast producing shrubs and trees by using integrated pest management strategies that target specific plants.

Habitat Information Needs

- Can created mineral springs (e.g., salt blocks buried in seeps) be located and function to increase distribution of Band-tailed Pigeon nesting territories?
- Is there a threshold in the abundance and/or type of fruit, berry, and mast producing shrubs and trees within a successful Band-tailed Pigeon nesting territory?
- Are there vegetation features (or patch configurations/sizes) associated with mineral springs/seeps that make these sites more productive for Band-tailed Pigeons?

Photo courtesy of Olympic National Park

Photo by Ted Ardley

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: MONTANE WET MEADOWS
Focal Species: LINCOLN'S SPARROW (*Melospiza lincolnii*)

Habitat Issue

Montane wet meadows are varying-sized, patchily distributed, unique components of the coniferous forests of western Oregon and Washington. Lincoln's Sparrows are obligate to montane wet meadows for nesting habitat. Grazing can reduce the suitability of the habitat by altering the vegetative composition and abundance. Tree harvesting adjacent to wet meadows can alter the hydrological component of the meadows and reduce the quality of the habitat due to erosion, especially where there are steep slopes.

Habitat Objectives

- **Sites: Maintain a 0.1 km (0.17 mi) no–harvest buffer zone around montane wet meadows.**

Assumptions/Data Sources: The habitat objective for a 0.4 km (0.25 mi) no-harvest buffer zone around montane wet meadows is a subjective judgment to provide protection to these discreet and limited habitats.

Habitat Conservation Strategies

- Avoid timber management activities (e.g., road construction) in montane wet meadows.
- Restrict domestic animal grazing from montane wet meadows.

Habitat Information Needs

- What are the appropriate buffer widths around montane wet meadows necessary to maintain suitable hydrological conditions and an abundant food source for Lincoln's Sparrow?

Photo by Bob Altman

Photo by Gary Smyle

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: ALPINE GRASSLANDS
Focal Species: AMERICAN PIPIT (*Anthus rubescens*)

Continued

Unique Forest Habitats—*Continued*

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: ALPINE GRASSLANDS
Focal Species: AMERICAN PIPIT (*Anthus rubescens*)

Habitat Issue

Alpine grasslands occur above treeline on the highest mountain ranges. American Pipits are obligate to alpine grassland habitats for nesting and reproduction. Alpine grassland habitats are one of the most likely habitats to be reduced in size by the effects of climate change. Grazing can reduce the suitability of these fragile habitats by altering the vegetative composition and abundance, and exacerbate the anticipated losses from climate change.

Habitat Objectives

Sites: Restrict domestic animal grazing from alpine grasslands <10 ha (25 ac), and limit the timing and/or areas of domestic animal grazing on all alpine grasslands >10 ha (25 ac). Not a habitat objective—a strategy.

Assumptions/Data Sources: The habitat objective for restricted or limited grazing in alpine grasslands is a subjective judgment to protect these fragile habitats.

Habitat Conservation Strategies

- Conduct management (i.e., tree and shrub removal) to maintain the herbaceous dominance of grasslands where woody encroachment is occurring.

Habitat Information Needs

- What are the threshold levels of grazing that result in compromised density and/or reproductive success of American Pipits in alpine grasslands?
- Is management to thwart encroachment of woody vegetation sufficient to maintain populations of American Pipit or are there additional climate change issues related to herbaceous vegetation (e.g., changes in species composition) that are also affecting American Pipit populations?

Photo by Erik Akerson

Photo by Glan Tepke

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: WATERFALLS
Focal Species: BLACK SWIFT (*Cypseloides niger*)

Habitat Issue

Waterfalls are unique and limited features of the coniferous forested landscapes of western Oregon and Washington. Black Swifts are obligate to waterfalls for nesting and roosting. Waterfall presence and quality is dependent on stream flows which can be affected by forest harvest activities within the watershed.

Habitat Objectives

- **Sites: Maintain a 0.1 km (0.17 mi) no-harvest buffer zone around known nesting waterfalls.**

Population Objectives

- **Maintain breeding populations at 100% of known and newly located sites.**

Assumptions/Data Sources: The habitat objective for a 0.1 km (0.17 mi) no-harvest buffer zone around nesting waterfalls is a subjective judgment to provide protection to these discreet and limited nesting sites. The population objective for maintaining 100% of the populations is based on the small population of this species, and its obligate relationship to waterfalls.

Habitat Conservation Strategies

- Avoid management activities that reduce stream flows to waterfalls.

Habitat Information Needs

- Complete inventory of waterfalls for nesting Black Swifts in western Oregon.

Photo by Erik Ackerson

Photo by Glen Tepke

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: LARGE HOLLOW SNAGS
Focal Species: VAUX'S SWIFT (*Chaetura vauxi*)

Habitat Issue

Large snags with hollow trunks provide unique and essential habitat for several wildlife species. In late-successional unmanaged forests, large hollow snags can be regularly occurring due to natural processes. Vaux's Swifts require these snags for nesting and roosting in late-successional conifer forests (Bull and Collins 1993). Suitable large hollow snags for Vaux's Swift are rare in forests managed for wood products, but they have been reported nesting and roosting in logged forest in northeastern Oregon (Bull and Hohmann 1992) where some large snags are retained. If nesting habitat can be provided in forests managed for wood products, it will likely require long rotations with snag and/or green-tree retention (recruitment snags) at all harvest entries and through multiple rotations. Proximity to aquatic/riparian habitats for increased prey base may be important for Vaux's Swift in drier sites (e.g., mixed-conifer forests of the Klamath Mountains ecoregion).

Habitat Objectives

- **Landscapes: Provide an ≥5 potential nest/roost structures (as described below) per square mile within landscape management units (e.g., watersheds, townships, sections) at any point in time, under the following conditions:**
  - **≥30% with broken tops (created or natural)**
  - **up to 20% can be snags**
  - **≤70% can be live trees with obvious signs of defects (broken tops, large cavity excavations)**
- **Sites: Maintain a 2 ha (5 ac) no harvest buffer around all known nest or roost sites.**
- **Sites: Where ecologically appropriate, initiate actions to maintain or provide the following conditions:**
  - **hollow snags in different stages of decay that are**
  - **>68 cm (27 in) dbh and >25 m (82 ft) tall**
  - **aerial accessible either above the canopy or in canopy gaps**
  - **in forest patches with ≥60% canopy closure**

Assumptions/Data Sources: Most data are from forests in northeastern Oregon, and from a limited sample size of nests. Objectives for canopy closure, snag size and height are based on data from Bull and Collins (1993). Objectives for nest/roost conditions reflect a range of potential nest types to maintain the species throughout an area.

Habitat Conservation Strategies

- Extend rotation ages to >100 years to provide snags of sufficient size, and retain these snags and recruit replacement snags (large live trees) at each harvest entry.
- In harvest units and riparian buffer zones, retain the largest live trees, particularly dying or defective trees (e.g., broken tops, fungal conks, insect infestations), through rotations as recruitment snags for potential nest sites.
- Retain known or suitable nesting and roosting snags, particularly hollow snags, from all harvest and salvage activities and restrict access for fuelwood cutters.
- If snags have not been retained (or insufficient in number), create snags through blasting tops, inoculation with heart rot, or other effective methods if size of trees meets species requirements.
- Where possible, introduce fire into forests with large snags to enhance processes to create hollow snags.
- Avoid use of pesticides near retained snags (Washington Department of Fish and Wildlife 1995).

Continued

Unique Forest Habitats—*Continued*

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: LARGE HOLLOW SNAGS
Focal Species: VAUX'S SWIFT (*Chaetura vauxi*)

Habitat Information Needs

- Data are needed on all aspects of Vaux's Swifts nesting ecology and habitat use in coniferous forests. For example, are there limiting factors such as microclimate, proximity to water or forest openings?
- In forests manage for wood products, will riparian buffer zones or logged forest provide Vaux's Swift nesting habitat if suitable large hollow snags are retained? If so, are there limiting factors such as buffer width, patch size, snag distribution, density, or configuration?
- How can processes that create hollow snags (e.g., heart rot, fire) be incorporated and maintained through forest management?
- Will Vaux's swifts recolonize areas where suitable snags are created? Are there variables to consider such as proximity to riparian habitats, proximity to other nesting areas?

Photo by Bob Altman

Photo by Glen Tepke

Forest Stage: UNIQUE FOREST HABITAT
Habitat Attribute: LANDSCAPE MOSAIC FOREST
Focal Species: BLUE (SOOTY) GROUSE (*Dendragapus obscurus*)

Habitat Issue

Some wildlife species are associated with the juxtaposition of several habitat types or successional stages to meet their habitat requirements. These "landscape" species have threshold requirements for the presence and amount of habitat types or conditions.

Habitat Objectives

- **Sites: Maintain an interspersion of tree cover (20–50%), shrub cover (10–40%), and herbaceous cover (30–60%) within a 0.8 km (0.5 mi) radius.**

Assumptions/Data Sources: The site-level habitat objective for interspersion of tree, shrub, and herbaceous cover is based mostly on Schroeder (1984) with subjective modifications for the Pacific Northwest.

Habitat Conservation Strategies

- In managed landscapes, ensure diversity of habitat types and conditions.

Habitat Information Needs

- Is there a particular range of patch configurations etc. that favor occupancy and reproduction of Sooty Grouse?

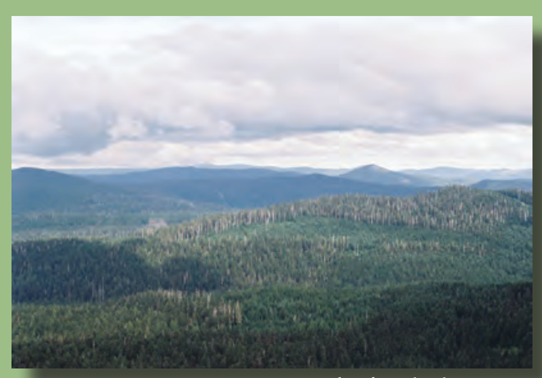

Photo by Erik Ackerson

Klamath Mountains Mixed Conifer and Mixed Hardwood-Conifer Forests

The structurally and floristically complex mixed forests of the Klamath Mountains ecoregion of southwestern Oregon provide a diversity of habitat conditions unique to western Oregon and Washington due not only to floristic diversity but also to substantial variability in elevation and aspect.

Photo by Bob Altman

Kalamath Mountains Mixed Conifer and Mixed Hardwood-Conifer Forests

Photo by Bob Altman

Photo by Bill Hubick

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: PINE-OAK CANOPY/SUBCANOPY TREES
Focal Species: PURPLE FINCH (*Carpodacus purpureus*)

Habitat Issue

The presence of ponderosa pine and several species of oaks in the mixed forest of the Klamath Mountains ecoregion of southwestern Oregon provide unique habitat opportunities for several bird species with habitat affinities for those trees. The economic incentives for harvest of large ponderosa pines and the economic disincentives for the presence and competition of large oaks results in potential loss of the habitat value these trees provide under some forest management practices.

Habitat Objectives

- **Sites: Maintain >60% canopy/subcanopy closure, especially where pine and oak are part of the canopy.**
- **Sites: Where ecologically appropriate (e.g., drier sites), maintain >25% canopy cover of pine and oak trees.**

Assumptions/Data Sources: The significant relationship of Purple Finch with pine and oak canopy trees is based on data from southwestern Oregon (Alexander 1999). The site-level habitat objective for >60% cover in the canopy and subcanopy, and >25% canopy cover of pine and oak trees was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Retain all mature pine-oak canopy trees.
- Conduct thinning or other forest management to select for growth of mature pine and oak trees in ecologically appropriate sites.
- Where managed regeneration is occurring, plant pine and oak trees in ecologically appropriate sites (e.g., drier sites).

Habitat Information Needs

- What are the threshold and most suitable levels of canopy cover and cover of pines and oaks for Purple Finch occupancy and population viability?
- Are there patch size thresholds for Purple Finch occupancy and population viability?

Kalamath Mountains Mixed Conifer and Mixed Hardwood-Conifer Forest — *Continued*

Photo by Bob Altman

Photo by Michael Stubblefield

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: DENSE SHRUB UNDERSTORY
Focal Species: NASHVILLE WARBLER (*Vermivora ruficapilla*)

Habitat Issue

Many bird species are highly associated with understory shrub-layer vegetation in the mixed forests of the Klamath Mountains ecoregion. The degree of development of a shrub understory is dependent on site conditions, with lower elevation and wetter sites most suitable, especially north facing slopes. Forest management activities such as harvest and thinning have immediate although usually short-term (i.e., <5 years) negative impacts on shrub-layer cover. In intensively managed forests, competing vegetation management (i.e., removal and management against deciduous vegetation) results in short-term and long-term negative effects on shrub-layer cover. Furthermore, a recent emphasis on fuels reduction as part of fire management is resulting in significant local losses of shrub cover with unknown cumulative impacts across the region.

Habitat Objectives

- **Sites: Where ecologically appropriate (e.g., wetter sites), maintain or provide >40% understory shrub layer cover.**

Assumptions/Rationale: The site-level habitat objective for 40% understory cover in the shrub layer was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Promote understory growth through natural disturbance or management that breaks up the forest canopy yet still maintains the dominance of a mid- or late-successional forest.
- Discontinue use of herbicides for deciduous tree and shrub control.

Habitat Information Needs

- What are the threshold and most suitable amounts of shrub cover for Nashville Warbler occupancy and population viability?
- What are the degrees of negative impacts of fuels reduction activities on Nashville Warbler habitat and populations?
- What are the range of spatial patterns of patches that promote occupancy and population viability of Nashville Warblers while effectively reducing fire risk?

Photo by Bob Altman

Photo by Bill Hubick

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: SHRUB-HERBACEOUS INTERSPERSION UNDERSTORY
Focal Species: HERMIT THRUSH (*Catharus guttatus*)

Habitat Issue

Some bird species in the mixed forests of the Klamath Mountains ecoregion require a shrub layer for nesting and open herbaceous ground for foraging. The relationship between shrub and herbaceous cover is dependent on site conditions, especially moisture levels affected by variables such as elevation, aspect, proximity to streams, etc. Furthermore, a recent emphasis on fuels reduction as part of fire management is resulting in significant local losses of shrub cover with unknown cumulative impacts across the region.

Habitat Objectives

- **Landscapes: Within 1,000 ha (2,500 ac) blocks, provide patch sizes according to the following forest cover amounts for high suitability habitat:**
  - **>90% forest cover = >8 ha (20 ac) patch size**
  - **>80% forest cover = >26 ha (64 ac) patch size**
  - **>70% forest cover = >66 ha (163 ac) patch size**
  - **>60% forest cover = >156 ha (385 ac) patch size**
  - **>50% forest cover = >353 ha (873 ac) patch size**
- **Sites: Where ecologically appropriate, maintain an understory ratio of shrub-herbaceous (includes bare ground) cover within a range of 30–70% for each parameter.**

Assumptions/Data Sources: The landscape-level objective for the relationship between patch size and forest cover is based on summarized data from throughout Western North America indicating the sensitivity of Hermit Thrush to forest fragmentation (Rosenberg et al. 2003). The site-level habitat objective for 30–70% understory cover of either shrubs or herbaceous cover was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Remove or explicitly control the timing and intensity of grazing to develop and promote the long-term persistence and balance of shrub and herbaceous communities.
- Promote understory growth through natural disturbance or management that breaks up the forest canopy yet still maintains the dominance of a mid- or late-successional forest.
- Where ecologically appropriate in drier mixed conifer forests, maintain large forest tracts (i.e., minimize fragmentation) for highly suitable habitat.

Habitat Information Needs

- What are the threshold and most suitable ratios of shrub and herbaceous cover for Hermit Thrush occupancy and population viability?
- Are Hermit Thrush sensitivities to forest fragmentation in Western North America (Rosenberg et al. 2003) applicable to the mixed conifer/mixed conifer-hardwood forests of the Klamath Mountains?
- What are the range of spatial patterns of patches that promote occupancy and population viability of Hermit Thrush while effectively reducing fire risk?

Kalamath Mountains Mixed Conifer and Mixed Hardwood-Conifer Forest — *Continued*

Photo by Bob Altman

Photo by Matt Lee

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: FOREST CANOPY EDGES
Focal Species: WESTERN TANAGER (*Piranga ludoviciana*)

Habitat Issue

Many forest birds find suitable habitat at the juxtaposition of the canopy and forest openings where increased sunlight supports greater foliage and insect density. Forest canopy edge habitats occur naturally in the complex mixed forests of the Klamath Mountains ecoregion due to the floristic diversity and variable growth site potential due to moisture, elevation, aspect, etc. Intensive forest management can reduce the understory foliage density and diversity to support insect populations and/or reduce the forest edge canopy cover below levels needed for forest birds such as Western Tanager.

Habitat Objectives

- **Sites: Where ecologically appropriate, maintain a dispersed or patchy forest canopy with cover between 40–70%.**

Assumptions/Data Sources: The site-level habitat objective for 40–70% dispersed or patchy canopy cover was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Promote forest edges through natural disturbance or management that breaks up the forest canopy yet still maintains the dominance of a mid- or late-successional forest.
- Conduct variable density thinning with some small openings to create more edge habitat.

Habitat Information Needs

- What are the habitat suitability relationships between forest cover and edge habitat for Western Tanager occupancy and population viability?

Photo by Pepper Trail

Photo by James Leupold - U.S. Fish & Wildlife

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: MONTANE BRUSHFIELDS
Focal Species: FOX SPARROW (*Passerella iliaca*)

Habitat Issues

Montane brushfields occur naturally at higher elevations where soils and other conditions (e.g., south facing slopes, harsher climate) are more suitable for lower growing shrubby vegetation than large trees and dense forests.

Habitat Objectives

- **Sites: Where ecologically appropriate, maintain shrub cover >60% within a forest with canopy cover <30% cover.**

Assumptions/Data Sources: The site-level habitat objective for >60% shrub cover and <30% canopy cover was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Discontinue use of herbicides for deciduous tree and shrub control for species associated with deciduous shrub and small tree cover.
- Minimize or discontinue grazing in naturally occurring montane brushfields to maintain shrub cover levels and the herbaceous understory and interspersion that protects the soils from erosion, especially on steeper slopes.

Habitat Information Needs

- What are the threshold and most suitable amounts of shrub cover for Fox Sparrow occupancy and population viability?

Kalamath Mountains Mixed Conifer and Mixed Hardwood-Conifer Forest — *Continued*

Photo by Jaime Stephens

Photo by Tom Grey

Forest Type: KLAMATH MOUNTAINS MIXED CONIFER and MIXED HARDWOOD-CONIFER FORESTS
Habitat Attribute: POST-WILDFIRE
Focal Species: LAZULI BUNTING (*Passerina amoena*)

Habitat Issue

Some bird species respond positively to the conditions created by wildfires. Lazuli Buntings demonstrate a strong positive response to early-successional conditions following fires throughout their range (Hutto 1995, Leidolf et al. 2007) including the Klamath Mountains ecoregion (Seavy 2006, Fontaine 2007). Salvage logging to harvest the standing dead trees is a management option in post-wildfire habitat. Salvage logging not only removes standing dead tree habitat for birds, but also can negatively impact the presence and/or quality of shrub habitat through ground-disturbing activities. Furthermore, post-salvage planting and management for conifer trees often selects against deciduous trees and shrubs through activities of competing vegetation management.

Habitat Objectives

- **Sites: Maintain post-wildfire vegetation, especially deciduous shrub/tree vegetation, where opportunities exist or can be managed for with <20% live tree cover and a shrub-herbaceous (includes bare ground) cover ratio that is within a range of 30-70% for each parameter.**

Assumptions/Data Sources: The site-level habitat objective for amounts of tree, shrub, and herbaceous cover was subjectively developed based on collective experience of several individuals.

Habitat Conservation Strategies

- Discontinue use of herbicides for deciduous tree and shrub control for species associated with deciduous vegetation in post-fire habitat.
- Restore fire as a management tool where ecologically appropriate.
- Maintain areas of unaltered post-fire habitat where regeneration can occur naturally.
- Retain and encourage the development of shrubs within post-fire habitat
- Minimize the impact to shrubs during management activities in post-fire habitat

Habitat Information Needs

- What are the threshold and most suitable amounts and ratios of tree, shrub, and herbaceous cover for Lazuli Bunting occupancy and population viability?
- Under what conditions do nest parasitism or nest predation negatively influence breeding success of Lazuli Bunting populations in open conditions following fires?

Implementation

As stated earlier, our goal for landbird conservation is to promote long-term persistence of healthy populations of native landbirds. To facilitate accomplishing this goal, the quantitative biological objectives we have presented will need to be:

- integrated across focal species and habitat types and conditions
- implemented at several geographic and ecological scales
- coordinated among various landowners and land management agencies
- monitored and adjusted as new data warrant

Implementation also will likely require the need for areas which function as reserves (primarily federal lands), and as described throughout this document, a blend of conventional forestry with modifications such as longer rotations, structural heterogeneity, and efforts to create old-growth attributes in managed forest (Bunnell et al. 1997). Thus implementation to achieve our landbird conservation objectives will require careful consideration of numerous potential options to maximize conservation efforts, and integrate the diverse values and goals of landowners with that of bird conservation. Our biological objectives are intended to be the foundation for developing these comprehensive, integrated strategies. An overview of the process and example case studies of the integration of multi-species objectives in land management planning and implementation is presented in Bettinger et al. (2001).

It is beyond the scope of this document to attempt to describe all the potential considerations when developing an implementation strategy for landbird conservation. Some of these have been described in other sources (e.g., Altman and Hagar 2007). Herein, we describe some things to consider relative to the habitats and focal species emphasized in the document.

"…implementation to achieve our landbird conservation objectives will require careful consideration of numerous potential options to maximize conservation efforts, and integrate the diverse values and goals of landowners with that of bird conservation. Our biological objectives are intended to be the foundation for developing these comprehensive, integrated strategies."

Protected Areas

The importance of protected areas as a part of natural resource conservation and ecosystem management has been well documented (Noss 1996, Dellasalla et al. 1996). Within our geographic scope, there are existing and proposed protected areas to address the conservation needs of wildlife species in coniferous forests of the Pacific Northwest, especially late-successional forests. Within this document, it is not our intent to expand on this topic, but to recognize the value of these areas and support their role in conservation through our biological objectives for late-successional forest.

"At small scales, management decisions should be based on how a parcel of land can contribute to bird conservation by emphasizing the most ecologically appropriate habitat attributes and focal species based on site-specific factors unique to that area."

Scale and Landscape Considerations

Biological objectives at the site-scale for one focal species or habitat attribute can be in direct conflict with those for another. Indeed, actions designed to manage for one focal species are often detrimental to other focal species. For example, at the site scale, the objective to provide deciduous canopy trees for Pacific-slope Flycatcher in late-successional forest is counter to the objective to maintain high canopy cover of coniferous trees for Hermit Warbler. Likewise the open subcanopy needs of Hammond's Flycatcher are in direct conflict with the multilayered understory and subcanopy needed by Varied Thrush. However, management actions should be employed in an integrated and complementary design across the landscape to accommodate these conflicting objectives at the site-scale. This will require cooperative decisions by appropriate land managers at the landscape scale on the proportion and spatial distribution of the area desired in particular successional stages or containing particular habitat attributes.

It also is impractical and may be inappropriate to attempt conservation for the entire landbird community or all our focal species on any one property. At small scales, management decisions should be based on how a parcel of land can contribute to bird conservation by emphasizing the most ecologically appropriate habitat attributes and focal species based on site-specific factors unique to that area. For example, areas with relatively poor site potential for growth and development of characteristics associated with older forest conditions (e.g., drier sites) could be designated as management areas for early and mid-successional focal species. Areas with relatively good site potential for growth and development of characteristics associated with older forest conditions could be designated as management areas for focal species associated with these conditions.

Conversely, at smaller scales, multiple biological objectives for focal species can be achieved simultaneously through a combination of management actions. For example, combining variable-spaced thinning with retention of old-growth clumps from the pre-harvest stand will further diversify forest structure through stand development and potentially reduce short-term negative effects of thinning on bird species associated with dense forest canopies and old-growth attributes (e.g., Pacific-slope Flycatcher and Hermit Warbler). These actions also will increase the likelihood that younger forests will be used by species associated with older forests and larger trees such as Brown Creeper (Dellasala et al. 1996).

It also will be important to consider where habitat conservation networks are necessary to conserve landbird populations. This may include a network of upslope and riparian corridors to connect tracts of similar habitat. Although the connectivity of habitats that function as corridors may not be essential for mobile animals like birds (With 1999), the connectivity may be particularly important for area-sensitive species such as Winter Wren and Varied Thrush when it results in an expansion of the area of suitable habitat.

Regional Prioritization of Ecoregions, Forest Types, and Forest Conditions

This document encourages habitat management at all scales. However, for those making decisions on allocation of resources at regional scales, we suggest the highest priorities for conservation of focal species and their associated habitat attributes include three ecoregions, two forest types, and one successional stage:

Regional Scale: High Priority Ecoregions

- Klamath Mountains
- Oregon Coast Range
- Olympic Peninsula

Regional Scale: High Priority Forest Types

- Western Hemlock/Western Red-cedar forest
- Mixed conifer and hardwood-conifer forest of the Klamath Mountains ecoregion

Regional Scale: High Priority Forest Conditions

- Late-successional Forest

It is noteworthy that the three high priority physiographic provinces include all the coastal forest ranges in western Oregon and Washington. These areas have been heavily impacted and have disproportionately high numbers of declining species. Among the high priority forest types, Western hemlock/Western red-cedar provides high quality habitat for nearly every focal species, and also is the most impacted forest type from habitat loss and alteration. The mixed conifer and hardwood-conifer forests of Klamath

"…it is widely recognized and we fully support the prioritization of late-successional forest because of the reduction of this successional stage throughout coniferous forests of western Oregon and Washington."

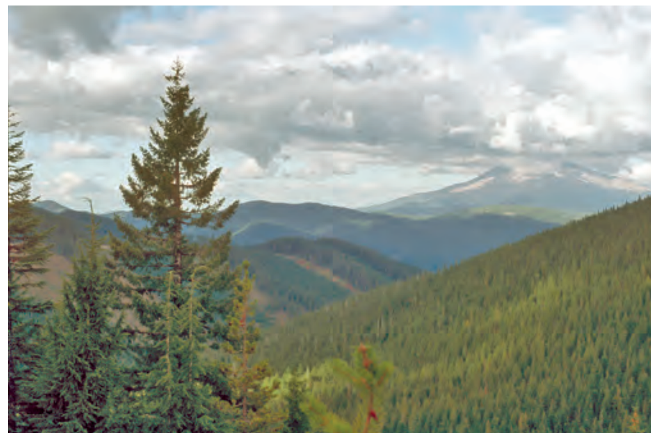

Photo by Erik Ackerson

Mountains ecoregion of southwestern Oregon support the greatest diversity of landbird species in the coniferous forests of western Oregon and Washington. Finally, it is widely recognized and we fully support the prioritization of late-successional forest because of the reduction of this successional stage throughout coniferous forests of western Oregon and Washington.

Below the regional scale, numerous other decisions have to be made relative to the "ecological appropriateness" of the area for emphasizing certain habitat attributes or species, and finally the more specific decisions regarding the species or habitat attributes to emphasize in implementing conservation actions. To facilitate some of these decisions, we prioritize focal species by forest type and ecoregion in Table 8, and then summarize the key habitat relationships and biological objectives for the focal species and associated habitat attributes in Table 9. It should be noted that if conservation is not recommended (or a low recommendation) for a species at a particular place, it may still be appropriate to conduct habitat management for the habitat attribute using a surrogate species (i.e., other species that will benefit; see Appendix A).

Conservation Design

Because of the complexities of scale, species, and ownerships as described above and throughout this document, efficient and effective implementation of landbird conservation across the region will not only require extensive partnerships and cooperation, but also a strong scientific biological foundation within the context of multiple biological and non-biological goals and objectives. Many agencies and organizations are undertaking this type of "conservation design" either independently within their ownership (e.g., Comprehensive Conservation Plans of the U.S. Fish and Wildlife Service) or in partnership across large landscapes (e.g., Ecoregional Planning of The Nature Conservancy). It is beyond the scope of this document to provide a spatially-explicit, integrated design of how habitat conservation should occur to support our biological objectives. However, for illustrative purposes, we provide an example of conservation design for Pacific-slope Flycatcher and a suite of late-successional focal species on U.S. Forest Service lands within the Hamma Hamma watershed (Appendix C). Additionally, we encourage bird conservation partners to use our biological objectives as part of the development of spatially-explicit landscapes for bird conservation.

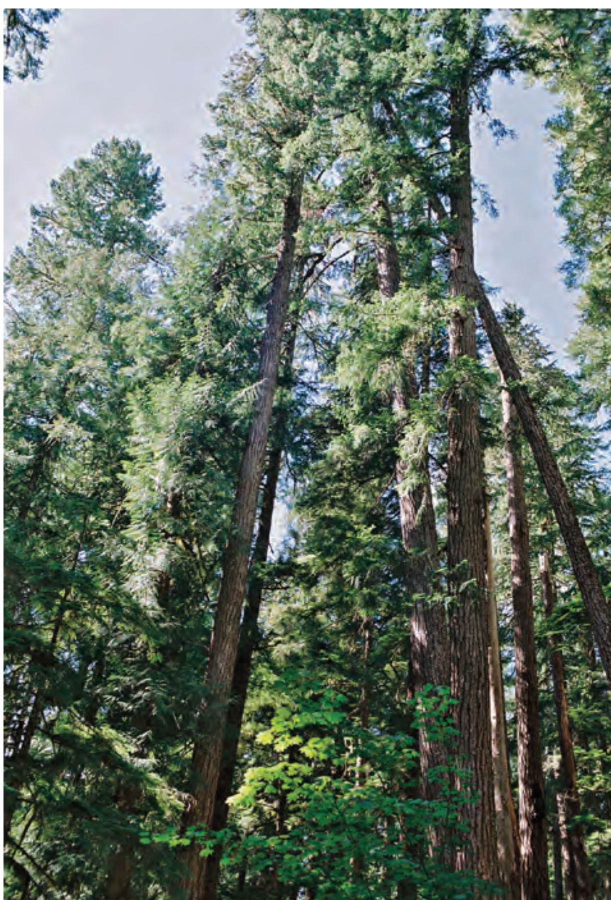

Photo by Erik Ackerson

Opportunities for Participation

Implementation of landbird conservation in the coniferous forests of western Oregon and Washington will require a broad range of partnerships, an extensive amount of cooperation, and considerable financial resources. However, the opportunities for participation in landbird conservation as described in this document are numerous. These could occur at any level from a small landowner who provides habitat for one species to detailed, complex multi-agency/organization multi-species conservation efforts within large-scale management units such as ecoregions. These types of large-scale efforts will require participation from federal and state natural resource agencies, forest products industry, academia, private environmental organizations, etc.

Recently, Joint Venture partnerships have expanded their mission beyond wetland and waterfowl conservation to function as a delivery mechanism for all-bird, all-habitat conservation. Because of the tremendous habitat diversity within the PCJV, and the limited amount of resources available for bird and habitat conservation, the PCJV partnership is focusing its current efforts on lowland habitats (e.g., riparian, oak, grassland) within the landscape of its traditional focus on wetlands. Thus, most coniferous forest habitat, which occurs at higher elevations, is not a current focus of the PCJV. However, where tracts of coniferous forest occur in the lowland landscapes there are opportunities to work with bird conservation partners to provide "added value" to PCJV projects, by including coniferous forest habitat management activities.

Photo by Erik Ackerson

Table 8. Regional prioritization of forest types and ecoregions for conservation of focal species in coniferous forests of western Oregon and Washington.[1]
(Note: The use of tables to prioritize species or habitats for an ecoregion, forest type, or habitat condition should be considered "tools" for planning and initiating conservation actions, but should not replace local knowledge or data on the applicability of those same species and habitats).

Forest Stage	Habitat Attribute	Focal Species	Forest Type[2]					Ecoregions[3]							Elevations[4]
			SS	WH	SF	MH	MC	OP	CR	KM	NC	SC	WC	HC	
Old Growth/ Mature	Large snags	**Pileated Woodpecker**	2[5]	1	2	3	2	2	1	2	2	2	2	3	Low-mid
Old-growth/ Mature	Large trees	**Brown Creeper**	2	1	2	2	2	2	1	2	2	1	1	2	All
Old-Growth/ Mature	Deciduous canopy/ subcanopy	**Pacific-slope Flycatcher**	1	1	2	4	2	1	1	2	2	2	2	4	Low-mid
Old Growth/ Mature	Mid-story tree layers	**Varied Thrush**	2	2	1	1	3	2	1	3	1	1	1	1	Mid-high
Mature/ Young	Canopy closure	**Hermit/Townsend's Warbler**	3	1	2	2	2	3	2	2	4	1	1	2	All
Mature/ Young	Open mid-story	**Hammond's Flycatcher**	4	2	1	1	2	2	2	2	1	1	1	2	Mid-high
Mature/ Young	Deciduous understory	**Wilson's Warbler**	1	1	2	2	2	1	1	2	2	2	2	2	All
Mature/ Young	Forest floor complexity	**Winter Wren**	1	1	1	1	2	1	1	2	1	1	1	1	All
Young/ Pole	Deciduous canopy trees	**Black-throated Gray Warbler**	1	1	3	4	1	2	1	1	2	2	2	4	Low-mid
Sapling/ Seedling	Residual canopy trees	**Olive-sided Flycatcher**	2	1	1	1	1	2	2	2	1	1	1	1	All
Sapling/ Seedling	Snags	**Northern Flicker**	2	1	1	2	1	1	1	1	1	1	1	2	All
Sapling/ Seedling	Deciduous shrub layer	**Orange-crowned Warbler**	1	1	3	3	1	1	1	2	2	2	2	3	Low-mid
Unique	Mineral springs	**Band-tailed Pigeon**	1	1	2	4	1	1	1	2	2	2	2	4	Low-mid
Unique	Alpine	**American Pipit**	4	4	4	4	4	2	4	4	1	1	4	1	High
Unique	Waterfalls	**Black Swift**	4	4	2	1	2	4	4	4	1	1	1	1	Mid-high
Unique	Wet meadows	**Lincoln's Sparrow**	4	4	3	2	3	4	4	3	2	2	3	1	High
Unique	Nectar-producing plants	**Rufous Hummingbird**	1	1	2	2	2	1	1	2	1	1	1	2	All
Unique	Landscape mosaic forest	**Blue (Sooty) Grouse**	3	2	1	1	2	2	2	2	1	1	1	1	All

[1] The habitat relationships presented here are for breeding season nesting habitat only and do not include the six focal species for southwestern Oregon which are representative of only one forest type (MC) and one ecoregion (KM). Primary sources include: Manuwal et al. (1987), Smith et al. (1997), Alexander (1999), Johnson and O'Neil (2001), Marshall et al. (2003), and Wahl et al. (2005).

[2] Only conifer-dominated forest types are considered. SS=Sitka Spruce; WH=Western Hemlock (includes Western Red-cedar and Douglas-Fir); SF = Pacific Silver Fir; MH = Mountain Hemlock; MC = Mixed Conifer (includes Shasta Red Fir; southwest Oregon only) Source; Franklin and Dyrness, (1980).

[3] Ecoregions. OP = Olympic Peninsula (Washington); CR = Coast Range (Oregon and Washington); KM = Klamath Mountains (Oregon); NC = Northern Cascades (Washington); SC = Southern Cascades (Washington); WC = Western Cascades (Oregon); HC = High Cascades (Oregon)

Continued

Table 8. Regional prioritization of forest types and ecoregions for conservation of focal species in coniferous forests of western Oregon and Washington.[1] — Continued

[4] Elevations identify where the species is most abundant and where conservation should be emphasized. Birds may occur outside of these limits, but these are peripheral to the core of the species breeding distribution and of less conservation importance. The subjective elevation categories of low, mid, and high should be considered relative to the range of elevations that occur within the area of interest.

[5] The subjective categorizing of focal bird species use of forest types and ecoregions is provided to assist land managers to prioritize conservation towards the forest type(s) or ecoregions(s) most important for that species. Lower numbers indicate a higher degree of importance for that forest type or ecoregion for that species relative to other forest types or ecoregions for that species (i.e., higher priority).

1 = focal species is highly associated with this forest type or ecoregion (i.e., its breeding population is of high abundance relative to other forest types or ecoregions) and this is the most appropriate forest type or ecoregion to target for conservation activities for this species provided other factors are suitable (e.g., range, successional stage, habitat features, etc.).

2 = focal species is moderately associated with this forest type or ecoregion (i.e., its breeding population is of moderate abundance relative to other forest types and ecoregions) and it is appropriate to target this forest type or ecoregion for conservation activities for this species provided other factors are suitable (e.g., range, successional stage, habitat features, etc.).

3 = focal species has a low association with this forest type or ecoregion (i.e., its breeding population is of low abundance relative to other forest types and ecoregions) and it is not recommended to target this forest type or ecoregion for conservation activities for this species, although recognition of the limited use of this forest type or ecoregion by this species is appropriate.

4 = focal species either does not occur or only occasionally occurs as a breeding species in this forest type or ecoregion and conservation activities for this species are not recommended. If conservation is not recommended (low or no association) for a focal species at a particular place based on this table, it may still be desirable to conduct habitat management for the habitat attribute using a surrogate species from the "species to benefit" list in Appendix A.

Using the Regional Prioritization Table

Determine your ecoregion and forest type. Look for focal species with 1s or 2s to target for conservation. For focal species with 3s or 4s, consider the applicability of other species listed under species to benefit in Appendix A (i.e., their range and abundance) to capture the habitat attributes of the non-targeted 3s and 4s species. *Example* Silver Fir forest type in the North Cascades ecoregion: Focal species not to be targeted include Black-throated Gray Warbler and Orange-crowned Warbler. Surrogate species from the species to benefit list include Cassin's Vireo or Black-headed Grosbeak for Black-throated Gray Warbler and MacGillivray's Warbler for Orange-crowned Warbler.

Photo by Erik Ackerson

Table 9. Summary of habitat relationships and biological objectives for focal species in coniferous forests of western Oregon and Washington.

Forest Condition	Habitat Attribute	Focal Species	Habitat Relationships/Biological Objectives				
			Vegetative Composition[a]	Vegetation Structure	Patch size	Landscape	Special Considerations
Old-Growth/ Mature	Large snags	**Pileated Woodpecker**	Douglas-fir	>70% canopy closure with >70% conifer; 2 nest snags/ha >80 cm dbh and >15 foraging snags/ha 25–70 cm dbh		>40% >60 years old with >30% late-successional	retain defective and dying trees; maintain 2 ha no-harvest buffer around nest and roost trees
Old-growth/ Mature	Large trees	**Brown Creeper**	Douglas-fir	>70% canopy closure; ≥15 trees/ ha >50 cm dbh with >3 >70 cm; riparian buffer width >30 m	>30 ha	≥ 3 blocks >30 ha/sq mi or one >85 ha/sq mi	include large snags for nesting; tree density may effect energetics
Old-Growth/ Mature	Deciduous canopy/ subcanopy trees	**Pacific-slope Flycatcher**	red alder (Leu 2000), big-leaf maple	≥ 20% deciduous canopy cover; riparian buffer width >40 m		90% of 1,000 ha landscapes as late-successional with patches of deciduous and mixed forest	wet site conifers such as western hemlock, western redcedar; near riparian zones
Old-Growth/ Mature	Mid-story tree layers	**Varied Thrush**	deciduous trees and wet site conifer trees	>70% canopy closure; >30% deciduous sub-canopy/understory; riparian buffer width >70 m	>30 ha	≥3 blocks >30 ha/sq mi or one >85 ha/sq mi	fruit/berry shrubs and trees; forest floor debris; mixed tree composition
Mature/ Young	Canopy closure	**Hermit/ Townsend's Warbler**	Douglas-fir (Pearson 1997, Janes 2003)	>90% canopy closure; mean tree dbh >30 cm; riparian buffer >70 m		>55% of landscape as suit-able with >25% as young forest	retain patches of forest >2 ha (retention aggregates) rather than selective cuts
Mature/ Young	Open sub-canopy	**Hammond's Flycatcher**	Douglas-fir	>50% canopy cover; 0.2–0.3 relative stem density; riparian buffer >70 m	>15 ha	≥6 blocks >20 ha/sq mi or one >120 ha/sq mi; 80–90% canopy closure with >80% coniferous	high canopy closure; thinning can open understory
Mature/ Young	Deciduous understory	**Wilson's Warbler**	western sword fern (Altman and Hagar 2007), bracken fern, vine maple, Califor-nia hazel, oceanspray (Hagar 2004)	>40% understory cover of shrubs/ trees; >25% shrub layer of western sword or bracken fern; riparian buffer width >30 m		>60% canopy cover of deciduous or mixed forest	retain patches of forest (retention aggregates) rather than selective cuts
Mature/ Young	Forest floor complexity	**Winter Wren**	ferns	10 down logs/ha >61 cm dbh: tree dbh >40 cm; >60% shrub layer cover; riparian buffer width >40 m	>30 ha	≥ 2 blocks >30 ha or one >60 ha/sq mi; >10% as deciduous or mixed forest	stumps, rootwads, slashpiles
Young/Pole	Deciduous canopy trees	**Black-throated Gray Warbler**	big leaf maple, alder, California hazel	>20% deciduous canopy cover; riparian buffer width >55 m		>30% young/pole forest	wet site conifers
Sapling/ Seedling	Residual canopy trees	**Olive-sided Flycatcher**	mountain and western hemlock; noble and silver fir (Altman and Sallabanks 2000)	3 1-ha areas 10–30 trees/ha >12 m; rest avg 5 trees/ha >12 m; trees >25% foliage volume	>20 ha	>30% early successional forest	retain understory hemlocks and true firs, and large snags

Table 9. Summary of habitat relationships and biological objectives for focal species in coniferous forests of western Oregon and Washington. — Continued

Forest Condition	Habitat Attribute	Focal Species	Habitat Relationships/Biological Objectives				
			Vegetative Composition[a]	Vegetation Structure	Patch size	Landscape	Special Considerations
Sapling/ Seedling	Deciduous shrub layer	**Orange-crowned Warbler**	alder, willow, currant, snowberry, vine maple	>30% cover of deciduous shrubs and small trees		>30% as early successional	primarily coastal forests; approx. 10–15 year window of habitat suitability in early successional
Unique	Nectar-producing plants	**Rufous Hummingbird**	salmonberry, currant, rhododendron, penstemon, paintbrush	>20% of shrub/herbaceous as nectar-producing plants			open space for aerial courtship display
Unique	Mineral springs	**Band-tailed Pigeon**	cascara, elderberry, wild cherry, madrone, huckleberry; Douglas-fir (Leonard 1998)	herbicide no-spray zone around patches >0.2 ha with >75% cover of foraging plants		interspersion of seral stages	juxtaposition of mineral and food sources; uneven canopy; mature trees for nesting; >2 ha no-harvest buffer around mineral springs
Unique	Alpine	**American Pipit**		patches of tussocks and vegetation clumps			south-facing meadows; rocky hillsides
Unique	Waterfalls	**Black Swift**					open flight access; dark, moist ledges behind water
Unique	Large hollow trees	**Vaux's Swift**		Snags >68 cm dbh with >60% canopy cover		≥5 nest/roost structures per sq mi	>2 ha no-harvest buffer around nest or roost sites
Unique	Wet meadows	**Lincoln's Sparrow**	dense sedges and forbs with low alder and willow	interspersion of herbaceous and woody			bogs, watercourses within moist meadows
Unique	Landscape mosaic forest	**Blue (Sooty) Grouse**	diverse and variable	interspersion of tree cover (20–50%), shrub (10–40%), herbaceous (30–60%) within 0.8 km radius			deciduous shrubs breeding; conifer trees in winter
Southwest Oregon Mixed Forest	Pine and oak trees	**Purple Finch**	ponderosa pine, California black oak, Oregon white oak	>60% canopy/subcanopy cover with >25% pine and oak trees			berry-producing trees and shurbs
Southwest Oregon Mixed Forest	Dense shrub understory	**Nashville Warbler**	Pacific madrone, California black oak	>40% shrub layer cover			
Southwest Oregon Mixed Forest	Shrub-herbaceous interspersion	**Hermit Thrush**		Ratio of shrub-herbaceous within 30–70% cover for each parameter	Variable by forest cover (see text)	>66 ha if >70% forest cover; >8 ha if >90% forest cover	Semi-open canopies; fruit and berry-producing trees and shrubs
Southwest Oregon Mixed Forest	Forest canopy edge	**Western Tanager**	Douglas-fir, ponderosa pine	Dispersed or patchy forest canopy between 40–70%			

Continued

Table 9. Summary of habitat relationships and biological objectives for focal species in coniferous forests of western Oregon and Washington. — Continued

Forest Condition	Habitat Attribute	Focal Species	Habitat Relationships/Biological Objectives				
			Vegetative Composition[a]	Vegetation Structure	Patch size	Landscape	Special Considerations
Sapling/ Seedling	Deciduous shrub layer	**Orange-crowned Warbler**	alder, willow, currant, snowberry, vine maple	>30% cover of deciduous shrubs and small trees		>30% as early successional	primarily coastal forests; approx. 10–15 year window of habitat suitability in early successional
Southwest Oregon Mixed Forest	Post-fire	**Lazuli Bunting**	deciduous shrubs and trees, especially oaks	<20% live tree cover and shrub-herbaceous cover ratio of 30–70% for each parameter			

[a] Plant species or types considered important components of suitable habitat.

These habitat relationships/biological objectives are for high quality habitat and they may not represent the comprehensiveness or detail presented in the text due to the need for brevity in this table. Please review chapter 6 for more detail. Additionally, herein we provide measurements in metric units only to save space.

Photo by Erik Ackerson

Monitoring and Research

When habitat management actions are undertaken as described in this document, monitoring and/or research programs should be designed and implemented to:

- test the effectiveness of the actions
- evaluate assumptions built into biological objectives
- direct adaptive management to achieve desired results

Monitoring is essential to evaluate the effectiveness of actions implemented. In conjunction with research, monitoring also is important for providing data to evaluate assumptions and revise and update biological objectives in the adaptive management process. Research is particularly essential since many of the biological objectives are based on limited data or professional judgment. Additionally, there is the broader need to test the assumption associated with using a suite of focal species to meet the avian conservation needs for the coniferous forest ecosystem. The NABCI monitoring subcommittee recommends that monitoring be fully integrated into bird management and conservation practices; be aligned with management and conservation priorities; be part of coordinated monitoring programs among organizations; and be integrated across spatial scales to effectively solve conservation or management problems (NABCI 2007).

Large-scale monitoring programs, like the BBS, can be used as one tool to track the long term regional response of bird populations to habitat management conducted based on recommendations in this document, however the potentially weak correlation of the relationships between the two and the time required to assess statistical changes in the BBS data make this approach less than satisfactory for most purposes. Regional bird monitoring programs like the Klamath Bird Monitoring Network (Alexander et al. 2004) use a variety of monitoring techniques at a variety of spatial and temporal scales to measure landscape level and site specific trends in population abundance and demographics that can help to asses the individual and cumulative effectiveness of local or smaller-scale regional management actions with regards to biological objectives described herein. Finally, local or project-level monitoring is essential to support evaluation of the biological objectives in this document, and it should be designed and conducted in a consistent and systematic manner to allow for integration at larger scales (Ralph et al. 1993).

After reviewing forest research initiatives involving partnerships among federal, state, private and non-governmental scientists, the Department of Agriculture's Forest Research Advisory Committee suggested that broad-based research partnerships be established during early planning stages to facilitate participation of forest managers and other stakeholders in the development and prioritization of relevant research questions (Forest Research Advisory Committee [FRAC] 2008). The research and monitoring priorities put forth in this document and by PIF in general (www.partnersinflight.org/pif_needs/searchform.cfm) represent such a collaborative approach and builds increased ownership in the results by all parties.

> ***"Data are especially needed on reproductive success and population viability to provide the best measure of species fitness, and determine where source and sink habitats are occurring."***

Integration of Research with Monitoring

This document provides numerous opportunities for integration of monitoring and research activities. In addition to the primary need for validation of the biological objectives, three recurrent research themes throughout the document and within the Information Needs section for each focal species/habitat attribute in *Biological Objectives and Habitat Conservation Strategies* are:

- focal species reproductive success and population viability in various forest conditions and from different forest management activities
- area-requirements (i.e., patch size minimums) necessary for occupancy and population viability of area-sensitive (i.e., forest interior) focal species
- landscape-level assessments of habitat needs for some focal species

Data are especially needed on reproductive success and population viability to provide the best measure of species fitness, and determine where source and sink habitats are occurring. Some examples of western Oregon and Washington studies conducted to determine optimal nesting habitats from reproductive data are Pearson (1997) for Hermit Warbler, Leu (2000) for Pacific-slope Flycatcher, Altman (1999) for Olive-sided Flycatcher, and community-level studies such as Sallabanks and Quinn (2000).

The need for data on reproductive success is particularly important where different silvicultural practices are occurring such as green-tree retention or thinning because of the prevalence of these activities and their promotion as management tools to achieve conditions associated with natural late-successional forests. Additionally, there are data that indicate these types of management (i.e., green-tree retention) may increase predation rates on some open-nesting species (Vega 1993). A community-level ongoing project at several locations in Oregon and Washington entitled Demonstration of Ecosystem Management Options (Aubrey et al. 2009) has reported on bird response to five harvest strategies that vary green-tree retention levels and spatial distribution.

“Monitoring and research are part of the adaptive management loop that provides a framework to increase our knowledge base and revise biological objectives with updated information.”

Photo by Erik Ackerson

Turning Monitoring and Research Results into Adaptive Management

The direct outgrowth of monitoring and research conducted to support the recommendations in this document should be adaptive management. Monitoring and research are part of the adaptive management loop that provides a framework to increase our knowledge base and revise biological objectives with updated information.

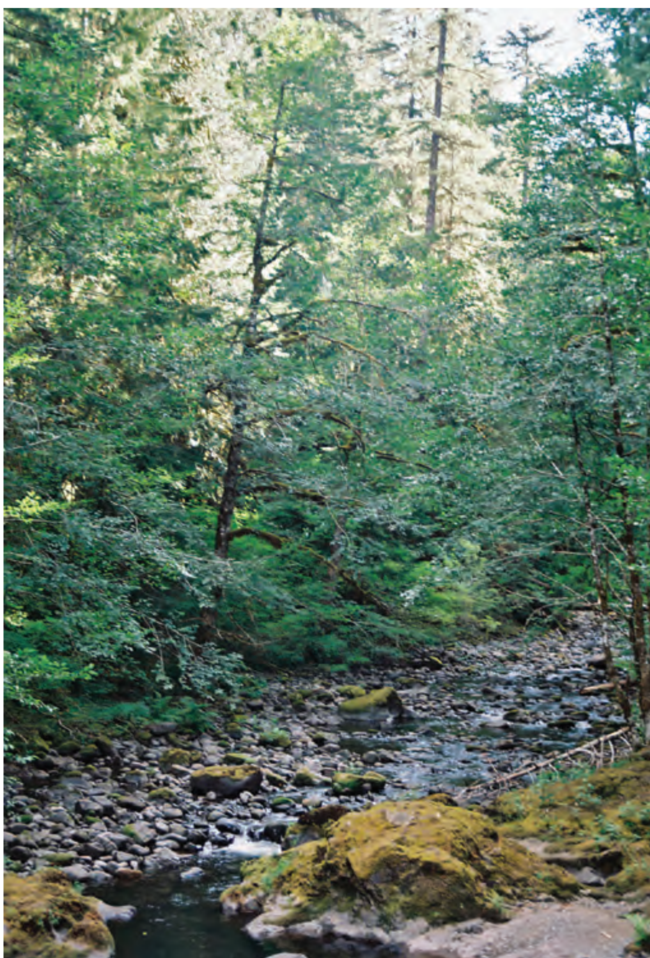

Photo by Erik Ackerson

Within the PIF conservation planning process, species assessment and effectiveness monitoring are employed in the design and implementation of regional conservation objectives; this facilitates integration of PIF conservation objectives with priority land management challenges (Alexander in review). Monitoring and research results inform the design of projects that meet priority management objectives (e.g., fire hazard reduction) in concert with bird conservation objectives and serve as a catalyst for adaptive management. Bird monitoring data can be used to identify opportunities to integrate PIF conservation objectives within the land management process and influence the design of future projects that fall within land management priorities and funding mechanisms. Effectiveness monitoring can be used to evaluate the compatibility of projects designed to meet priority management objectives (e.g., fire hazard reduction) with bird conservation objectives. By monitoring the ecological effects of management actions using standard bird monitoring methods, land managers can integrate PIF conservation objectives and design treatment projects to meet potentially competitive management objectives (e.g., fuels reduction and conservation of coniferous forest bird species).

Education and Outreach

Conservation of landbirds in the coniferous forests of western Oregon and Washington will require not only the implementation of a variety of habitat biological objectives and conservation strategies as described herein, but also increased awareness and support from a variety of audiences to ensure there are resources and opportunities to effectively conduct the conservation activities. Information must be communicated to these audiences in an effective manner to garner their support for bird conservation. Education can be defined broadly as the presentation of information to change individuals' knowledge, attitudes, or behaviors. This definition includes activities referred to as outreach, interpretation, communication, and marketing.

Primary Audiences

The two primary audiences for education related to this document are public land managers and private landowners. Public land managers generally are familiar with and have a positive attitude towards bird conservation plans as an available tool for management, but can be further aided by either top-down direction within their agency and/or guidance from a regional bird conservation expert. Private landowners tend to be unaware of bird conservation plans and the opportunities for integration with their land management. A primary constraint in implementation of bird conservation objectives by these audiences is a lack of personal interaction with someone who can provide guidance on the use of the information in the document. Although many individuals and organizations can aid local land managers and private landowners in plan implementation, without adequate funding there is a limit to how many people can be reached on a personal level. Thus, we describe below some components to consider in an education program to effectively educate land managers and landowners about bird conservation and the biological objectives presented in this document.

Key Messages

The following key messages are suggested for any education program targeting public land managers and private land owners for support and implementation of the biological objectives and habitat conservation strategies in this document:

- In the coniferous forests of western Oregon and Washington, there are twice as many landbird species with significantly declining trends as there are species with significantly increasing trends.
- We use a suite of "focal species" to represent and describe the habitat and population objectives for the entire avian community.
- Our recommendations focus on the ecological relationships between focal species and their habitat through the presentation of quantitative, prescriptive biological objectives for habitat and bird populations.

"In translating the recommendations in this document to public land managers and private landowners, the educational objective is to stimulate the implementation of our biological objectives and conservation strategies into practices on the ground."

- Manipulation of forest conditions as part of forest management can be designed and implemented to achieve our biological objectives for bird conservation.

Involving Education Experts

Professional educators are skilled in following various principles for effective education. Most Oregon-Washington PIF organizations employ education and outreach staff. For the most effective translation of the information and recommendations in this document into education programs, it is suggested that teams of scientists and educators work together and include stakeholders if possible. Additionally, partner organizations in the national Bird Education Alliance for Conservation (BEAC; http://www.birdedalliance.org/) provide a ready source for information and expertise. The mission of the BEAC is to promote bird conservation education, to engage new audiences in conservation action, to develop the tools necessary to improve bird conservation messages and education materials, and to incorporate education as a tool into conservation efforts.

Decision Support Tools

In translating the recommendations in this document to public land managers and private landowners, the educational objective is to stimulate the implementation of our biological objectives and conservation strategies into practices on the ground. Success is dependent on effective communication and education techniques. In order to reach this goal it is critical to deliver the message and the necessary suite of tools to land managers. One of the most effective ways of doing this is through Decision Support Tools (DSTs). DSTs, produced in various formats (e.g., interactive computer programs, brochures and pamphlets, white papers) that link priority land management challenges and bird conservation objectives in a language specific to target audiences (e.g., land management agency decision makers, private land owners). These tools synthesize the best available science information to enhance decision-making through analysis and visualization of management alternatives.

Photo by Erik Ackerson

DSTs can be descriptive or interactive. One example of an interactive DST to support landbird conservation in the coniferous forests of western Oregon and Washington uses landbird demographic information (e.g., productivity) from the MAPS program and proposed land management to predict population outcomes for priority/focal species (See: *Interactive Decision Support Tool for Landbird Demographic Responses to Land Management).* An example of a descriptive habitat DST prepared by the education and outreach staff at Klamath Bird Observatory for focal species in the mixed conifer and conifer-hardwood forests of the Klamath Mountains ecoregion of southwestern Oregon is presented in Appendix C. An example of a species regional landscape-level descriptive DSTs (Pacific-slope Flycatcher) prepared by the Institute for Bird Populations is presented in Appendix D.

Interactive Decision Support Tool for Landbird Demographic Responses to Land Management

A recent emphasis in bird conservation has been the development and use of Decision Support Tools (DST) for assisting in land management and conservation decision-making. Although most of these are conceptual tools that provide descriptive information through the use of text or graphics, some interactive tools are being developed that allow a user to input quantitative data into mathematical models that will provide quantitative outputs.

One pertinent example for the coniferous forests of western Oregon and Washington is Managing Landbird Populations of Forests of the Pacific Northwest (www.birdpop.org/usfsr6/usfspnwr6.htm). This web-based, interactive DST developed by The Institute for Bird Populations in collaboration with U.S. Forest Service Region Six and the Bureau of Land Management can help land managers assess the impact of proposed management on the demographics (adult and young population sizes, and indices of reproductive success) of focal/priority species. It uses spreadsheets to quantify the "what if" scenarios of proposed management using pre-management demographic data from the MAPS (Monitoring Avian Productivity and Survivorship) program, several geospatial layers, and proposed management scenarios simulated in GIS. Pre- and post-management values of spatial parameters are used to populate the spreadsheets which report changes that will occur in the demographic parameters for a target species. The simulation and adaptation of the management scenarios for a variety of species can allow the user to assess the "community effect."

Ensuring Effectiveness of Education Efforts

It cannot be assumed that educational programs will be useful, of high quality, or lead to intended impacts. Conducting evaluation provides findings to aid us in decision-making about educational programs in all phases of program planning, implementation, and completion or repetition. A front-end evaluation allows for decisions about whether a program should be implemented, what strategies to use, and what content to present. A formative evaluation that takes place throughout the life of a program offers information about how to improve the program. A summative evaluation is conducted upon program completion to gauge the impact of the program. Each of these types of evaluations has a role in aiding in decision-making about the effectives of education activities associated with bird conservation strategies. Increasing, grant-making foundations and agencies are requiring that education programs demonstrate outcomes with an evaluation component.

Photo by Erik Ackerson

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Appendix A. Priority species most likely to benefit from habitat management or restoration actions directed towards focal species and associated habitat attributes in westside conifer forests. [1,2,3]

Forest Stage/ Habitat Attribute	Large snags	Large trees	Decid trees	Mid-story layers	Closed canopy	Open mid-story	Decid shrub layer	Forest floor complex	Decid trees	Residual trees	Snags	Decid shrub layer
Old-Growth/ Mature	**PIWO** ***BRCR*** CBCH NPOW RBSA VASW	**BRCR** ***HEWA*** CBCH COHA GCKI NOGO NPOW RECR	**PSFL** ***BGWA*** ***BGHR*** ***VATH*** CAVI PUFI RBSA	**VATH** ***WIWA*** HUVI NSWO								
Mature/Young					**HEWA** ***BRCR*** ***WIWR*** COHA GCKI NPOW STJA TOWA RECR	**HAFL** ***PSFL*** COHA NOGO	**WIWA** ***BLGR*** ***OCWA*** ***RUHU*** HUVI MGWA RUGR	**WIWR** ***OCWA*** ***WIWA*** MGWA				
Young/Pole									**BGWA** ***CAVI*** ***BHGR*** ***PSFL*** HUVI PUFI RBSA RUGR			
Sapling/Seedling										**OSFL** ***WETA*** COHA NOGO RECR STJA	**NOFL** PUMA WEBL	**OCWA** ***BLGR*** ***HUVI*** ***RUHU*** DUFL FOSP MGWA MOQU RUGR SPTO WIFL WREN

Photos by Erik Ackerson

Continued

Appendix A. Priority species most likely to benefit from habitat management or restoration actions directed towards focal species and associated habitat attributes in westside conifer forests. [1,2,3] **— Continued**

Forest Stage/ Habitat Attribute	Nectar Plants	Wet Meadows	Alpine	Waterfalls	Large Hollow Snags	Mineral Springs	Landscape Mosaic Forest	Inerior forest canopy subcanopy	Dense understory	Shrub-herb mix	Open forest canopy edge	Montane brushfields	Post-Fire
Unique Forest Habitats	**RUHU**	**LISP**	**AMPI**	**BLSW** ***AMDI***	**VASW** ***PIWO*** FLOW NPOW NSOW RBSA	**BTPI**	**BLGR** ***BTPI*** NOGO						
Klamath Mountains Mixed Conifer								**PUFI** ***BRCR*** ***BGWA*** ***HAFL*** ***HEWA*** ***PSFL*** GCKI NSWO STJA	**NAWA** ***BLGR*** ***OCWA*** ***WIWA*** HUVI MGWA RUHU	**HETH** LABU MOQU SPTO	**WETA** ***BHGR*** ***CAVI*** ***OSFL*** COHA NOGO PUFI	**GTTO** DUFL FOSP MGWA MOQU RUGR RUHU WREN	**LABU** ***OSFL*** PUMA

Photo by Erik Ackerson

Photo by Pepper Trail

[1] Includes only priority species listed in Table 6. Listed priority species have a strong breeding-season habitat association with the habitat attribute and would likely benefit greatly from conservation directed towards the focal species and the associated habitat attribute. The potential benefit is only appropriate if the site is within the range of the priority species to benefit, and the habitat type or condition is highly suitable for that priority species.

[2] The species to benefit list can provide a good source list for species to use as a surrogate when the focal species is not appropriate for a site due to range, habitat type, elevation, etc.

[3] Order of species listing:

Bold, larger font = Focal species as designated in the landbird conservation strategy for that habitat attribute (Table 5).
Bold italics = Focal species designated in the landbird conservation strategy for a different habitat attribute (Table 5).
Regular font = Priority species (Table 6) not used as focal species elsewhere in the strategy.
Species are listed alphabetically within the aforementioned order of status, and not by degree of potential benefit.

AMDI = American Dipper
AMPI = American Pipit
BGWA = Black-throated Gray Warbler
BHGR = Black-headed Grosbeak
BLGR = Blue (Sooty) Grouse
BLSW = Black Swift
BRCR = Brown Creeper
BTPI = Band-tailed Pigeon
CAVI = Cassin's Vireo
CBCH = Chestnut-backed Chickadee
COHA = Coopers Hawk
DUFL = Dusky Flycatcher
FLOW = Flammulated Owl
FOSP = Fox Sparrow
GCKI = Golden-crowned Kinglet
GTTO = Green-tailed Towhee
HAFL = Hammond's Flycatcher
HETH = Hermit Thrush
HEWA = Hermit Warbler
HUVI = Hutton's Vireo
LABU = Lazuli Bunting
LISP = Lincoln's Sparrow
MGWA = MacGillivray's Warbler
MOQU = Mountain Quail
NAWA = Nashville Warbler
NOFL = Northern Flicker
NOGO = Northern Goshawk
NPOW = Northern Pygmy-owl
NSOW = Northern Saw-whet Owl
OCWA = Orange-crowned Warbler
OSFL = Olive-sided Flycatcher
PIWO = Pileated Woodpecker
PSFL = Pacific-slope Flycatcher
PUFI = Purple Finch
PUMA = Purple Martin
RBSA = Red-breasted Sapsucker
RECR = Red Crossbill
RUGR = Ruffed Grouse
RUHU = Rufous Hummingbird
SPTO = Spotted Towhee
STJA – Steller's Jay
TOWA = Townsend's Warbler
VASW = Vaux's Swift
VATH = Varied Thrush
WEBL = Western Bluebird
WETA = Western Tanager
WIFL = Willow Flycatcher
WIWA = Wilson's Warbler
WIWR = Winter Wren
WREN = Wrentit

Appendix B. Relationships between thinning and breeding bird species abundance in conifer forests in the Northern Pacific Rainforest Bird Conservation Region (BCR 5).

Species [1]	Significantly Higher Abundance In Thinned [2]	Similar (Non-Significant) Abundance Thinned and Unthinned [3]	Significantly Lower Abundance in Thinned [2]	Comments
American Robin	B, D, E, F, J [4]	G, H, K		Thinning usually results in higher abundance in the short-term (1–5 years), with no change in abundance in the mid- to long-term (5–15 years). Heavier intensity thinning appears more likely to result in increased abundance in the short-term (1–5 years) than lighter intensity thinning.
Band-tailed Pigeon		H		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Black-headed Grosbeak		B, G, K		Limited data suggests thinning results in no change in abundance in the short-, mid-, or long-terms (1–15 years).
Black-throated Gray Warbler		B, C, G	D, K	Mixed results suggest thinning results in lower abundance or no change in abundance in the short- and mid- to long-term (1–15 years); thus local effects and/or thinning intensity may result in variability in response.
Brown Creeper	H, K	F, G, L	C, D	Mixed results suggest thinning usually results in lower abundance in the short-term (1–5 years) and no change in abundance in the mid- and long-term (5–20 years) or higher abundance in the mid- to long-term (5–15 years); thus local effects and/or thinning intensity may result in variability in response.
Calliope Hummingbird		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Cassin's Vireo	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Chestnut-backed Chickadee	F, H	A, B, D, E, J, K, L	C	Mixed results suggest thinning usually results in no change in abundance in the short- and mid- to long-term (1–20 years), or higher abundance in the mid-term (5–10 years); thus local effects and/or thinning intensity may result in variability in response.
Chipping Sparrow	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Dark-eyed Junco	B, D, E, F, J, K	C, G	H	Thinning usually results in higher abundance in the short-term (1–5 years) and mid- to long-term (5–15 years); although local effects may result in no change or lower abundance in the short-term (1–5 years) or mid-term (5–10 years). Thinning intensity (light to heavy) does not appear to make much of a difference.
Dusky Flycatcher	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Evening Grosbeak	D, H, K	F, G		Mixed results suggest thinning results in higher abundance or no change in abundance in the short- and mid- to long-terms (1–15 years); thus local effects and/or thinning intensity may result in variability in response.
Fox Sparrow		E, G		Limited data suggests thinning results in no change in abundance in the short-term (1–5 years) or mid-term (5–10 years); long-term effects on abundance not reported.

Continued

Appendix B. Relationships between thinning and breeding bird species abundance in conifer forests in the Northern Pacific Rainforest Bird Conservation Region (BCR 5). —Continued

Species [1]	Significantly Higher Abundance In Thinned [2]	Similar (Non-Significant) Abundance Thinned and Unthinned [3]	Significantly Lower Abundance in Thinned [2]	Comments
Golden-crowned Kinglet		E, F, H, L	B, C, D, J, K	Mixed results suggest thinning usually results in lower abundance in the short-term (1–5 years) and mid- to long-term (5–15 years) or no change in abundance in the mid- and long-term (5–20 years). Heavier intensity thinning appears more likely to result in reduced abundance than lighter intensity thinning.
Gray Jay	B	D, H, K		Limited data suggests thinning usually results in no change or an increase in abundance in the short-term (1–5 years) and no change in abundance in the mid- to long-term (5–15 years).
Hairy Woodpecker	A, B, D, K, L	C, G, H		Mixed results suggest thinning usually results in higher abundance in the short-, mid-, and long-terms (1–20 years); although local effects and/or thinning intensity may result in no change in abundance in the short-term (1– 5 years) or mid-term (5–10 years).
Hammond's Flycatcher	B, D, G, J, K, L	C		Consistent response that thinning usually results in higher abundance in the short-, mid-, and long-terms (1–20 years), although local effects and/or thinning intensity may result in no change in abundance in the short-term (1–5 years).
Hermit Thrush		G	B, C, E, J	Limited data suggests thinning results in lower abundance in the short- or mid-term (1–10 years), or no change in abundance in the mid-term (5–10 years); long-term effects on abundance not reported.
Hermit Warbler	G, J	C, F, H, K, L	B, D	Mixed results suggest thinning usually results in lower abundance in the short- to mid-term (1–10 years), with local effects resulting in no change in abundance or higher abundance in the mid- to long-term (5–20 years). Heavier intensity thinning appears more likely to result in reduced abundance than lighter intensity thinning in the short-term (1–5 years).
Hutton's Vireo	H	B, C, L	D, F, K	Mixed results suggest thinning results in lower abundance or no change in abundance in the short-, mid- and long-terms (1–20 years) or higher abundance in the mid-term (5–10 years); thus local effects and/or thinning intensity may result in variability in response.
Lazuli Bunting		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
MacGillivray's Warbler	B, H, J	G		Limited data suggests thinning results in higher abundance in the short- and mid-term (1–10 years) or no change or higher abundance in the mid-term (5–10 years); long-term effects on abundance not reported.
Mountain Chickadee	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Mountain Quail		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Nashville Warbler		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Northern Flicker	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Orange-crowned Warbler		E		Limited data suggests no change in abundance in the short-term (1–5 years); mid- and long-term effects on abundance not reported.

Appendix B. Relationships between thinning and breeding bird species abundance in conifer forests in the Northern Pacific Rainforest Bird Conservation Region (BCR 5). — Continued

Species [1]	Significantly Higher Abundance In Thinned [2]	Similar (Non-Significant) Abundance Thinned and Unthinned [3]	Significantly Lower Abundance in Thinned [2]	Comments
Pacific-slope Flycatcher		B, E, F	D, H, J, K, L	Mixed results suggest thinning results in no change in abundance in the short-term (1–5 years) or lower abundance in the short-, mid-, and long-term (1–20 years). Heavier intensity thinning appears more likely to result in reduced abundance than lighter intensity thinning.
Pileated Woodpecker		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Purple Finch		B, G		Limited data suggests thinning results in no change in abundance in the short- and mid-term (1-10 years); long-term effects on abundance not reported.
Red-breasted Nuthatch	F, G, H, K, L	A, C, D, J		Thinning usually results in no change in abundance in the short- or mid-term (1–10 years), but higher abundance in the mid- and long-term (5–20 years).
Red-breasted Sapsucker	B	E, G		Limited data suggests thinning results in higher abundance in the short-term (1–5 years) with no change in abundance in the mid-term (5–10 years); long-term effects on abundance not reported.
Rufous Hummingbird	B, C			Limited data suggests thinning results in higher abundance in the short-term (1–5 years); mid- and long-term effects on abundance not reported.
Song Sparrow	H	E		Limited data suggests thinning results in no change in abundance in the short-term (1–5 years) and higher abundance in the mid-term (5–10 years); long-term effects on abundance not reported.
Spotted Towhee	H	G		Limited data suggests thinning results in higher abundance or no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Steller's Jay	C	E, G, H, J, L	D	Thinning usually results in no change in abundance in the short-, mid-, and long-term (1–20 years), although local effects and/or thinning intensity may result in lower or higher abundance in the short-term (1–5 years).
Swainson's Thrush	H, J, L	B, E, K	D	Mixed results suggest thinning most often results in no change in abundance in the short- and mid- to long-terms (1–15 years), although local effects may result in lower abundance in the short-term (1–5 years) and higher abundance in the mid- and long-term (5–20 years).
Townsend's Solitaire	B, D, G	C		Limited data suggests thinning usually results in higher abundance in the short- and mid-term (1–10 years), although local effects and/or thinning intensity may result in no change in abundance in the short-term (1–5 years); long-term effects on abundance not reported.
Townsend's Warbler		H	E	Limited data suggests thinning results in lower abundance in the short-term (1–5 years) and no change in abundance in the mid-term 5–10 years); long-term effects on abundance not reported.
Varied Thrush		E, F, L	B, D	Thinning usually results in lower abundance in the short-term (1–5 years) and no change in abundance in the mid-term (5–10 years) and long-term (10–20 years). Heavier intensity thinning appears more likely to result in reduced abundance than lighter intensity thinning.
Warbling Vireo	D, G, K	B		Mixed results suggest thinning results in higher abundance or no change in abundance in the short-term (1–5 years) with higher abundance in the mid- to long-term (5–15 years).

Continued

Appendix B. Relationships between thinning and breeding bird species abundance in conifer forests in the Northern Pacific Rainforest Bird Conservation Region (BCR 5). — Continued

Species [1]	Significantly Higher Abundance In Thinned [2]	Similar (Non-Significant) Abundance Thinned and Unthinned [3]	Significantly Lower Abundance in Thinned [2]	Comments
Western Tanager	B, C, D, H, J, K	G, L		Thinning usually results in higher abundance in the short-term (1–5 years) and higher abundance or no change in abundance in the mid- to long-term (5–15 years).
White-headed Woodpecker	G			Limited data suggests thinning results in higher abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Wilson's Warbler	H, L	B, D, K	E	Mixed results suggest thinning most often results in no change in abundance in the short- and mid- to long-term (1–15 years); although local effects and/or thinning intensity may result in lower abundance in the short-term (1–5 years) and higher abundance in the mid- and long-term (5–20 years).
Winter Wren	F, K	D, L	B, H, J	Mixed results suggest highly variable response; thinning can result in lower abundance in the short- and mid-term (1–10 years) or no change in abundance in the short-term (1–5 years) or long-term (10–20 years) and higher abundance in the mid- to long-term (5–15 years); thus local effects and/or thinning intensity may result in variability in response.
Western Wood-pewee		G		Limited data suggests thinning results in no change in abundance in the mid-term (5–10 years); short- and long-term effects on abundance not reported.
Yellow-rumped Warbler	C, G			Limited data suggests thinning results in higher abundance in the short-term (1–5 years) and mid-term (5–10 years); long-term effects on abundance not reported.

[1] Species listed here are those cited in the studies below that are considered to be associated with young conifer forests in the Guide.
[2] Higher and lower abundances in thinned stands reflect statistically significant differences as reported in the studies.
[3] Similar abundance between thinned and unthinned indicates there was no significant difference reported in the studies.
[4] Letters correspond to studies listed in the table below (ordered by years post-thin).

Reference	Study Type [5]	Years Post-Thin	Level of thinning [6]	Location
A Weikel (1997)	experimental	1–2	Moderate to Heavy	Northern Coast Range, OR
B Hagar et al. (2004)	experimental	1–4	Moderate to Heavy	West-central Cascades, OR
C Dillingham et al. (2007)	experimental	2–3	Moderate to Heavy	Southern Coast Range, OR
D Hayes et al. (2003)	experimental	1–6	Moderate to Heavy	Northern Coast Range, OR
E Dellasalla et al. (1996)	observational	3–5	Light to Moderate	Southeast AK (Prince of Wales Island)
F Artman (1990)	observational	4–6	Moderate to Heavy	West-central Cascades, WA
G Siegel and DeSante (2003)	observational	5–11	Light to Moderate	Northwestern Sierra Nevada, CA
H Manuwal and Palazotto (2004)	observational	8–11	Light and Heavy	Puget Lowlands, WA
J Hagar and Friesen (2009)	experimental	10–12	Light to Heavy	West-central Cascades, OR
K Hagar et al. (1996)	observational	5–15	Light to Moderate	Central and Northern Coast Range, OR
L Muir et al. (2002)	observational	10–24	Light to Moderate	Central Coast Range, OR

[5] The summary includes both experimental studies (pre- and post-thinning in the same stand) and observational studies (comparing thinned and unthinned stands in two different places).
[6] The description of the level of thinning was taken from the study or modified slightly to be relative to the other studies. It is based generally on the volume removed and remaining tree densities, although data presented in the studies were not always sufficient to apply consistent standards of light, moderate, and heavy thinning.

Klamath Bird Observatory

Birds in Mixed-conifer Hardwood Forests

Managing fire-adapted ecosystems in southwestern Oregon

Decision Support Tool
DSTs present relevant information from regional research and monitoring efforts and applicable literature to inform land management decisions.

DST Framework
Klamath Bird Observatory DSTs convey science-based information to stakeholders who can implement strategies that benefit birds and their habitats. Our DSTs identify links between management challenges and bird conservation objectives.

Why Birds?
Birds are excellent ecological indicators. Their habitat associations are well known and they respond quickly to changes in habitat. Many species can be easily and inexpensively detected using standard monitoring methods. Partners in Flight has identified conservation focal species that are strongly associated with important habitat attributes. These focal species demonstrate measurable responses to management that alters their habitat attributes. Therefore bird monitoring can be used as a cost-effective tool for evaluating the effectiveness of management actions within an adaptive management framework.

Mixed-conifer Hardwood Forest

Ecological diversity is high in mixed-conifer hardwood forests of southwestern Oregon. Some of the dominant tree species in this habitat are Douglas-fir, true firs, ponderosa pine, oaks, and Pacific madrone. This forest type is found at elevations from sea level to ~6,000 feet. Unlike the wetter climates in much of western Oregon, the climate conditions in parts of southwestern Oregon tend to be much milder and drier as characteristic of a Mediterranean Climate.

Conservation Concerns

Partners in Flight has developed a series of regional bird conservation plans that identify habitat conservation objectives for birds that are associated with specific habitat types. The Oregon-Washington Partners in Flight plan titled *Habitat Conservation for Landbirds in Coniferous Forests of Western Oregon and Washington* identifies important conservation issues and needs in the mixed-conifer hardwood forests of southwestern Oregon's Klamath Mountains:

Mixed-conifer hardwood forest in the Klamath Mountains of southwestern Oregon.

- This habitat supports the highest coniferous forest bird diversity in all of western Oregon and Washington.
- This biodiversity is associated with structural complexity and a high diversity and abundance of hardwood trees.
- This diverse forest composition and structure, historically maintained by frequent mixed-severity fires, has been altered by a combination of timber and fire management.

Conservation Focal Species and Habitat Objectives

The Oregon-Washington Partners in Flight coniferous forest conservation plan identifies focal species that are associated with important habitat attributes in functioning coniferous forest ecosystems. By managing landscapes for habitat attributes that are important for these species, many other species and elements of biodiversity benefit. Habitat objectives for focal species that occur in mixed-conifer hardwood forests of southwestern Oregon include a mix of the following attributes.

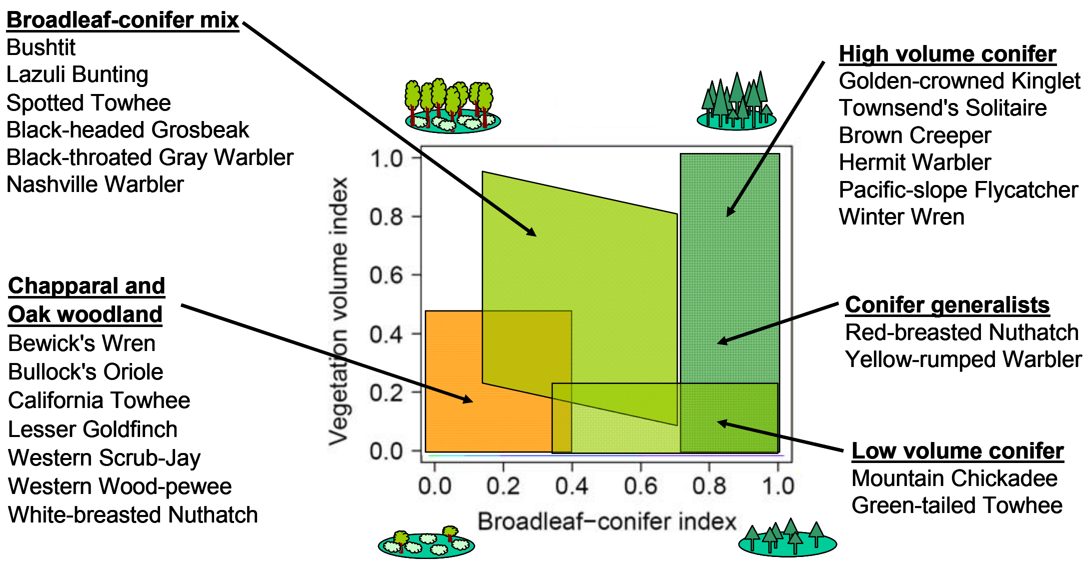
- Mature forest conditions including:
  - ◊ large snags
  - ◊ deciduous canopy trees
  - ◊ mid-story tree layers
- Younger stands including:
  - ◊ closed canopy
  - ◊ open mid-story
  - ◊ deciduous understory
  - ◊ forest floor complexity
  - ◊ deciduous canopy trees
- Sapling/seedling habitats including:
  - ◊ residual canopy trees
  - ◊ snags
  - ◊ deciduous vegetation
- Mixed forests including:
  - ◊ pine-oak canopy/subcanopy
  - ◊ dense shrub understory
  - ◊ shrub-herbaceous interspersion
  - ◊ forest canopy edges
  - ◊ post-fire conditions

Klamath Bird Observatory

Land Management Challenges and Conservation Opportunities

The mosaic of structurally diverse mixed-conifer hardwood forests in southwestern Oregon was historically maintained by frequent mixed-severity wildfires. A century of fire suppression has increased the risk of uncharacteristically severe wildfires. To address this management challenge various projects involving a variety of forest treatment prescriptions are being implemented to restore these fire adapted forest ecosystems and reduce risks associated with stand replacing fires.

Bird monitoring efforts in southwestern Oregon have resulted in models that predict the occurrence of birds, including conservation focal species. Using simple forest characteristics, such as vegetation volume and conifer-hardwood composition, bird occurrence can be predicted across varying forest conditions. Forest characteristics can also be used to describe the diverse mosaics typically found in fire-adapted mixed-conifer hardwood forests, as well as forests that have become less diverse as a result of fire suppression.



Without fire, high volume conifer stands become more abundant. A variety of restoration techniques are being designed to simulate the effects of mixed-severity fire and increase lower volume mixed-conifer hardwood conditions across the landscape. These changes in vegetation can cause bird species composition to shift from a high volume conifer community to a mixed-conifer hardwood community. Black-throated Gray Warblers are expected to benefit from treatments that result in recruitment of broadleaf hardwoods into the forest canopy, while Hermit Warblers are less likely to use this habitat.

Combined with information from the Partners in Flight Oregon-Washington coniferous forest conservation plan, results from local bird monitoring efforts are being used to inform management planning associated with fuel reduction programs in southwestern Oregon. By predicting the response of focal species to management activities and then monitoring the results of various restoration techniques within an adaptive management framework, the ability of such projects to meet desired conditions and bird conservation objectives is being measured.

References (Abbreviated)

Alexander. 2011. Integrating Conservation and Management Objectives. US Fish & Wildlife Service BTP-R1014-2011
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Altman and Alexander. 2012. Habitat Conservation for Landbirds in Coniferous Forests. Oregon-Washington PIF
Betts et al. 2010. Thresholds in Forest Bird Occurrence as a Function of Early-seral Broadleaf Forest. Ecological Applications
Seavy and Alexander. 2011. Bird Habitat in Broadleaf-Conifer Forest. Journal of Wildlife Management

Monitoring

As management in mixed-conifer hardwood forests is implemented, bird monitoring can be used to evaluate the ability to meet multiple land management objectives within an adaptive management framework. Bird monitoring provides information about species composition, abundance, and fitness (e.g., productivity). Monitoring the response of birds to land management allows us to evaluate its effectiveness. Results can be used to inform future management and identify opportunities to tie bird conservation objectives with priority management objectives, such as fuel reduction.

Sponsors

Joint Fire Sciences Program

National Fish and Wildlife Foundation

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 Decision Support Tool Mixed-conifer Hardwood Forests Version 1.6

Appendix D. Decision support tool fact sheet for the landscape-level conservation and management of the Pacific-slope Flycatcher in Pacific Northwest Forests.

THE INSTITUTE FOR BIRD POPULATIONS
www.birdpop.org

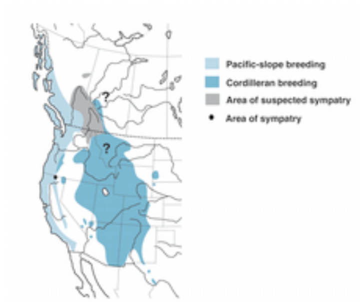
LANDSCAPE MANAGEMENT GUIDELINES FOR BREEDING LANDBIRDS OF PACIFIC NORTHWEST FORESTS

"WESTERN" FLYCATCHER (*Empidonax difficilis*)

Author: Phil Nott, The Institute for Bird Populations, California.

INTRODUCTION:

"Western" Flycatcher is a medium-small (14-17cm, 9-12g) insectivore that prefers to breed in a variety of mixed, coniferous and broadleaf forested habitats, where they are associated with streams, and open understory that benefit foraging. The Pacific-slope Flycatcher of the Pacific Northwest winters in scrubby forests of western Mexico, whereas the Cordilleran Flycatcher (eastern slope) winters in the montane forests of central Mexico.



CONSERVATION STATUS:

Breeding Bird Survey (BBS) data collected in the Dissected Rockies showed a non-significant increase, but no MAPS data were available for this province.

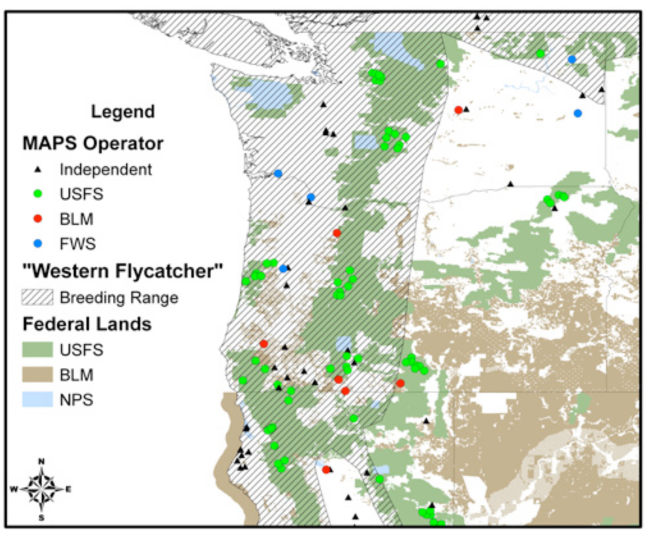


Fig 1. Active MAPS stations and Forest Service (FS), Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), and National Park Service (NPS) lands in the northwestern United States. The hatched area represents "Western" Flycatcher breeding range within the mapped extent.

Breeding Bird Survey (BBS) data collected in the Cascade Mountains (Table 1) showed a significant decline. Similarly, MAPS data from Mount Baker, Wenatchee, and Willamette national forests (Fig. 1), within the Cascade Mountains province, showed significantly declining numbers of adults, stable numbers of young, and high survival rate.

Table 1. Summary of "Western" Flycatcher BBS (1992-2007) and MAPS data (1992-2007) for the Dissected Rockies (DR), Cascade Mountains (CM), Southern Pacific Rainforests (SPR), and Pitt-Klamath (P-K) physiographic provinces.

	DR	CM	SPR	P-K
BBS Adult Trend	+0.71	**-2.68**	**-2.31**	-1.73
MAPS Results				
# Stations		13	6	7
Adult Trend		-1.05	**-2.89**	-1.37
Young Trend		-7.65	+1.61	-5.25
Productivity Index		0.223	0.113	0.176
Survival Rate		0.488	**0.535**	0.464

MAPS data from Siuslaw national forest (in SPR province) showed non-significantly declining numbers of adults and young and low survival rate consistent with the declining BBS trend.

MANAGEMENT GUIDELINES:

Managers should maintain a variously-aged coniferous and mixed forest dominating 60-90% (median 75%) of the 1250 hectares that lie within a 2-kilometer radius landscape. Preferred characteristics include ~1% successional habitat. ,2-10% coverage of deciduous forest, including up to ten hectares of riparian habitat (using 15m buffer around perennial streams). Coniferous and mixed forest coverage should approach 90% (~1100 hectares) which ensures some 900 hectares of core habitat.

Numbers of adult "Western" flycatchers correlated negatively with the core area of shrub-successional habitat, whereby the lowest numbers were associated with forests containing ~10-15 hectares of such habitat. Adult numbers were also lower in areas with more extensive deciduous forest.

www.blm.gov

A COLLABORATION IN BIRD CONSERVATION BETWEEN THE INSTITUTE FOR BIRD POPULATIONS, POINT REYES STATION, CALIFORNIA AND KLAMATH BIRD OBSERVATORY, ASHLAND, OREGON, WITH SUPPORT FROM THE USDA FOREST SERVICE REGION SIX, THE NATIONAL FISH AND WILDIFE FEDERATION, AND THE BUREAU OF LAND MANAGEMENT.

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We suggest that managers maintain or restore large patches of thin-canopy coniferous and mixed forests, including large core areas, within more densely canopied forest to benefit the reproductive success of “western” flycatchers. Our data also suggest that the maintenance of riparian buffer zones, especially deciduous components, should help support healthy productive populations. It appears that relatively undisturbed, closed-canopy forests may not be beneficial to this species; however, a mosaic of large (>1000 hectares) different-aged stands were associated with increasing numbers of both young and adults. The 1,250 hectare landscape shown in Fig. 2a provides excellent breeding habitat in mixed coniferous-deciduous forest.

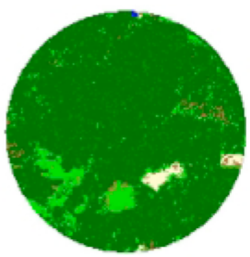
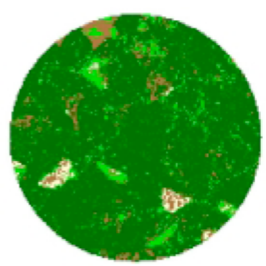


Fig. 2. a) Two-kilometer radius National Land Cover Dataset (NLCD) image centered on the Mary’s Creek MAPS station on Siuslaw National Forest, OR (left). The station recorded high numbers of adult and young flycatchers, and high reproductive success. The landscape is at ~300 meters elevation and mostly covered in mature mixed forest (dark green) and more open canopy forest (light green). Especially note the high forest cover percentage and lack of edges or patches of shrub or regenerating forest (brown and tan).



b) Conversely, the landscape around Crab Creek MAPS station at ~200m elevation on Siuslaw National Forest, OR (right) exhibits a widespread high level of fragmentation caused by clearcuts and other disturbances resulting in a low percentage of “core” forest, and larger patches of thinned forest (lighter green), shrub habitat (tan), and grassland (pale yellow). Consequently, this area supported low numbers of adult and young “Western” Flycatcher, and poor reproductive success.

A habitat conservation plan for breeding landbirds of coniferous forests in Oregon and Washington (Altman 1999) recommends that management to maintain late successional forest, and riparian corridors (especially deciduous shade trees) would be beneficial to breeding populations. Altman specifically recommends that managers “provide late-successional forest with ~20% deciduous canopy cover, particularly where associated with riparian zone or wet site deciduous trees such as red alder and big leaf maple. In harvest units with hardwood site potential, retain deciduous canopy trees and/or western hemlock and western red cedar trees in small residual clumps (retention aggregates) near or adjacent to the riparian zone to provide suitable nesting and foraging habitat. Riparian buffer zones within harvest units should be >40 meters wide, and meet stand-level habitat conditions described above.”

Forest pests and future climate

Predicted milder winters and hotter, drier summers in Washington and Oregon may result in more frequent, widespread, and intense forest pest outbreaks. Nott et al. (2002) showed a strong relationship between the winter activity of the North Atlantic Oscillation (NAO) and the El Nino Southern Oscillation (ENSO) and the subsequent productivity of “Western” Flycatcher. High reproductive success was associated with wet winter and spring conditions across the non-breeding range and mild winters across the breeding range.

Extensive outbreaks of forest pests may provide ample food for breeding birds but they also thin the canopy cover, thereby changing the micro-climate and leading to a more developed mid-story and understory. Thus, the predicted drier, open canopy conditions may increase the availability of quality flycatcher breeding habitat, but drier summers may decrease the deciduous component of the forest.

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