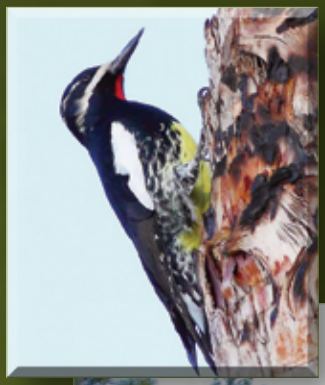
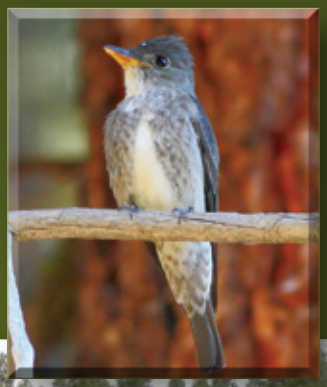
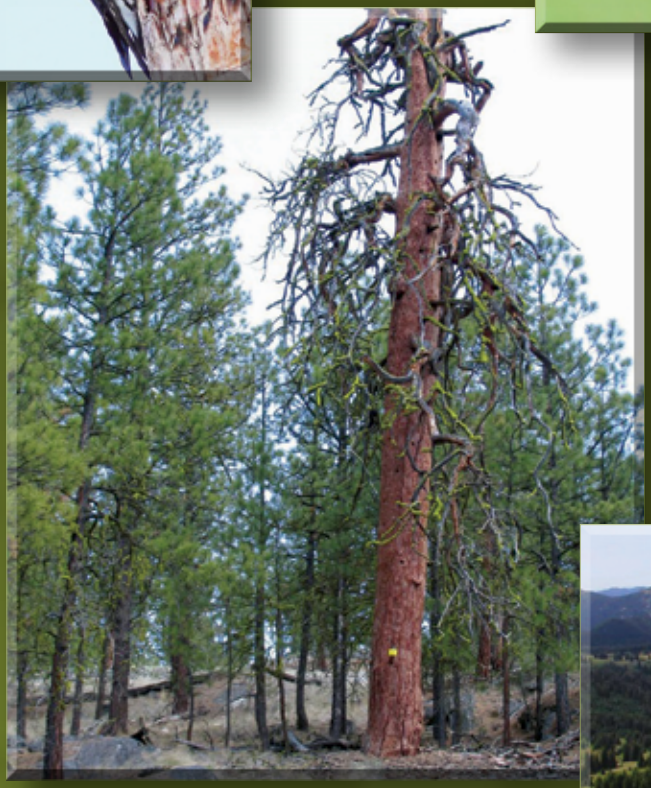
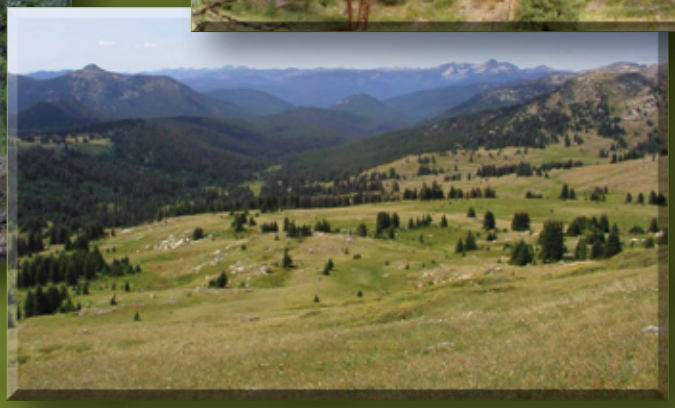
Conservation of Landbirds and Associated Habitats and Ecosystems in the Northern Rocky Mountains of Oregon and Washington









Version 2.0

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

PARTNERS IN FLIGHT · PARTNERS EN VUELO · COMPAÑEROS EN EL VUELO

AMERICAN BIRD CONSERVANCY

OREGON / WASHINGTON PARTNERS IN FLIGHT

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Conservation of Landbirds and Associated Habitats and Ecosystems in the Northern Rocky Mountains of Oregon and Washington

Version 2.0

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Executive Summary

This document has been prepared to stimulate and support a proactive approach to the conservation of landbirds and associated habitats and ecosystems in the Northern Rocky Mountains of 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 with healthy populations of landbirds.

The Environment, the Birds, and the Conservation Issues

The Northern Rocky Mountains is a large, topographically diverse area of mountains, intermontane valleys, and alpine meadows covering major portions of four states and two provinces. Approximately 25% of the region occurs in Oregon and Washington, and over 60% of the land is in public ownership, primarily the U.S. Forest Service.

There are approximately 125 regularly breeding landbird species. There are no endemic landbird species (i.e., species unique to the region), however several breeding species are relatively unique to only this part of Oregon and Washington. Some of these include American Redstart, Gray Catbird, Northern Waterthrush, Spruce Grouse, and Upland Sandpiper. Three landbird species have been extirpated as breeding species from some parts of the region including Upland Sandpiper, Sharp-tailed Grouse, and White-headed Woodpecker.

Landbird conservation issues are as diverse as the landscape, and vary in scale from local land use decisions to changes in ecological processes at landscape scales. Most of the challenges of landbird conservation arise either directly or indirectly from conflicts with the human footprint that result in habitat changes and alteration of natural ecological processes. The primary conservation issues for landbirds and their habitats include declining landbird populations, forest health and forest management, wildfire and salvage logging, livestock grazing, and climate change.

Goals and Process

The primary goal of this document is to promote the long-term persistence of healthy populations of native landbirds and associated habitats and ecosystems. 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 habitat attributes 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 and responsibility species that would benefit from habitat conservation for focal species
- establish measurable habitat objectives to achieve the desired habitat conditions based on the habitat requirements of the focal species
- establish measurable population objectives for focal species to be used as one metric for tracking habitat management for the desired habitat attributes
- recommend habitat conservation strategies that can be implemented to achieve the habitat and population objectives
- conduct monitoring to assess the habitat and focal species response to the habitat conservation strategies and progress towards the habitat and population objectives
- implement adaptive management as appropriate to adjust habitat management towards the trajectory of the habitat and population objectives

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 this 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 all landbird species and communities.

Priority Habitats

Three habitat types and one habitat category that included several habitat types were selected as priority habitats:

- Dry Forest (ponderosa pine and ponderosa pine/Douglas-fir/grand-fir)
- Mesic Mixed Conifer Forest (late-successional)
- Riparian Woodland
- Unique Habitats (i.e., post-wildfire, cliffs and rock outcrops, alpine montane meadows, subalpine forest, whitebark pine, aspen, lowland wet meadows, upland grasslands, juniper woodland, riparian shrub, sagebrush-steppe, and montane shrubland).

Focal Species

Our strategy for achieving functioning ecosystems for landbirds is described through the habitat requirements of 24 "focal species." By managing for a suite of species representative of important habitat components, many other species and elements of biodiversity also will be conserved. The following landbird focal species were selected based on their degree of association with important habitat attributes in ecosystems of the Northern Rocky Mountains of Oregon and Washington:

Habitat Type	Habitat Attribute	Focal Species
Dry Forest (Ponderosa Pine and Ponderosa Pine/Douglas-fir/ Grand-fir)	large patches late-successional forest with heterogeneous canopy cover	White-headed Woodpecker
	interspersion herbaceous openings and patches of dense sapling/pole trees	Flammulated Owl
	open herbaceous understory with scattered sapling pines	Chipping Sparrow
	large snags	Lewis's Woodpecker
Mesic Mixed Conifer Forest (Late-Successional)	large snags	Williamson's Sapsucker
	high canopy cover and foliage volume	Townsend's Warbler
	patches of dense understory shrubs	Nashville and Orange-crowned Warbler
	forest edges and openings with scattered trees	Olive-sided Flycatcher
Riparian Woodland	large snags	Red-naped Sapsucker
	high canopy and subcanopy cover and foliage volume	Red-eyed Vireo and Yellow Warbler
	patches of dense understory foliage and cover	MacGillivray's Warbler
	broken canopies with extensive habitat contrast edges	Western Wood-pewee
Unique Habitats	*Forest Types*	
	Post-Wildfire	Black-backed Woodpecker
	Whitebark Pine	Clark's Nutcracker
	Subalpine Forest	Hermit Thrush
	Juniper Woodland	Gray Flycatcher
	Aspen	Warbling Vireo
	Shrubland Types	
	Montane Shrubland	Calliope Hummingbird
	Riparian Shrub	Willow Flycatcher
	Sagebrush-Steppe	Vesper Sparrow
	Grassland Types	
	Alpine Montane Meadows	Lincoln's Sparrow
	Upland Grassland	Savannah Sparrow
	Lowland Wet Meadows	Bobolink
	Non-Vegetated Types	
	Cliffs and Rock Outcrops	Golden Eagle

Biological Objectives and Habitat Conservation Strategies

Based on the habitat relationships of our focal species, biological objectives (i.e., habitat and population) are recommended and habitat 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:

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

The types of biological objectives presented include:

- regional landscape-level habitat objectives
- focal species habitat objectives at site and landscape scales
- focal species population objectives

Habitat 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.

Implementation

Because of the diversity of landbird species and habitats in the Northern Rocky Mountains, conservation will require a complex array of conditions within variable landscape patterns. Implementation also will likely require the need for areas that function naturally with limited or no management intervention (e.g., some federal lands), and areas where desired landbird habitat conditions will need to be achieved by incorporating a wide range of habitat management and restoration activities within a working landscape of various land uses (e.g., forestry, agriculture, grazing, recreational).

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.

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.

This document encourages habitat management for all focal species and habitat types. However, for those making decisions on allocation of resources at regional scales, the highest priorities for landbird conservation include:

- Protection of all remaining late-successional forest
- Restoration of dry forest habitat
- Management for appropriate natural regeneration of post-wildfire habitat
- Restoration of riparian woodland and riparian shrub habitat

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. 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

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.

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LANDBIRD CONSERVATION

Partners in Flight

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 (www.orwapif.org), formed in 1992, has been at the forefront of landbird conservation, not only in the Pacific Northwest but 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). Oregon-Washington 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.

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 document also supports efforts to reduce the need for future listings of bird species under the Endangered Species Act (ESA)**.

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 delivery and tracking of bird conservation (Sidebar: *Bird Conservation Regions*). There are 67 BCRs in North America and Hawaii (NABCI 2000), including the Northern Rocky Mountains Bird Conservation Region (BCR 10) which encompasses all of the geographic scope of this document (Figure 1).

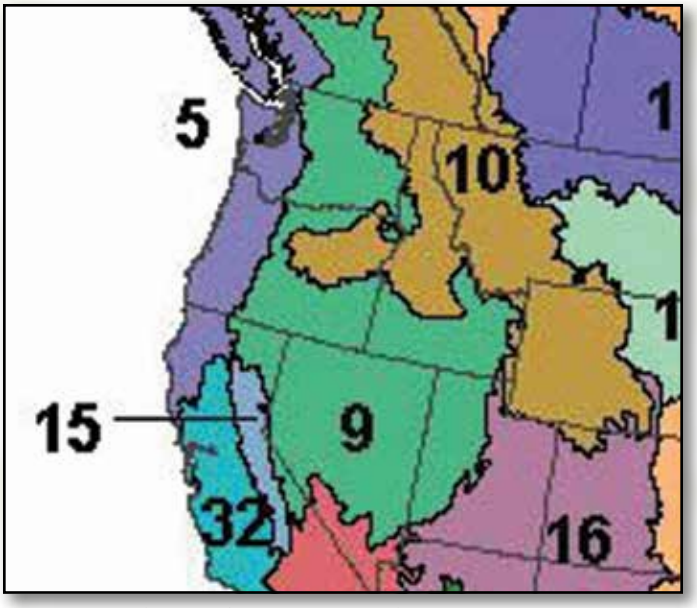


Figure 1. *Northern Rocky Mountains Bird Conservation Region (BCR 10) within Oregon and Washington.*

Bird Conservation Regions

Historically, most conservation land management decisions were made based on local goals and objectives for land use. However, it is increasingly evident for natural resource conservation, especially with highly mobile animals such as birds, that effective conservation requires that local planning and implementation be designed in the broader context of larger areas such as ecoregions or sub-ecoregions (Noss 1983, Franklin 1993). Conservation and management directed towards ecological landscapes that have been designed to meet the diverse needs of all bird species result in the most efficient use of resources and the greatest likelihood of success. The desirable ecological units for the planning, delivery, and tracking of bird conservation, Bird Conservation Regions (BCRs), have been identified and described under the North American Bird Conservation Initiative (www.nabci-us.org/bcrs.html).

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 Intermountain West Joint Venture (IWJV; www.iwjv.org), which encompasses the geographic scope of this document. The focus of the IWJV is on empowering partnerships to enhance delivery of science-based habitat conservation across the interior West. The primary ways in which the IWJV partnership is advancing landbird conservation are through the development of habitat and population objectives for selected priority landbird species as part of their implementation plan (Casey 2013), and through support of habitat protection, management, and restoration activities by diverse partnerships, with a strong focus on private lands and Farm Bill programs and practices. They also provide decision support tools to inform management decisions (e.g. their HABPOPS database, http://data.pointblue.org/partners/iwjv/), capacity grants to enhance partnerships (http://iwjv.org/funding-opportunity/iwjv-capacity-grants-program), and play a key role in the delivery of the Sage Grouse Initiative (http://iwjv.org/sage-grouse-initiative-strategic-watershed-action-team-0).

PURPOSE AND SCOPE

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 Northern Rocky Mountains of 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. It is assumed that 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 within the scope of this document to discuss integration of bird conservation with other management objectives. The purpose is to provide those interested in landbird 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
- the quantitative, measurable objectives that are recommended to support conservation of those landbird species, habitat attributes, and ecosystems in which they occur

"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 Northern Rocky Mountains of Oregon and Washington."

Version 2.0

This document is an update of *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington* (Altman 2000a). **Among PIF bird conservation plans nationally, one of the unique features of Version 1.0 of the Oregon-Washington 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, prescriptive 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.**

In Version 2.0, not only are the biological objectives for habitat attributes updated based on new data, but there is continued leadership in being progressive and innovative by providing examples of habitat objectives at landscape scales and population objectives that encourage habitat management for small populations where appropriate. It is hoped that the presentation of these types 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 judgment used to develop the objectives.

Since the development of Version 1.0 in the mid to late 1990s, considerable changes have occurred in the world of bird conservation. Internationally and nationally, there has been the emergence of NABCI and BCRs, and the enhanced role of Joint Ventures in landbird conservation. Within PIF, there has been extensive advancement and use of the Species Assessment Database which uses biological criteria to evaluate species vulnerability (Panjabi et al. 2005), an emphasis on the geospatial design of landscapes for bird-habitat conservation through the publication of the Five Elements Process (Will et al. 2005), and the emerging recognition of the importance of full life cycle conservation for migratory birds (Berlanga et al. 2010). Additionally, the North American Landbird Conservation Plan (i.e., 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). A follow-up document which included Mexico (i.e., Trinational Plan), further expanded the vision and connectivity necessary for migratory bird conservation (Berlanga et al. 2010). Finally, an updated version of the Continental Plan was completed in late 2016 (Rosenberg et al. 2016).

Vital Rates of North American Landbirds

In 1989 The Institute for Bird Populations initiated the Monitoring Avian Productivity and Survivorship (MAPS) program using a continent-wide network of constant-effort mist-netting and bird-banding stations (DeSante 1992) to assist in the conservation of North American landbirds through demographic monitoring. One of the principal results of this effort has been the publication of **Vital Rates of North American Landbirds (www.VitalRatesOfNorthAmericanLandbirds.org) which provides estimates of key demographic parameters, often called vital rates, for many North American landbirds using data during the 15 year period 1992-2006**. The objective of these analyses was to document and describe temporal (annual) and spatial (at the scale of BCRs) variation in productivity, survivorship, recruitment, and other demographic parameters to provide hypotheses regarding the proximate drivers of population change. An example is whether population was most strongly affected by factors acting on the breeding or wintering grounds. Results are presented several ways. Visual displays include sampling information and graphs of annual estimates for each of the eight demographic parameters estimated from temporal analyses, and sampling information and maps of BCRs showing color-coded BCR-specific estimates for the same eight parameters from spatial analyses. Additionally, there are summary tables of means, standard deviations, and coefficients of variation from both temporal and spatial analyses, and scatterplots and correlation matrices for pairwise correlations among the estimated demographic parameters. Lastly, there are species account narratives that summarize and interpret the results, particularly as they relate to the demographic correlates of both temporal population changes and spatial differences in population trends. The primary uses and value of this information is that it uses information on productivity, survivorship, and recruitment to enable a deeper understanding of the causes of population changes, which will enable conservationists to more effectively target conservation actions to the times and places in the annual cycle where they will do the most good.

Outside of PIF, there has been the development of an interactive web-based decision support tool for assessing species population changes relative to habitat changes (i.e., HABPOPS), significant advancement in knowledge of landbird species demographic limiting factors (Sidebar: *Vital Rates of North American Landbirds*), and significant changes in management of public forest lands. The latter includes greatly accelerated levels of forest restoration to address forest health issues (e.g., large-scale unnatural wildfires and insect infestations and associated salvage logging), and the development of Collaborative Forest Cooperatives that bring diverse stakeholders together to develop recommendations for management of public forest lands.

Integration with Other Conservation Plans

This document is intended to complement the goals, objectives, and strategies in several other planning and conservation processes and initiatives by filling a niche that is usually absent in those efforts – quantitative, prescriptive recommendations for habitat conditions most suitable for individual and suites of landbird species at several geographic scales (e.g., regional, landscape, site). The use and implementation of these recommendations can be done independently for landbird-specific conservation or complementary within the context of broader conservation goals to support and strengthen other plans including:

- Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004) and update in preparation for completion in late 2016.
- State Wildlife Action Plans (ODFW 2005, WDFW 2005) (Sidebar: *Integration with State Wildlife Action Plans*)

This document is intended to complement the goals, objectives, and strategies in several other planning and conservation processes and initiatives by filling a niche that is usually absent in those efforts – quantitative, prescriptive recommendations for habitat conditions most suitable for individual and suites of landbird species at several geographic scales (e.g., regional, landscape, site).

- Intermountain West Joint Venture Implementation Plan (IWJV 2013) (Sidebar: *Integration with Intermountain West Joint Venture Implementation Plan*)
- Draft Revised National Forest Land Management Plans including Blue Mountains (USFS 2014) and Colville (USFS 2016)
- The Nature Conservancy's (TNC) Ecoregional Assessments for Okanagan Highlands (Pryce et al. 2006), Canadian Rockies (Rumsey et al. 2003), and Middle Rockies-Blue Mountains ecoregions (Klahr et al. 2000)
- Interior Columbia Basin Ecosystem Management Plan (Wisdom et al. 2000)

Integration with State Wildlife Action Plans

The States of Oregon and Washington recently completed updates of Version 1.0 of their Comprehensive Wildlife Conservation Strategies (i.e. 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 types of actions that need to occur to support their conservation. However, they mostly do not provide quantitative targets or objectives to support implementation of their recommended actions. The greatest potential integration of recommendations in this document with the State Wildlife Action Plans is the prescriptive, quantitative habitat and population objectives that provide the next step for specifically directing conservation and management of priority species and habitats.

The biological objectives and conservation strategies described in this document should be integrated with other conservation planning and implementation in the Northern Rocky Mountains of Oregon and Washington to provide functioning ecosystems for the region's diverse array of landbird species. Some examples of how this integration can or has been used include:

- in environmental assessments (e.g., biological evaluations) that address migratory birds as required under Executive Order 13186 – the Responsibilities of Federal Agencies to Protect Migratory Birds
- as a guide to direct and monitor restoration efforts through specific habitat conditions or species objectives
- to comparatively assess how alternatives in environmental analyses meet conservation objectives at multiple scales.

Integration with the Intermountain West Joint Venture Implementation Plan

The IWJV partnership recently prepared an Implementation Plan which established a framework for science-based habitat conservation built upon the model of Strategic Habitat Conservation (IWJV 2013). It provides quantitative habitat and population objectives that translate continental bird population objectives to ecoregional scales and identifies the quantity and quality of habitat needed to support priority bird populations at goal levels. The greatest potential integration of recommendations in this document with the IWJV Implementation Plan is the prescriptive, quantitative 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 IWJV Implementation Plan. Additionally, recommendations in this document are provided for many habitats and species not addressed in the IWJV Implementation Plan, thus providing quantitative targets and specific habitat conditions to achieve those targets for a broader array of landbird species.

Geographic Scope

The Northern Rocky Mountains as defined in this document encompasses forest and non-forest habitats in two ecoregions, the Blue Mountains in northwestern and northcentral Oregon and a small part of southeastern Washington, and the Okanagan Highlands of northeastern and northcentral Washington (Franklin and Dyrness 1973). For the purposes of cross-walking with other documents, the Okanagan Highlands ecoregion is the same as the Northern Glaciated Mountains in the Interior Columbia Basin Ecosystem Management Plan (Wisdom et al. 2000). In the Washington State Wildlife Action Plan (WDFW 2005) and The Nature Conservancy Ecoregional Planning (Rumsey et al. 2004, Pryce et al. 2006), the Okanagan Highlands is further subdivided into a Canadian Rockies ecoregion in the northeastern corner of Washington and the Okanogan Highlands to the west of that.

This geography includes many similarities in forest types and associated habitats, and also contrasts with adjacent non-forest shrub-steppe rangelands and grasslands in Oregon and Washington. It falls entirely within BCR 10, which also includes substantial area outside of Oregon and Washington. Despite the similarities in habitats, management practices, and land uses, some noteworthy environmental differences exist within a few relatively distinct geographic areas. This provides the opportunity for a finer-scaled spatial framework for establishing some biological objectives at smaller geographic scales where appropriate. These subregions include the Ochoco Mountains in northcentral Oregon, and the Canadian Rockies in northeastern Washington.

Birds and Habitats

The conservation emphasis of this document is native landbird species that regularly breed in the Northern Rocky Mountains of Oregon and Washington. Because breeding bird species occur in all the habitats and conditions that support non-breeding bird species, there is an underlying assumption that habitat management for breeding birds will likely support most, if not all, of the habitat needs of non-breeding birds in these habitat types.

Although only the conservation of landbirds during the breeding season is emphasized, factors that operate outside the breeding season may adversely affect their populations. This is 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 of breeding populations. There is no attempt to address the extensive breadth of those issues in this document, although there is significant emerging science on the need for full life cycle conservation of migratory birds (Martin et al. 2007, Hostetler et al. 2015) (Sidebar: *Full Life Cycle Stewardship of Migratory Birds*). Until specific limiting factors have been identified for each migratory bird species, appropriate conservation actions on the breeding grounds are considered to be a stewardship responsibility of a natural resource shared with many other countries and peoples (Altman and Hagar 2007). Bird conservation partners are encouraged to seek opportunities to develop international partnerships and projects to support conservation of shared migratory landbirds (Berlanga et al. 2010). A conservation business plan is being prepared to provide direction on opportunities for collaborative projects that will benefit landbirds of North American western conifer and conifer-hardwood forests, and Sierra Madre pine-oak and cloud forests of Mexico and northern Central America (Sidebar: *Saving Western Migratory Birds*).

Full Life-Cycle Stewardship of Migratory Birds

Conservation of migratory birds requires actions that provide habitat and ensures healthy populations throughout the year. Habitat conditions in one season can affect the reproduction and survival of migratory birds in subsequent seasons. For example, the quality of winter habitat can affect the timing of migration, leading to decreased survival or reproductive success (e.g., Norris et al. 2004, Rockwell et al. 2012). Therefore, **actions to improve conditions in the tropics can have far-reaching positive effects on landbirds on their breeding grounds in North America.** Conversely, although many northern breeding migrants spend up to eight months each year in tropical habitats, the health of habitats on the breeding grounds where production of the next generation occurs is critical to a species population.

Mortality during migration may be 15 times higher for some species than during the relatively stable breeding or winter periods (Berlanga et al. 2010). Yet we know little about the routes of their migration or the hazards they face including anthropogenic threats, such as windows, tall lighted structures, wind turbines, indiscriminate pesticide use, and unrestrained cats. For migratory bird conservation to be effective and efficient, we need to know how, where, and when these migratory animals travel, and need to implement appropriate conservation actions throughout their life cycle. Thus, full life cycle conservation for migratory birds - geographic linking of individuals or populations between different stages of the annual cycle - breeding, migration and winter – has become an essential component of landbird conservation (Marra et al. 2010).

Even within the context of breeding birds, this document does not directly address all landbird species, but instead emphasizes a suite of "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 conditions (e.g., American Robin, Downy Woodpecker, Song Sparrow), and thus are of less concern for conservation.

A few landbird species are not directly addressed in this document because they already have species-specific conservation strategies and/or recovery plans. This includes two ESA federally-delisted species with recovery plans, Bald Eagle and Peregrine Falcon, and Greater Sage Grouse which has been the focus of significant conservation planning efforts throughout the intermountain west in this region

Saving Western Migratory Birds

Birds that breed in North America's western conifer and conifer-hardwood forests and migrate to over-winter in the Sierra Madre pine-oak and cloud forests of Mexico and northern Central America are imperiled. For many species, their populations have been declining for decades and the declines are worsening. A conservation business plan is being developed by an international group of agencies and organizations to increase understanding that the steepening bird population declines indicate immediate need for large-scaled conservation actions. www.oas.org/en/sedi/dsd/biodiversity/WHMSI/ConservationBusinessPlan.asp

The business plan includes three primary target species that are focal species for conservation in the northern Rocky Mountains as described in this document, Flammulated Owl, Calliope Hummingbird, and Olive-sided Flycatcher. The plan also outlines a strategic framework including nine projects aimed at the direct and indirect threats that cause habitat loss and degradation. The proposed actions will restore and protect target forest habitats, improve forest management, fill information gaps with better science, and offer community education, development, and capacity building. The plan identifies indicators associated with the target species and habitats that will be used to measure conservation success within the context of the plan's strategic framework and project goals and objective.

(e.g., Sage Grouse Initiative, www.sagegrouseinitiative.com). However, existing recommendations for management and conservation of these species has great significance for the conservation of other landbirds. For example, designated areas for management and conservation of the Greater Sage Grouse are an important opportunity for the conservation of other sagebrush-steppe species such as Brewer's Sparrow, Sage Thrasher, and Vesper Sparrow.

This document also does not address birds that primarily use aquatic or wetland habitats such as shorebirds and wading birds (e.g., Great blue-Heron, Spotted Sandpiper), waterfowl (e.g., Mallard), and colonial waterbirds (e.g., Yellow-headed Blackbird). Only a few landbird species are closely associated with these habitats (e.g., Common Yellowthroat, Marsh Wren, Red-winged Blackbird, Wilson's Snipe). Additionally, conservation planning for these types of birds is being conducted by other entities and initiatives (e.g., IWJV, North American Waterfowl Management Plan, National and Regional Shorebird Plans, North American Colonial Waterbird Plan).

This document only addresses the conservation of shrub-steppe, grassland, and juniper birds to a limited degree as unique habitats embedded in the forest-dominant landscape of this region. These habitats are the predominant and priority habitats in other ecoregions, and are fully covered in another PIF plan entitled Conservation Strategy for Landbirds in the Columbia Plateau of Eastern Oregon and Washington (www.orwapif.org). Although conservation of landbird species in these habitats is part of this document, their conservation is most important in the Columbia Plateau and Northern Great Basin ecoregions.

There are only limited geospatial habitat objectives presented in this document, usually at larger scales such as ecoregions. This spatially-explicit aspect of landbird conservation has been a focus of other plans such as 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 Bird Habitat Conservation Areas in the IWJV Coordinated Bird Conservation Plan (iwjv.org/resource/iwjv-2005-implmentation-plan; IWJV 2005), and 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). Bird conservation partners should seek spatially-explicit guidance for landbird conservation from the aforementioned plans and others that provide these types of recommendations.

THE ENVIRONMENT

The Northern Rocky Mountains is a large area of mountains and intermontane valleys covering major portions of four states and two provinces. Approximately 25% of the region occurs in Oregon and Washington (Pryce et al. 2006). Over 60% of the land is in public ownership, primarily the U.S. Forest Service. Climate varies extensively from both north to south and east to west, with many finer-scaled variations due to local topographic changes.

A thorough description of the physical and environmental setting and the historic and current vegetation 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.

Physical Features

The Northern Rocky Mountains is topographically diverse, and abrupt elevation changes from valley floors to mountain summits are not uncommon (Quigley et al. 1996). The landscape includes mountains with narrow valleys, basins, and alpine meadows. Maritime climate, westerly winds, and mountainous terrain yield <25 cm (10 in) of precipitation at the lowest elevations to >203 cm (80 in) in mountainous areas. Soils in many areas are only moderately productive because of shallow depths associated with cold temperatures and low precipitation. The most productive soils occur in valleys and basins where soils are often deep and have high water-holding capacity due to their increased volcanic ash content. The dominant valley bottom settings include both steep, confined valleys with step-pool and rapids dominated streams, and broad, gently sloping valleys with meandering streams in well-developed floodplains at lower elevations.

The forest-dominated landscape provides a link between the Northern Rocky Mountains of western Idaho with the mountains of the Cascade Range in both Oregon and Washington. Within the transition zones, physiographic elements of Rocky Mountain forests merge with some of those from coastal forests to create a complex landscape (Franklin and Dryness 1973). In addition, many transitional zones also occur where forest vegetation mixes with that of steppe and shrub-steppe communities, especially at lower elevations. Elevations range from approximately 275 m (900 ft) to nearly 3,500 m (10,000 ft) in the highest peaks of the Blue Mountains (Franklin and Dyrness 1973). Most of the higher elevations have been glaciated.

Land Use

Land use is as diverse as the topography, although resource extraction, particularly timber harvesting, has been the predominant land use. There is a unique contrast in the tree removal objectives, with extraction manifested exclusively as logging in the wetter forested areas, but clearings in the drier areas are often associated with the removal of juniper to improve rangeland. Fertile grasslands support large hay and livestock operations in areas where windblown silt has created thick soils, while smaller agricultural operations persist in other areas where soils are less developed (Busacca, 1991). There are several designated wildnerness areas, and there is extensive recreational use of the forests, especially the remote areas. A minor land use more historical than current is mining.

Vegetation

The information presented below is a cursory overview of the principal features of the vegetation and plant associations that provide habitat for landbirds. More detailed accounts have been described in several sources including Franklin and Dyrness (1973), Hall (1973a,b), Daubenmire (1988), Johnson et al. (1994), Clarke and Bryce (1997), and Johnson and O'Neill (2004).

Vegetation and plant associations are extremely diverse, dependent on a number of interrelated factors including soils, slope, rainfall, and elevation. In general, there is a progression of vegetation types with increasing elevation, beginning with grasslands at the lowest elevations, and changing to shrublands, ponderosa pine dry forest, mesic mixed conifer forest, subalpine forest and parkland, and alpine meadows (Bryce and Omernik 1997). However, the complexities of the diverse physiography and topography result in a patchwork mosaic of vegetation types and disturbance regimes that leads to a highly variable juxtaposition of plant communities and wildlife habitats, and thus landbird species distributions.

The dominant vegetation is coniferous forest, however the elevational diversity contributes to a variety of ecological systems ranging from sagebrush-grasslands to subalpine and alpine meadows, and alkaline fens to salt-desert scrub (Figure 2). The forests are regularly interspersed with varying-sized nonforest openings of shrublands, grasslands, and riparian corridors. As a result, much of these forests were naturally fragmented (Sallabanks et al. 1999).

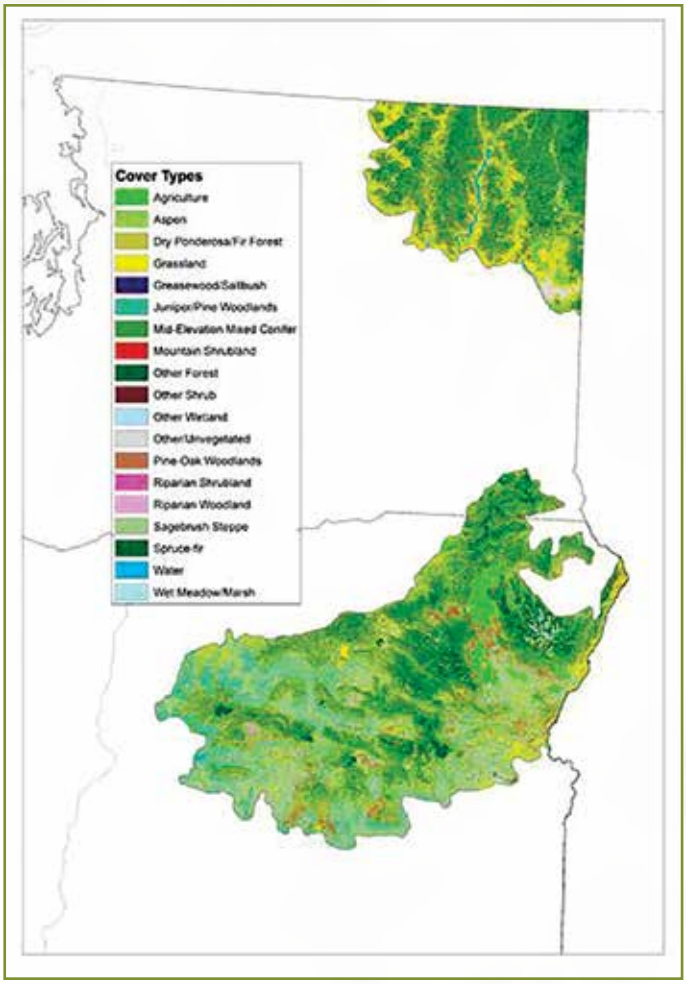


Figure 2. *Vegetation cover types in the Northern Rocky Mountains (BCR 10) within Oregon and Washington.*

Pre-European Settlement

Pre-European settlement vegetation was dominated by coniferous forests, but also included a complex mosaic of non-forest types such as shrublands, grasslands, wetland, and alpine habitats (Kuchler 1966). Forest and other habitat types were determined and maintained by numerous topographic (e.g., slope, aspect) and physical factors (e.g., temperature, moisture) and natural disturbances (e.g., fire). Historically, vegetation communities were relatively well-defined by elevation and natural processes (e.g., fire).

Historical dry forest conditions have been extensively summarized (e.g., Noss et al. 2006, Courtney et al. 2008, Johnson et al. 2008, Crist et al. 2009). Ponderosa pine occurred on the warmest and driest sites, and generally at the lowest elevations, approximately 600-1,200 meters in the Okanogan Highlands and 900-1,500 m in the Blue Mountains (Franklin and Dyrness 1973). Much of the climax ponderosa pine forest was characterized by an open park-like understory maintained by regular low intensity fires which seldom killed adult trees (Agee and Skinner 2005). Grand fir and white fir were also locally important components of this dry forest type (Table 1).

Most dry forest sites were characterized by low tree densities and dominance of larger, older trees of fire-and drought-resistant species such as ponderosa pine and western larch (Munger 1917, Youngblood et al. 2004, Spies et al. 2006, Kolb et al. 2007, Johnson et al. 2008). The understory was open, park-like and maintained by regular low-intensity wildfires. Spatial heterogeneity also was evident, including fine-scale low-contrast structural patchworks (Franklin and VanPelt 2004, Larson and Churchill 2012), and denser, more even-structured forests, consisting of mixtures of Douglas-fir, grand fir, western larch, and ponderosa pine. The latter even dominated some dry forest landscapes as a result of more severe fires and insect epidemics (e.g., Hessburg et al. 2005, 2007).

Table 1. *Native vegetation characteristic of forest habitats in the Northern Rocky Mountains of Oregon and Washington.*

Forest Type	Tree Species	Common Shrubs	Common Herbaceous Plants
Dry Forest	ponderosa pine, grand fir, white fir, western larch	snowberry, mountain mahogany, bitterbrush, mountain big sagebrush	elk sedge, pinegrass, wheeler's bluegrass, bluebunch wheatgrass
Mesic Mixed Conifer Forest	Douglas-fir, western larch, lodgepole pine, grand fir	Rocky mountain maple, Pacific yew, mallow ninebark, big huckleberry, snowberry, thimbleberry, twinflower	western fescue, oak-fern, coolwort foamflower, sword-fern, pinegrass, elk sedge, Hooker's fairy bells
Subalpine Forest	subalpine fir, Englemann spruce, lodgepole pine, whitebark pine	big huckleberry, fool's huckleberry, grouse huckleberry	heartleaf arnica, Queen's cup beadlily, sidebells pyrola

The mesic mixed conifer zone historically occurred at relatively mid elevations and sites that were not moisture-stressed. Douglas-fir, grand fir, and western larch were the principal tree species (Table 1), but there was considerable regional variation in importance among tree species in this zone. For example, in the Blue Mountains, grand fir was probably the most extensive forest zone, and Douglas-fir was minimal in extent (Franklin and Dyrness 1973). Conversely, in the Okanogan Highlands of northeastern Washington, Douglas-fir was a more dominant component of the landscape than grand fir.

The subalpine fir zone was the coolest and wettest forest zone and it also included a deep winter snowpack. Dominant tree species included subalpine fir, Englemann spruce, and lodgepole pine (Table 1). The lower elevation boundary was approximately 1,300-1,700 m and it extended upward to the ecotone with alpine habitat (Franklin and Dyrness 1973). These forests are conspicuous in frost pockets and other habitats characterized by accumulation of cold air. At tree line scattered throughout the planning area, whitebark pine was an important forest community. Some of the more common native species characteristic of all these forest zones are listed in Table 1.

Current Vegetation

Current vegetation has changed substantially due to a number of factors. **Coniferous forest still dominates the landscape, but the composition of forest types and conditions has changed more from anthropogenic factors rather than historically by natural forces that used to maintain the landscape.** These anthropogenic factors include fire suppression, unnatural fire regimes including unprecedented large-scale fires and forest pest outbreaks, intensive forest management, grazing, and widespread development of roads associated with development and recreation (Hann et al. 1997, Sallabanks et al. 2001). Associated consequences from these activities that impact the current vegetation include exotic species invasion, alteration of natural disturbances, and fragmentation and isolation of habitat patches (Baker et al. 2007). The consequences to wildlife are highly variable, both positive and negative, but clearly the ability of the landscape to be maintained to full ecosystem functionality is questionable (Henjum et al. 1994).

Fire suppression, timber harvesting, and more recently climate change have blurred the relatively distinct historical elevational zonation of forest vegetation (Bryce and Omernik 1997). Douglas-fir, grand fir, and Englemann spruce have expanded their range to lower elevations beyond their normal mesic locations. Old-growth ponderosa pine trees have been harvested, and fire suppression and encroachment of other species has resulted in denser thickets of mid-successional fir-dominated forests where late-successional ponderosa pine used to occur. Estimates of the extent of alteration vary. In the Blue Mountains, the proportion of forest land dominated by ponderosa pine has declined from 80% in 1936 to 25% in 1992 (Hessburg et al. 1994). In the 1930s, approximately 60% of the original low elevation old-growth ponderosa pine in the Blue Mountains still existed; by the early 1990s, only 20-25% still existed, and by the early 2000's about 10% (Henjum et al. 1994). Most of the remaining patches are <40 ha (100 ac), and likely too small to maintain ecosystem processes and many old-growth dependent species (DellaSala et al. 1996).

Coniferous forest still dominates the landscape, but the composition of forest types and conditions has changed more from anthropogenic factors rather than historically by natural forces that used to maintain the landscape.

The effect of extensive road development networks also has adversely affected wildlife. Based on an extensive synthesis of the literature, Wisdom et al. (2000) identified 13 direct or indirect factors associated with road development that impacted >70% of the 91 vertebrate species analyzed (includes many landbirds). Additionally, the adverse effects on wildlife from road-associated factors may be additive to that of habitat loss and alteration (Wisdom et al. 2000).

In addition to forest ecosystems, other ecosystems have been degraded to the point of reduced functional integrity. For example, in lower elevation zones of subalpine parkland, fire suppression has likely altered patterns of succession that favor a denser tree canopy and changes in species composition (Franklin and Dyrness 1973). There also has been an extensive invasion of meadows with tree species throughout the region (Franklin and Dyrness 1973), perhaps due to climatic change in the last 50 years.

THE PROCESS

Conceptual Approach

Numerous conceptual approaches for wildlife conservation have been proposed and implemented in recent decades. These 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 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) suggested that a coarse filter (i.e., habitats, landscapes, ecosystems) and fine-filter (i.e., individual species and their habitat needs) approach that is nested and overlapping is the most likely to provide effective wildlife conservation.

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 both 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.

Within PIF, bird conservation is prioritized by the quantitative scoring system of the Species Assessment Database (www.rmbo.org/pifassessment/ [PIF Science Committee 2012]), 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 using priority birds is likely to be compromised because desired conditions for some/many habitat features is dependent on the chance that a priority species is associated with those desired conditions. This results is an opportunistic and unbalanced approach for the conservation of ecosystems or habitats. 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).

The two primary goals for bird conservation under the PIF Initiative are 1) helping species at risk, and 2) keeping common birds common

Given the limitations of the priority species approach for habitat or ecosystem or conservation, and the recommendations of Salwasser (2001), this document emphasizes a multiple-scale approach for landbird conservation. This includes representation of the habitat types and habitat conditions most important to landbirds (coarse-filter), as described through the specific habitat requirements of a suite of individual bird species most representative of the range of desired habitat types and habitat conditions (fine-filter).

At the core of this approach is the use of focal species (Sidebar: Focal Species), an approach increasingly used for conservation of biodiversity (Hannon and McCallum 2004, Wiens et al. 2008). This concept was initially characterized by Lambeck (1997), and has been extensively used in Oregon-Washington PIF planning (e.g., Altman 2000a). More recently the same concept has been promulgated by the U.S. Fish and Wildlife Service (USFWS) as "surrogate species" (www.fws.gov/landscape-conservation/surrogate-species-faqs.htlm). It is important to emphasize that **use of the term focal species in this document, as recommended by Lambeck (1997), is not the same as the often generic use of the term focal species by maqny conservation entities to mean "the priority species that we are focusing on."**

The use of a suite of focal species, rather than a single focal species, provides an efficient and more comprehensive tool to support ecosystem management because it ensures that conservation is directed at the range of important habitat conditions for birds within the ecosystem, and not just the relatively limited habitat relationships of a single species. 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

Focal Species: A Tool for Ecosystem Conservation

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 (Lambeck 1997). Further, the use of focal species draws immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem for landbirds.

component(s) of the habitat needed by those species are likely already addressed through the suite of focal species. It also provides the opportunity to include priority species either as focal species or as stand-alone unique habitat species with species-level recommendations for their conservation. This hybrid approach of using both vulnerable and representative species (i.e., priority and focal, respectively), should provide a solid framework for achieving broad-scale conservation of all landbirds in priority habitats throughout the region.

Components of the Process

The process to support the conceptual approach described above includes the following components, which are summarized in the following sections and presented in detail in the Biological Objectives section:

- identify habitats that are conservation priorities for landbirds
- identify the desired habitat attributes 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 and responsibility species that would benefit from habitat conservation for focal species
- establish measurable habitat objectives to achieve the desired habitat conditions based on the habitat requirements of the focal species
- establish measurable population objectives for focal species to be used as one metric for tracking habitat management for the desired habitat attributes
- recommend habitat conservation strategies that can be implemented to achieve the habitat and population objectives
- conduct monitoring to assess the habitat and focal species response to the habitat conservation strategies and progress towards the habitat and population objectives
- implement adaptive management as appropriate to adjust habitat management towards the trajectory of the habitat and population objectives

Priority Habitats

Priority habitats were selected based on a combination of factors including:

- priority status in the previous Oregon-Washington PIF bird conservation plan for this region (Altman 2000a)
- loss, alteration, and current condition of the habitat relative to that of historic conditions (Wisdom et al. 2000)
- designated as priority in other conservation plans (e.g., IWJV Implementation Plan (Casey 2013), Blue Mountains National Forests Proposed Revised Land Management Plan (www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3792953.pdf), Oregon and Washington State Wildlife Actions Plans [ODFW 2005, WDFW2005], The Nature Conservancy's Okanogan Ecoregional Assessment (Pryce et al. 2006)
- designated as a priority in a statewide process (e.g., Priority Habitats and Species, WDFW)
- importance to one or more priority species as designated by the USFWS, BLM/USFS, ODFW, WDFW

Three habitat types and one habitat category that included several habitat types were selected as priority habitats:

- Dry Forest (ponderosa pine and ponderosa pine/Douglas-fir/grand-fir)
- Mesic Mixed Conifer Forest (late-successional)
- Riparian Woodland

- Unique Habitats (i.e., post-wildfire, cliffs and rock outcrops, alpine montane meadows, subalpine forest, whitebark pine, aspen, lowland wet meadows, upland grasslands, juniper woodland, riparian shrub, sagebrush-steppe, and montane shrubland).

General descriptions of the three priority habitat types are presented in later sections. Estimated acreage of many of the priority and unique habitats is presented in Table 2.

Habitat Attributes

Desired habitat attributes (Sidebar: *Habitat Attributes*) were selected based on a review of scientific literature on bird-habitat relationships to determine the range of important habitat attributes for landbirds within the context of the ecologically desired conditions for the priority habitats. This does not include habitat attributes which may be important to other taxa or the broader ecological community, but are not a primary habitat feature for landbirds (e.g., seeps for amphibians and downed logs for mammals).

Habitat Attributes

The term habitat attribute is used to describe those habitat features, conditions, or elements that function as important life requisites for the focal species representing them. The presentation of quantitative objectives for habitat attributes provides land managers with descriptive and measurable targets to strive to achieve through management or natural succession.

Because there is considerable latitudinal and elevational variability in the geographic scope of this document, there also is high variability in 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 attributes, there

The characterization of bird-habitat relationships in the habitat objectives 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 these broad-scale characterizations should not replace local knowledge or data available for the conservation of focal species and their associated habitat types and habitat attributes.

Table 2. *Acreage of some priority habitat types in the Northern Rocky Mountains of Oregon and Washington.*[1]

Habitat	Total Acres	BCR 10 OR Acres	BCR 10 WA Acres	IWJV Crosswalk Habitat Type
Mesic Mixed Conifer Forest	6,181,596	3,360,330	2,821,266	Mid-Elevation Mixed Conifer
Sagebrush-Steppe	3,745,778	3,615,581	130,197	Sagebrush Steppe
Dry Forest	1,697,633	1,276,978	420,655	Dry Ponderosa/Fir Forest
Juniper Woodland	1,511,095	1,505,594	5,501	Juniper/Pine Woodland
Upland Grassland	1,449,428	612,423	837,005	Grassland
Montane Shrubland	494,091	326,086	168,005	Montane Shrubland
Subalpine Forest	484,940	403,529	81,411	Spruce-Fir
Riparian Woodland	290,672	242,907	47,765	Riparian Woodland
Aspen	194,585	191,458	3,127	Aspen Woodland
Lowland Wet Meadow	192,589	126,116	66,470	Wet Meadow/Marsh
Riparian Shrub	18,301	18,142	159	Riparian Shrubland

[1]**Acres are those for BCR 10 (i.e., Northern Rockies BCR) in Oregon and Washington from the IWJV Implementation Plan (Casey 2013).**

can be variation in response to the specific parameters of the habitat attribute. **The characterization of bird-habitat relationships in the habitat objectives 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 these broad-scale characterizations should not replace local knowledge or data available for the conservation of focal species and their associated habitat types and habitat attributes.**

Focal Species

Focal species were selected based on a combination of factors including review of scientific literature, focal species in the previous Oregon-Washington PIF bird conservation plan relevant to the project area (i.e., Altman 2000a), focal species designated in other conservation planning (e.g., Wisdom et al. 2000), and the following criteria:

- regularly occurring breeding species throughout the geographic area under consideration
- strongly associated with the habitat such that it is a primary habitat type for the species, and they reach some of their highest breeding densities in this habitat type
- strongly associated with an important habitat feature or condition within the habitat type such that they could demonstrate significant responses to management or restoration targeted at the habitat feature or condition
- readily monitored using standard techniques to be able to track progress towards objectives at multiple scales

When more than one species would seemingly make a good focal species for a particular habitat attribute, preference was given to priority species or responsibility species and/or species for which more knowledge exists about its life history and ecology to provide the information for setting biological objectives. One example is White-headed Woodpecker which is not regularly occurring throughout the region and occurs in relatively low densities where it does occur, but is a high priority species and has been studied relatively extensively.

Although there was an attempt to ensure the completeness of the geographic representation of each focal species, there is priority habitat where some of the focal species may not occur as breeding species. In these cases, the recommendation is to use the habitat objectives presented for the focal species, and one of the species listed under "species to benefit" (Appendix A) for tracking population response to habitat management or progress towards any population objective for the focal species.

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, or threats to habitat. An assumption of the 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. 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 the conservation of these species, priority species were recognized and designated as unique habitat focal species with biological objectives if appropriate, or integrated where appropriate as species to benefit from conservation actions directed towards focal species.

Priority species were designated based on their primary association with a priority habitat(s) for breeding and their occurrence on one following lists:

- USFWS Birds of Conservation Concern (USFWS 2008)
- USFS Regional Forester's Threatened, Endangered, and Sensitive Species (www.fs.fed.us/r6/sfpnw/issssp/agency-policy/)
- BLM Threatened, Endangered, and Special Status Species (www.blm.gov/or/resources/sss/index.php)
- ODFW Strategy Species (ODFW 2005)
- WDFW Strategy Species (WDFW 2005)

Integration of Responsibility Species

As part of the goal of keeping common birds common, PIF has traditionally stressed the importance of "responsibility" which highlights geographic areas with a high percent of a species population. This implies a level of responsibility to be good stewards of species where there is a high responsibility for the species based on population size, and that conservation actions taken in these areas will have the greatest effect on the species population. Herein, responsibility species are designated based on data from the PIF population estimates database (www.rmbo.org/pifpopestimates/Database.aspx) using percent population in BCR 10 along with some arbitrary thresholds that reflect the reduced area of Oregon and Washington within the much larger geography of BCR 10. Responsibility species were recognized and designated as focal species with biological objectives if appropriate, or integrated 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. **Habitat and population objectives were established based on the premise that measurable, prescriptive targets for birds and associated habitat attributes are what is most needed by those working on-the-ground for landbird conservation. Conservation partners are encouraged to use the population and habitat objectives as a numerical context within which to stimulate and gauge the local and regional perspective of their conservation actions.**

The biological objectives are not regulatory, nor do they represent the policies or recommendations of any agency or organization (Sidebar: *Quantitative Biological Objectives*). Establishing quantitative biological objectives serves several purposes:

- targets for designing management plans and benchmarks for measuring success of management actions
- hypotheses for research, particularly when objectives are based on assumptions and/or expert opinion due to lack of data
- the best form of outreach to communicate to others what is needed to conserve landbirds
- a starting point for discussion of integration with broader ecosystem-based 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 professional judgment. To indicate this degree of variability, sources for the biological objectives are provided for each focal species (Assumptions/Data Sources). In many cases, the biological objectives were taken directly from recommendations in the scientific literature based on empirical data on bird-habitat relationships. Where bird-habitat relationships data are limited for a focal species, and the biological objectives are based more on professional judgment, these objectives become testable hypotheses for research. **All the numerical biological objectives should be viewed as dynamic, with an emphasis on the need for research, refinement, and improvement over time.**

Quantitative Biological Objectives

It is important to recognize that the **biological objectives in this document 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. **The 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, the 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 a 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 objectives.

Habitat Objectives

Several types of habitat objectives at different scales are presented in the document. At the regional scale, quantitative habitat objectives are presented for three priority conditions including the amount of late-successional habitat in dry forest and mesic mixed conifer forest, the amount of natural forest regeneration in post-fire habitat, and the amount of habitat relative to historic conditions and restoration priorities in riparian woodland. These were derived considering historic and current amounts and projected future land uses.

At smaller scales (i.e., 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 were 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 prescriptive, quantitative, site-level objectives for habitat conditions or attributes:

- means (rather than minimums) of available data were used because they are more likely to 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
- conditions of optimal or high quality habitat were emphasized for self-sustaining populations in geographic areas most suitable for maintaining or providing that habitat (i.e., ecologically appropriate)

Unless otherwise indicated, data on population abundance or density were used to establish habitat objectives that indicate good 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.**

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) continental population abundance objectives (i.e., maintain, increase by 50%, increase by 100%) to reverse population declines to the beginning of the BBS in 1968 (Rich et al. 2004). 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. The establishment of continental landbird population objectives was conceptually 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.

"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."

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
- 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

Bottom-up habitat-based regional assessments to establish landbird population objectives have not been completed for the geography of this document. Herein, population objectives were established for some species based on target density estimates for breeding pairs within suitable habitat. These were established based on a literature review and professional judgment that used focal species mean territory size as the minimum target to encourage the amount of habitat most likely to support the species. Additionally, for species susceptible to Brown-headed Cowbird nest parasitism, population objectives were set to maintain low levels of parasitism.

Landscape Objectives

In addition to site-level habitat attributes, for some bird species there are essential habitat relationships described by the composition and pattern of habitat types and/or structural attributes across the landscape. Thus, conservation of these species requires designing and implementing habitat management at the landscape-level. However, most of what is known about landbird ecology exists at the scale of individual birds/pairs or small populations at the site-level,

and less is known about the relationships between landbird populations and habitat at the landscape scale (Marzluff et al. 2000). Because recognition of the importance of landscape-level considerations for bird conservation is receiving more recent attention (Aubry 2007), some landscape-level objectives are provided in this document as appropriate.

Landscape objectives for focal species were developed in several ways including documented habitat relationships between species and landscape conditions (e.g., percent agriculture or development), species area requirements for occurrence or population viability, and emerging biological knowledge on demographic monitoring and species-specific ecological modeling (e.g., Nott and Pyle 2012, Nott et al. 2005). Further, some landscape objectives for the amount of area of suitable habitat were established for many focal species to encourage habitat management for small populations (e.g., >10 pairs) rather than individual pairs. All these objectives need to be tested in an effort to expand our knowledge of landbird ecology and management at the landscape scale.

Habitat Conservation Strategies

Habitat conservation strategies are provided as examples of management actions that may be used to support the habitat objectives or enhance conservation relative to a habitat attribute or focal species. These strategies are presented for both the habitat types as general recommendations, and also for each individual focal species to support achieving the specific habitat conditions or attributes that species represents.

The habitat strategies can be institutionalized into management practices or implemented on an opportunistic basis within the broader context of ecosystem management. The recommendations include only some of a variety of likely appropriate actions. Land managers should consult with ecologists and scientists from other disciplines to ascertain appropriate habitat conservation actions to prescribe for specific areas. These individuals also can be a valuable source of information for additional habitat management actions to achieve the biological objectives.

THE BIRDS

There are approximately 125 regularly breeding landbird species in the Northern Rocky Mountains of Oregon and Washington (Johnson and O'Neill 2001). Other species may occur in parts of the region, even occasionally as breeding species, but are not considered to be regular components of the avifauna. Some examples include Anna's Hummingbird, Black Rosy-finch, Blue Jay, and Clay-colored Sparrow. Additionally, many other species occur as migrants or wintering species only. Some examples include American Tree Sparrow, Bohemian Waxwing, Snow Bunting, Rough-legged Hawk, and White-winged Crossbill.

There are no endemic landbird species (i.e., species unique to the region), however several breeding species are relatively unique to only this part of Oregon and Washington. Some of these include American Redstart, Gray Catbird, Northern Waterthrush, Spruce Grouse, and Upland Sandpiper. Some species are substantially more abundant in the northern part of the region (i.e., Okanagan Highlands) than the southern part (i.e., Blue Mountains) including American Redstart, Black Swift, Calliope Hummingbird, Least Flycatcher, Northern Waterthrush, Spruce Grouse, and Red-eyed Vireo. Conversely, fewer species are substantially more abundant in the southern part of the region than the northern part including Lincoln's Sparrow and Williamson's Sapsucker.

Three landbird species have been extirpated as breeding species from some parts of the region. A historically small breeding population of Upland Sandpiper has been extirpated in Washington since 1993 (McAllister 1995, Smith et al. 1997). Sharp-tailed Grouse has been extirpated from eastern Oregon since the 1960s, although reintroductions and possible movement of Idaho birds has resulted in some small current populations (Coggins 2004). White-headed Woodpecker has been extirpated from a number of sites in the Blue Mountains where they were formerly relatively common in the late 1970s and early 1980s (Nielsen-Pincus 2005).

Bird-Habitat Relationships

An essential component for establishing biological objectives and recommending appropriate habitat strategies to support the biological objectives is an understanding of the relationships between landbird species and their habitat. The most recent synthesis of knowledge on this is *Wildlife Habitats and Species Associations in Oregon and Washington* (Johnson and O'Neil 2001), and two recent State bird books, Marshall et al. (2003) for Oregon, and Wahl et al. (2005) for Washington. Herein, available information on bird-habitat relationships from these compendiums and numerous other studies were used to support the selection of focal species and the setting of biological objectives.

Landbird Conservation Issues

Landbird conservation issues are as diverse as the landscape, and vary in scale from local land use decisions to changes in ecological processes at landscape scales. Most of the challenges of landbird conservation arise either directly or indirectly from conflicts with the human footprint that result in habitat changes and alteration of natural ecological processes. For many migratory species, issues occurring outside the geographic scope of this document also are likely affecting their breeding populations, perhaps even more significantly than local or regional issues.

Because most land ownership is large areas of public forest lands or industrial forest lands, a significant part of landbird conservation is addressing issues within the context of forest 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 and recommendations in the form of biological objectives that could be used in developing the policy/regulations that will be necessary to support landbird conservation.**

Declining Landbird Populations

The Breeding Bird Survey (BBS) (Robbins et al. 1986) is the primary source of population trend information for North American landbirds since 1968 (www.mbr-pwrc.usgs.gov/bbs/) (Sidebar: The Breeding Bird Survey: A Source for Landbird Population Trends). Extensive habitat changes prior to that time undoubtedly affected bird populations, but there are no quantitative data to document them. Attempts to assess the extent of bird population changes prior to the BBS have been documented through an examination of historical habitats at the time of European settlement (approximately 1850), and knowledge of bird species habitat relationships (Wisdom et al. 2000). This information is presented as available under each focal species account in the Biological Objectives section.

There are 38 BBS routes in the Northern Rocky Mountains of Oregon and Washington, some of which extend partially into other ecoregions. This includes 28 routes in the Blue Mountains (25 in Oregon and three in Washington) and 10 routes in the Okanagan Highlands. Within the

Blue Mountains, five routes are in the Ochoco Mountains subregion, and within the Okanagan Highlands, five routes are in the Canadian Rockies subregion.

There is no standard population trend analyses of BBS data specifically for the geographic scope of this document. Trend estimates for the much larger Northern Rockies BBS region, which includes parts of three other states and two Canadian provinces are presented in Table 3. Although these trends may not reflect landbird populations in just Oregon and Washington, similarities in physiography, land use, and habitat management across the entire Northern Rocky Mountains suggest that similar trends may exist in Oregon and Washington.

The Breeding Bird Survey: A Source for Landbird Population Trends

The Breeding Bird Survey (www.mbr-pwrc.usgs.gov/bbs/bbs.html), a volunteer-based survey initiated in the late 1960s, provides the best data on population trends of landbird species. Each June, volunteers conduct roadside counts on over 4,000 randomly selected routes across the North American continent. Data are stored and managed by the administering agencies, the U.S. Fish and Wildlife Service and the Canadian Wildlife Service.

Table 3. *Landbird species with statistically significant population trends in the Northern Rockies Breeding Bird Survey analyses.* [1,2]

Species	Significantly Declining Trends		Significantly Increasing Trends	
	Long-Term (1968-2012)	Short-Term (1980-2012)	Long-Term (1968-2012)	Short-Term (1980-2012)
American Kestrel	X	X		
American Redstart	X			
American Robin		X		
Barn Swallow	X			
Black-capped Chickadee	X			
Black-headed Grosbeak			X	X
Bobolink	X			
Brewer's Blackbird	X	X		
Brown-headed Cowbird	X	X		
Cassin's Finch	X	X		
Cassin's Vireo			X	
Cedar Waxwing			X	
Cliff Swallow	X			
Common Nighthawk	X			
Common Raven			X	X
Dark-eyed Junco	X			
Gray Catbird			X	X
Golden-crowned Kinglet	X			
Horned Lark	X	X		
Killdeer	X	X		
Least Flycatcher	X			
Lincoln's Sparrow			X	X
Mountain Chickadee	X			
Mourning Dove	X	X		
Northern Flicker	X			

Table 3. *Landbird species with statistically significant population trends in the Northern Rockies Breeding Bird Survey analyses.* [1,2] *(continued)*

Species	Significantly Declining Trends		Significantly Increasing Trends	
	Long-Term (1968-2012)	Short-Term (1980-2012)	Long-Term (1968-2012)	Short-Term (1980-2012)
Olive-sided Flycatcher	X	X		
Pacific Wren			X	
Pileated Woodpecker			X	
Pine Siskin	X			
Red Crossbill	X			
Red-eyed Vireo	X	X		
Red-naped Sapsucker			X	
Red-winged Blackbird	X			
Rock Wren	X			
Rough-winged Swallow	X			
Savannah Sparrow	X			
Song Sparrow	X	X		
Swainson's Thrush	X			
Varied Thrush	X			
Veery	X			
Vesper Sparrow	X			
Warbling Vireo			X	X
Western Tanager			X	X
Western Wood-pewee	X			
White-crowned Sparrow	X			
Willow Flycatcher	X			
Wilson's Warbler	X			
Yellow Warbler	X	X		
Yellow-rumped Warbler	X			

[1] Includes only native landbird species that are regular breeders in the Northern Rocky Mountains of Oregon and Washington.
[2] Includes only species with statistically significant trends and a relatively high confidence in the data with at least moderate precision and moderate abundance in routes (i.e., blue dot credibility measure: www.mbr-pwrc.usgs.gov/bbs/credhm09.html) (Sauer et al. 2014).

Green = priority species
Blue = focal species
Gray = responsibility species
Pink = focal and priority species
Red = focal, priority, and responsibility species

In the Northern Rocky Mountains, BBS data indicates more than three times as many species with statistically significant recent (1980–2012) and/or long-term (1966–2012) declining population trends than increasing population trends (i.e., 38 species versus 12 species) (Sauer et al. 2014). Additionally, other species may be experiencing population declines, but lack sufficient data for statistical confidence (e.g., Broad-tailed Hummingbird, Lewis's Woodpecker, Pinyon Jay, and Williamson's Sapsucker), or are not adequately addressed by the BBS such as owls.

Even more alarming than the ratio of declining to increasing species is the comparison with the previous Version 1.0 of this document when BBS trend data was through 1996. There were over twice as many species with significantly increasing trends than declining trends (36 versus 16) (Altman 2000a), almost the opposite of the current situation. This suggests substantial negative effects on many species populations in the last 15 years.

Forest Health

Composition and structure of existing dry forest landscapes have been dramatically altered by decades of fire suppression, grazing by domestic livestock, timber harvesting, and plantation establishment resulting in (1) fewer old trees of fire-resistant species, (2) denser forests with multiple canopy layers, slower growth, and reduced vigor in existing trees, (3) more densely forested landscapes with continuous high fuel levels, and, consequently, (4) more sites and landscapes highly susceptible to large-scale wildfire and insect epidemics (e.g., Hessburg et al. 2005, Noss et al. 2006).

Very little historical old-growth dry forest conditions (i.e. >200 years old) exist today. Where it does occur, tree densities and fuel accumulations present a significant risk to long-term survival and future restoration. Lightning-caused and accidental fires have the potential to burn with unprecedented and uncontrollable intensity and magnitude. This kind of large-scale fire removes the option for restoration because the remaining old-growth trees would be lost from the landscape and cannot be replaced for more than 200 years. Further, the intensity of large-scale fires often damages the soil or allows understory species better adapted to intense fire regimes to take hold. The result is generally delayed recolonization by all species where the soil is damaged, or recolonization by shrubs that outcompete seral tree species and prevent or delay their establishment for many years to come. The impact is the same, however, with the extended loss of the old growth dry forest from the landscape.

In the Northern Rocky Mountains, BBS data indicates more than three times as many species with statistically significant recent (1980–2012) and/or long-term (1966–2012) declining population trends than increasing population trends (i.e., 38 species versus 12 species)

The increased density of trees in degraded dry forest ecosystems, generally 10 to 100 times their historical density (Sloan 1998), has resulted in increased competition on these sites. Overstory trees have become water- and nutrient-stressed, making them more susceptible to disease and insect outbreaks (Sidebar: *Beetles and Forest Birds*). Regeneration is negatively affected with density-related stress, diseases, and insects which affect an older tree's ability to produce seed to recolonize sites for restoration. Further, the overall density of trees also affects the ability of ponderosa pine to regenerate and thrive in the understory.

Beetles and Forest Birds

Forest beetles play an important ecosystem role by principally attacking old or weakened trees, allowing younger trees to develop, while providing an important food resource to insectivores such as woodpeckers (Saab et al. 2014). However, tree mortality from large-scale bark beetle outbreaks are increasingly prevalent in western North America, causing considerable ecological change in forests with important implications for birds. A comprehensive review of literature on beetle infestations in lodgepole and ponderosa pine forests revealed a range of results among 25 landbird species (Saab et al. 2014). Some general conclusions were that cavity-nesting species responded more favorably to beetle-killed forests than species with open-cup nests, and species nesting in the shrub layer favored outbreak forests compared with ground and open-cup canopy nesters that generally showed mixed relationships. Bark-drilling species as a group clearly demonstrated a positive short-term association compared with that of other foraging assemblages. Cavity-nesting birds that do not consume bark beetles (i.e., secondary cavity-nesting species and nonbark-drilling woodpeckers), also exhibited some positive responses to outbreaks, although not as pronounced or consistent as those of bark-drilling woodpeckers.

Snags are deficient in many forests types, but especially dry forests and especially on private lands. Dead and dying trees are an essential component of natural forest ecosystems, providing invaluable habitat for landbirds, especially cavity-nesting birds, and a means for important nutrients to cycle back into the forest. While too many snags may indicate unhealthy conditions, a healthy forest always contains some amount of diseased, dying, and dead trees.

In dry forests prior to Euro-American settlement, regular understory fires and bark beetles were the primary disturbance factors maintaining snags across the landscape. The current situation is very different with snag removal, especially on private lands for aesthetics and safety, and on some public lands for fuelwood. Further, extensive reduction in old trees due to harvest has resulted in the snags that do occur being much smaller in diameter. Additionally, although there may be an actual increase in the number of snags due to large-scale wildfires and beetle infestations, the snags created by these circumstances are very dissimilar to historic conditions, and provide only limited value to focal and priority landbirds (Sidebar: Not all Snags are Created Equal).

Not all Snags are Created Equal

Many of the recent, large-scale wildfires and beetle infestations throughout the Pacific Northwest have occurred in lodgepole pine forests, which have a very different relationship with insects and fire than ponderosa pine dry forests. Lodgepole pine forests naturally grow very dense, and large intense wildfires and massive beetle infestations were part of the regular life cycle of these forests, setting the stage for a new cycle of dense tree regeneration. **Historic fires in dry forests and mesic mixed conifer forests most often were of low or moderate intensity (occasionally high intensity), and created a mosaic of burned and unburned conditions with snags of varying sizes, and both clumped and scattered across the landscape within the context of a living forest.** Thus, the large-scale and intensive, often complete tree mortality frequently seen today in both these forest types is often very different from what landbird species evolved with. Although the snags and habitats created by the current conditions of large-scale mortality can be important to some birds (e.g., Black-backed Woodpecker), they do little to benefit the focal and priority dry forest cavity-nesting birds due to the lack of larger snags and lack of heterogeneity in landscape and microsite habitat conditions.

American Bird Conservancy and Cavity-nesting Birds in Private Ponderosa Pine Forests

American Bird Conservancy in cooperation with numerous partners has developed a full-spectrum, regional conservation alliance to improve habitat conditions and increase populations of cavity-nesting birds in ponderosa pine forests of the Pacific Northwest. The program emphasis is high priority species such as Flammulated Owl, Lewis's Woodpecker, White-headed Woodpecker, and Williamson's Sapsucker in Oregon, Washington, Idaho, and Montana. The primary focus has been to assist private landowners to incorporate management prescriptions with the specific needs of the birds into the more general prescriptions of forest management to improve forest health. Additionally, there has been extensive on-the-ground habitat management. Three outreach brochures and a technical document on cavity-nesting bird conservation have been produced to assist private landowners (www.abcbirds.org/results/publications/#special-reports).

The importance of snags to cavity-nesting birds in Rocky Mountain forests is widely recognized (Bull et al. 1986, Saab and Dudley 1998). Among priority landbird species in this region, the four most widely recognized are all cavity-nesting birds highly associated with snags in dry forests – Flammulated Owl, Lewis's Woodpecker, White-headed Woodpecker, and Williamson's Sapsucker. These species have been the focus of a regional alliance for their conservation lead by the American Bird Conservancy (Sidebar: American Bird Conservancy and Cavity-nesting Birds in Private Ponderosa Pine Forests).

Forest Management

A principal conservation issue affecting breeding landbird populations in the Northern Rocky Mountains is forest management because of the dominance of forests across the landscape, and the extensive use of the forests for a variety of human activities and commodity production. 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).

The types of timber harvest and consequently impacts on landbirds have changed over the years. Early timber harvests targeted the largest trees in the easiest access lower elevations, which in most instances were ponderosa pine, and to a much lesser extent Douglas-fir and western larch (Sallabanks et al. 2001). This form of harvest, coupled with fire suppression, allowed smaller, shade-tolerant, late-successional species such as Douglas-fir to capture the growing space (Sampson et al. 1994). The result was a rapid shift on many sites from forests dominated by seral species to forests dominated by late-successional species, and from open forests of old growth trees to dense forests of young trees (Agee 1993, Wright 1996). This significantly changed the habitat available to birds associated with the historic open forests.

As forest management advanced with mechanization, intensive harvest practices such as clearcutting and replanting were the norm, especially at lower elevations. This completely and suddenly changed the landbird community with the greatest negative effects on less adaptive species with high site fidelity and narrower tolerances in habitat requirements. Today, the emphasis in forest management is on maintaining and reestablishing forest health through ecological restoration activities such as selective harvest (e.g., thinning), fuels reduction, and natural regeneration which is considered a more ecologically responsible harvest method in dry forests (Steele 1994). This change has often been referred to as "New Forestry" (Franklin 1989) or "Ecological Forestry" (Johnson and Franklin 2009). The basis for this type

Dry Forest Accelerated Restoration

After more than a century of active fire suppression and evolving timber management practices, dry forests that historically experienced low intensity surface fires have become forests that commonly experience crown fire, and extensive areas have become vulnerable to uncharacteristic outbreaks of insects, diseases, and wildfires. Thus, there is a great need for actively managing these degraded forests to mimic historic conditions, reduce catastrophic threats, and be more resilient to the uncertainties of climate change.

Comprehensive ecological restoration is becoming the foundation of federal land management (Bosworth 2006). Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed from a desired ecosystem state (Society for Ecological Restoration International 2004). A goal of forest health restoration is to regain ecological **integrity and forest functionality in frequent fire forests (i.e., dry forests) to more normalized levels of resilience to catastrophic fire, insects, disease and other disturbances, as well as maintaining forest structures prevalent prior to modern fire suppression policy and methods** (Maginnis and Jackson 2007).

Dry forests dominated by ponderosa pine are the target of most forest restoration activities in the western United States (Hessburg et al. 1999, Allen et al. 2002, Baker et al. 2007), primarily to reduce the risks of beetle outbreaks and fires, the latter especially near human habitation. Within eastern Oregon and Washington (includes area outside the geographic scope of this document, i.e., Cascade Mountains) it is estimated that there are more than 2.6 million acres of national forest lands in need of restoration (USFS unpublished outreach paper). Currently, the USFS implements forest restoration treatments on about 129,000 acres of dry forest annually in eastern Oregon, or just 1.4 percent of the USFS forestland in eastern Oregon not restricted from active forest management (Economic Assessment Team 2012). Thus, the rate of forest restoration has not kept pace with current and ongoing degradation, and the acres in need of restoration have out-paced restoration accomplishments. Therefore, there has been significant efforts on USFS lands to initiate landscape-level restoration projects to restore ecological resiliency and ensure socio-economic viability of the forests through an accelerated pace and scale of restoration.

Desirable restoration activities include silvicultural treatments that retain and release older trees, reduce tree densities through thinning, shift composition toward fire-and drought-tolerant tree species, incorporate spatial heterogeneity at multiple spatial scales, and reintroduce fire where appropriate (Franklin and Johnson 2012). In addition to these vegetation management activities, forest health restoration presents opportunities to improve the overall condition of forested watersheds and related habitat through watershed restoration activities such as upgrading stream crossing structures, improving and reducing road networks, stabilizing stream banks, and reintroducing native plant species. In many instances, acres protected from large-scale fires through forest restoration is greater than the actual amount of treated acres because untreated acres are likely to be protected from crown fires by nearby acres that are treated.

of forest management is an attempt to 1) use disturbance patterns and habitat heterogeneity that occur in unmanaged forests as a guide for harvest patterns and retention, and 2) accelerate re-establishment of late-successional forest conditions and structural elements such as snags, down logs, and vertical heterogeneity (Sidebar: *Dry Forest Accelerated Restoration*).

Landbird responses to forest management practices are complex, species-specific, and dependent upon many environmental and ecological factors. Because timber harvesting changes the structure, density, and vegetative diversity in forests, the new habitats may have beneficial or negative effects depending on the species (Ghalambor 2003). It is also important to recognize that habitat alterations during restoration activities may temporarily or permanently displace landbird species currently using those areas. However, most degraded dry forest habitats tend to support invasive bird species or habitat generalist species, both of which are usually widespread and fairly common and not of high conservation concern. Summaries of the effects of forest management on birds in coniferous forests of the Pacific Northwest have been synthesized by Hagar et al. (1995), Bunnell et al. (1997), and Sallabanks et al. (2001). More specifically, projections of potential landbird response to dry forest restoration activities is presented in Appendix B.

This document does not attempt to describe all the potential forest management activities that could be conducted to achieve the desired habitat conditions for landbirds. 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.

Wildfire

Wildfire historically was a regular and significant natural disturbance in the Northern Rocky Mountains, ranging from frequent low-severity fires to infrequent large-scale events (Kotliar et al. 2005). Dry forest sites typically experienced predominantly low-and mixed-severity fires at frequent intervals (e.g., 5–35 years), with much larger return intervals for mixed conifer forests (50-100 years) and subalpine forests (>100 years) (Agee 1993, Perry et al. 2011). Lower elevation forests and drier sites tended to burn more frequently with lower intensity, which would leave most of the large trees alive. The ecological persistence of many forest birds was facilitated by wildfire (Kennedy and Fontaine 2009, Fontaine and Kennedy 2012), which played a role in maintaining a mosaic of successional stages or habitat structures (e.g., snags) throughout forests of the Pacific Northwest (Huff et al. 2005).

Despite the long established history of wildfire in the Northern Rocky Mountains with its low-to-moderate precipitation and abundance of fuel sources (Heyerdahl et al. 2001), wildfire now poses a major threat to forests and associated bird species. **Vegetation build-up following decades of fire suppression over much of the 20th century has resulted in a fire regime that is well outside the historic range of variability** (McCullough et al. 1998). These fires not only pose an immediate threat to wildlife habitats, but also contribute to future fires by altering forest composition and structural characteristics, and making damaged trees more vulnerable to insect pests (McCullough et al. 1998). In an effort to reduce the threat of large, unmanageable forest fires, forest thinning and low-level prescribed fires are regularly being applied across the dry forest landscape to remove built-up fuels and excess understory growth (Mutch et al. 1993).

Vegetation build-up following decades of fire suppression over much of the 20th century has resulted in a fire regime that is well outside the historic range of variability

Salvage Logging and Cavity-Nesting Birds

Natural forest regeneration after wildfires is an historical ecological process under which landbirds evolved. Where current wildfires have occurred, there is significant pressure to conduct salvage logging to extract merchantable lumber. Salvage logging removes dead, dying, or weakened trees that provide nesting and foraging habitat for woodpeckers and other cavity-nesting species (Hutto and Gallo 2006, Saab et al. 2007). Significant research has been conducted to address the consequences of salvage logging on cavity-nesting birds under the Birds and Burns Network (www.fs.fed.us/rm/wildlife-terrestrial/birds-burns/). In mixed-severity ponderosa pine forests in western Idaho, among seven cavity-nesting bird species, Hairy Woodpecker was the only species in which partial-salvage logging had a measurable, negative impact on both nesting densities (Saab et al. 2007, 2009) and nesting success (Saab et al. 2011). Several other species, including black-backed woodpeckers, mountain bluebirds, and northern flickers, had higher nesting densities only in unlogged burned forest (Saab et al. 2007, 2009). Saab et al. (2011) concluded that carefully planned salvage logging can maintain habitat for successfully breeding cavity-nesting birds if the prescriptions include both unlogged reserves (especially if located centrally in post-wildfire forests, distant from unburned habitats that potentially serve as sources of nest predators), and partially logged areas that retain moderate snag diameters (>23 cm [9 in] dbh) and densities (45 snags/ha [18/ac]). Hutto (1995) commented similarly on the need for unlogged areas in forest burns to maintain microhabitat conditions for several bird species highly associated with the entire ecosystem that burned forests provide.

Several other non cavity-nesting bird species respond positively to the conditions created by wildfires. In particular, Olive-sided Flycatcher demonstrates a strong positive response to early-successional conditions following wildfires throughout their range (Hutto 1995, Sallabanks and McIver 1998). Salvage logging negatively impacts the presence and/or quality of shrub habitat through ground-disturbing activities. This can affect availability of flying insects, the principal prey item for Olive-sided Flycatcher. Furthermore, post-salvage planting and management for conifer trees often selects against deciduous trees and shrubs considered competing vegetation to conifer establishment.

Many landbird species that evolved with historic post-wildfire habitat, and find varying degrees of habitat suitability in the conditions associated with the more recent expansion of large-scale wildfires, face another challenge with salvage logging (Sidebar: *Salvage Logging and Cavity-Nesting Birds*). Post-wildfire salvage logging has become increasingly prevalent as the amount of forested area burned by wildfire has increased over the past two decades (McIver and Starr 2001, Beschta et al. 2004, Stephens and Ruth 2005, Lindenmayer et al. 2008).

Livestock Grazing

Livestock grazing began shortly after Euroamerican settlement, and by the late 1800s enormous herds of sheep and cattle roamed freely throughout lower elevation dry forests (Sallabanks et al. 2001). Current livestock grazing pressure is reduced from the early 1900s, but still results in some localized degradation of vegetation and soils, particularly in riparian areas (Gillen et al. 1984). It can contribute to reduced vegetative cover, compacted soil, decreases in native grasses, increases in the spread of noxious and exotic weeds, and alteration of hydrology, which affects the vegetative composition and structure of the habitat for birds. Intensive grazing also interrupts natural fire regimes by reducing fuels and the occurrence of low intensity fires from spreading in a normal pattern (Covington and Moore 1994).

There has been extensive research and summaries on the effect of livestock grazing, especially in riparian habitats, on bird abundance and populations (e.g., Bock et al. 1993, Tewksbury et al. 2002). **Responses are often species-specific, but any level of livestock grazing is detrimental to riparian landbirds to some degree, especially species dependent on understory vegetation composition and structure** (Martin and McIntyre 2007). High levels of livestock grazing result in significantly diminished abundance or absence of many landbird species (Taylor 1986). Further, livestock trampling and movement can destroy bird nests (Jensen et al. 1990). Complete exclusion of livestock grazing in riparian habitat is the most beneficial to bird populations (Krueper 1993, Earnst et al. 2012). However, seasonal exclusion (e.g., winter only) with controls on intensity can still provide suitable habitat for some species (Nelson et al. 2011).

Climate Change

It is generally predicted by most climate change scientists that temperatures will rise and precipitation will increase in the Northern Rocky Mountains (Funk et al. 2014), and there will be more frequent wildfires and insect-caused tree mortality (Carter 2003). More specifically, there will be higher minimum winter temperatures, higher late winter and early spring temperatures, and lower volumes of river flows, as well as earlier peak streamflows (Hidalgo et al. 2009; Barnett et al. 2008; Bonfils et al. 2008; Pierce et al. 2008). The prediction of higher temperatures will further exacerbate the current situation in which temperatures have risen more in the Rocky Mountain region than in the United States as a whole over the past 20 years (Funk et al. 2014).

Research has indicated that birds are impacted by climate change in a variety of ways, both directly such as distributional changes and indirectly by altering food supply or timing of reproduction or migration, thus affecting overall fitness (King and Finch 2013). One of the greatest concerns is the potential for unsynchronized responses of vegetation and birds to a changing climate that results in settlement (residency or movement) in marginal or unsuitable habitat.

Forest birds, especially western forest birds, are predicted to fare better in a changing climate than birds in other habitats (Peterson 2003, North American Bird Conservation Initiative 2010). Modeled projections of changes in distribution for Rocky Mountain forest birds indicated less changes than those of Great Plains birds

Forest birds, especially western forest birds, are predicted to fare better in a changing climate than birds in other habitats

(Peterson 2003). Conversely, montane forest birds, especially spruce-fir species, are considered to be especially vulnerable because the area available for them to colonize decreases as habitat and species ranges shift upwards in elevation due to climate change (King and Finch 2013). Alpine birds face an even greater challenge with a warming climate and encroaching forests resulting in less area and no opportunities to move (Jackson et al. 2015).

Herein, there is 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 habitats will likely result in changes in the distribution and abundance of those species. Early strategies identified to potentially mitigate the impacts of climate change on bird populations include:

- maintaining the resilience of habitats through active management to reduce compound stressors (fire suppression, human development, overgrazing, invasive species) that potentially interact with climate change and magnify its impact
- increasing the area of protected lands to include

greater representation of habitat refugia, where species are predicted to be buffered from the effects of climate change (Millar et al. 2007)

- establishing and maintaining habitat connectivity along elevational and latitudinal gradients through corridors or networks of preserves to facilitate incremental shifts in distribution by climate-adaptive species following likely routes of change in vegetation (Peters 1992, Mawdsley et al. 2009)

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. 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). The Audubon Birds and Climate Change Report, which documents the results of modeled analyses of bird data, provides projected outcomes on all North American birds (Langham et al. 2014).

Focal Species

A list of focal species and the habitat attributes they represent is presented below for each of the three priority habitat types and the 12 unique habitats.

Dry Forest

Dry Forest includes coniferous forest composed exclusively of ponderosa pine or co-dominated by ponderosa pine and Douglas-fir or grand fir. It occurs primarily at lower elevations and mostly on xeric, upland sites with shallow, rocky soils.

The justification for dry forest as a priority habitat is the extensive loss and degradation of these forests, especially ponderosa pine forests, and the number of priority bird species highly associated with this habitat type. Declines of dry forest habitat were among the most widespread and strongest declines among habitat types in an analysis of source habitats for terrestrial vertebrates in the ICBEMP (Wisdom et al. 2000). Within the Blue Mountains and Northern Glaciated Mountains, old forest, single overstory ponderosa pine habitat has declined by 96 and 99%, respectively. In addition to the overall loss of this forest type, two features, snags and old-forest conditions, have been diminished greatly and negatively impacted species such as Flammulated Owl, Lewis's Woodpecker, Pygmy Nuthatch, White-breasted Nuthatch, White-headed Woodpecker, and Williamson's Sapsucker.

The desired condition in dry forest is a large tree, single-layered canopy with an open, park-like understory dominated by herbaceous cover with scattered shrub cover and pine regeneration as ecologically appropriate. Because of the extensive loss of dry forest, habitat restoration is the most important strategy for conservation of landbirds associated with this habitat type (Sidebar: Dry Forest Restoration: Winners Trump Losers in Bird Conservation). Landbird conservation in dry forest emphasizes maintaining healthy ecosystems that include representative focal species for four habitat conditions. These include large patches of late-successional forest with heterogeneous canopy cover, interspersion of herbaceous openings and patches of dense sapling/pole trees, an open herbaceous understory with scattered sapling pines, and large snags (Table 4).

Table 4. *Habitat attributes and associated landbird focal species for conservation in Dry Forest habitats in the Northern Rocky Mountains of Oregon and Washington.*

Habitat Type	Habitat Attribute	Focal Species
Dry Forest (Ponderosa Pine and Ponderosa Pine/Douglas-fir/Grand-fir)	large patches late-successional forest with heterogeneous canopy cover	White-headed Woodpecker
	interspersion herbaceous openings and patches of dense sapling/pole trees	Flammulated Owl
	open herbaceous understory with scattered sapling pines	Chipping Sparrow
	large snags	Lewis's Woodpecker

Dry Forest Restoration: Winners Trump Losers in Bird Conservation

Restoration of degraded dry forests will reduce populations of landbird species that are provided suitable habitat in the closed canopy, dense understory mixed conifer forests that now dominate what was historically dry forest. This may include focal, priority, and responsibility species such as Northern Goshawk, Red-breasted Nuthatch, and Townsend's Warbler. This impact may surface as a concern at the project level, but these habitats represent degradation of historic dry forest conditions and they dominate the region. Even with an emphasis on restoration of historic dry forest conditions, there is not likely to be a shortage of the current degraded conditions in what was historically dry forest throughout the region. Further, populations of these mixed conifer forest species have benefitted from the habitat degradation with expansion of their suitable habitat at the expense of populations of focal, priority, and responsibility dry forest species such as Chipping Sparrow, Flammulated Owl, Lewis's Woodpecker, Pygmy Nuthatch, and White-headed Woodpecker.

Mesic Mixed Conifer Forest

Mesic mixed conifer forest includes coniferous forest composed primarily of cool moist Douglas-fir/Grand fir, cool dry Douglas-fir, western larch, hemlock, and occasional ponderosa pine. It occurs mostly at higher elevations, wetter sites, northerly aspects, and in draws where soils are mesic and more well-developed. This habitat type does not include sites that were historically dry forest, but are mixed conifer now due to fire suppression and encroachment of other conifer tree species.

The justification for mesic mixed conifer forest as a priority habitat is a substantial loss of the late-successional stage and important structural elements such as snags. It has been commonly harvested by regeneration prescriptions such as clearcuts or shelterwood cuts to reduce insect infestation and disease and reduce the risk of catastrophic fire. Landbird species highly associated with mesic mixed conifer forest that have been adversely impacted by the loss and degradation of late-successional conditions include Dusky Grouse, Golden-crowned Kinglet, Olive-sided Flycatcher, Red-breasted Nuthatch, Townsend's Warbler, and Varied Thrush.

The desired condition in mesic mixed conifer forest is a multi-layered late-successional forest with a diversity of structural elements (e.g., snags, dense shrub patches, high canopy cover) in large patches across the landscape. Landbird conservation in mesic mixed conifer forest emphasizes maintaining healthy ecosystems that include representative focal species for four habitat conditions. These include high canopy cover and foliage volume, patches of dense understory shrubs, forest edges and openings with scattered trees, and large snags (Table 5).

Riparian Woodland

Riparian woodland is primarily the woody vegetative structure (i.e., shrubs and trees) that occurs along bodies of water (e.g., streamside, lakeside) or in association with wet meadows and wetlands. It occurs primarily in lower elevation valley bottoms, and is a relatively minor component in extent but important in biodiversity.

The justification for riparian woodland as a priority habitat is substantial loss and degradation of this habitat type, declines in several species highly associated with this habitat type, and the overall importance of this habitat type in terms of biodiversity. Within the Blue Mountains and Northern Glaciated Mountains, cottonwood/willow habitat has declined by 100% in both regions (Wisdom et al. 2000). Landbird species highly associated with riparian woodland

Table 5. *Habitat attributes and associated landbird focal species for conservation in Mesic Mixed Conifer habitats in the Northern Rocky Mountains of Oregon and Washington.*

Habitat Type	Habitat Attribute	Focal Species
Mesic Mixed Conifer Forest (Late-Successional)	large snags	White-headed Woodpecker
	high canopy cover and foliage volume	Townsend's Warbler
	patches of dense understory shrubs	Nashville and Orange-crowned Warbler
	forest edges and openings with scattered trees	Olive-sided Flycatcher

with significantly declining population trends include American Redstart, Red-eyed Vireo, Veery, Willow Flycatcher, Western Wood-pewee, and Yellow Warbler.

The desired condition in riparian woodland is a structurally diverse vegetative community of native species that occur in natural diversity relative to hydrological influences. Landbird conservation in riparian woodland emphasizes maintaining healthy ecosystems that include representative focal species for four habitat conditions. These include: large snags, high canopy and subcanopy cover and foliage volume, patches of dense understory foliage cover, and broken canopies with extensive habitat contrast edges (Table 6).

Unique Habitats

Landbird conservation also is directed toward 12 Unique Habitats and associated focal species (Table 7). This category was used to capture a wide range of habitat types that are important for landbird conservation for one or more of the following reasons:

- relatively small in size and/or limited in extent and occur in disjunct patches dispersed throughout the mostly forest landscape (e.g., upland grassland, aspen, cliffs and rock outcrops)
- small to large contiguous patches that occur in narrow elevational windows (e.g., subalpine forest, juniper woodland, montane shrubland, alpine montane meadows, whitebark pine)
- ephemeral in occurrence and distribution dependent on natural factors such as fire and hydrology (e.g., post-wildfire, riparian shrub, lowland wet meadows)
- priority landbird species highly associated with these habitats that are not focal species in the priority habitat types (e.g., sagebrush-steppe)

Most unique habitats are structurally less complex than priority habitats, and usually can be represented by one focal species. Further, the uniqueness of these habitats often results in a high degree of habitat specialization for the focal species associated with them, which also are often priority species (e.g., Bobolink, Black-backed Woodpecker, Gray Flycatcher).

Sagebrush-steppe habitat is considered a unique habitat rather than a priority habitat for several reasons, despite the extensive amount of acreage of this habitat type (Table 2). Sagebrush-steppe habitat in the Northern Rocky Mountains tends to be disjunct and variable in size and distribution amid the predominantly forested landscape. Additionally, the most highly associated species occur as low density breeding species, and are often peripheral to the region relative to their range-wide distribution and population size. Perhaps most importantly, sagebrush-steppe habitat is the highest priority in the adjacent Columbia Plateau and Northern Great Basin ecoregions of Oregon and Washington. Thus, conservation of species such as Brewer's Sparrow, Ferruginous Hawk, Sagebrush Sparrow, Sage Thrasher, and Swainson's Hawk are most appropriately addressed in those ecoregions.

Priority Species

There are 39 priority landbird species identified by primary bird conservation partners that are regularly breeding species in the Northern Rocky Mountains of Oregon and Washington (Table 8). Lewis's Woodpecker is the only species identified as priority in all seven lists that were reviewed. Flammulated Owl and White-headed Woodpecker are the only species considered priority in six of the seven lists. Among the 39 species, 11 are focal species in this document and three are responsibility species.

Table 6. *Habitat attributes and associated landbird focal species for conservation in Riparian Woodland habitats in the Northern Rocky Mountains of Oregon and Washington.*

Habitat Type	Habitat Attribute	Focal Species
Riparian Woodland	large snags	Red-naped Sapsucker
	high canopy and subcanopy cover and foliage volume	Red-eyed Vireo and Yellow Warbler
	patches of dense understory foliage and cover	MacGillivray's Warbler
	broken canopies with extensive habitat contrast edges	Western Wood-pewee

Table 7. *Landbird focal species for conservation in Unique Habitats in the Northern Rocky Mountains of Oregon and Washington.*

Habitat Type	Focal Species
Forest Types	
Post-Wildfire	Black-backed Woodpecker
Whitebark Pine	Clark's Nutcracker
Subalpine Forest	Hermit Thrush
Juniper Woodland	Gray Flycatcher
Aspen	Warbling Vireo
Shrubland Types	
Montane Shrubland	Calliope Hummingbird
Riparian Shrub	Willow Flycatcher
Sagebrush-Steppe	Vesper Sparrow
Grassland Types	
Alpine Montane Meadows	Lincoln's Sparrow
Upland Grassland	Savannah Sparrow
Lowland Wet Meadows	Bobolink
Non-Vegetated Types	
Cliffs and Rock Outcrops	Golden Eagle

Although biological objectives for each priority species are not provided like they are for focal species, the priority species in Table 8 that are not focal species are recognized where they are likely to directly benefit from habitat 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.

Responsibility Species

There are 12 species with a relatively large percent of their population in the region, and thus considered to be a high responsibility for landbird conservation partners (Table 9). Six of the 12 also are focal or priority species for this region including three species, Calliope Hummingbird, Red-naped Sapsucker, and Williamson's Sapsucker, that are both focal and priority species.

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 (PIF Science Committee 2012). **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.

Table 8. *Landbird species designated as priority bird species by primary bird conservation partners in the Northern Rocky Mountains of Oregon and Washington.*[1]

Species[2]	USFWS BCC[3]	USFS/BLM Sensitive[4]	ODFW Strategy[5]	WDFW Strategy[6]	IWJV Priority[7]	PIF CPLAN[8]	WATCH LIST[9]
Black Swift	X	XY-OR				X	Yellow
Black-backed Woodpecker			X	X			
Bobolink		XY-OR,WA	X				Yellow
Brewer's Sparrow	X				X	X	
Calliope Hummingbird	X					X	
Cassin's Finch	X					X	Yellow
Evening Grosbeak							Yellow
Ferruginous Hawk	X	XY-OR	X		X		
Flammulated Owl	X		X	X	X	X	Yellow
Golden Eagle				X			
Grasshopper Sparrow		XY-OR					
Gray Flycatcher		XY-WA			X	X	
Great-gray Owl		XY-WA	X	X			
Greater Sage-grouse		XY-OR,WA	X			X	Yellow
Green-tailed Towhee		Y-WA				X	
Lewis' s Woodpecker	X	XY-OR,WA	X	X	X	X	Yellow
Long-billed Curlew	X	X-WA			X		Yellow
Loggerhead Shrike	X		X	X			
Mountain Quail		XY-WA		X			
Northern Goshawk		Y-WA		X			
Northern Waterthrush		XY-OR					
Olive-sided Flycatcher	X				X	X	Yellow
Peregrine Falcon	X	XY-OR,WA		X			
Prairie Falcon				X			
Pileated Woodpecker			X	X			
Pinyon Jay					X	X	Yellow
Pygmy Nuthatch				X			
Red-naped Sapsucker					X	X	
Rufous Hummingbird					X	X	Yellow
Sage Thrasher	X			X	X	X	
Sagebrush Sparrow	X			X	X	X	
Sharp-tailed Grouse		XY-WA					
Short-eared Owl		X-WA				X	
Swainson's Hawk	X				X		
Upland Sandpiper	X	XY-OR	X				
Vaux's Swift				X			
White-headed Woodpecker	X	XY-OR,WA	X	X	X	X	
Williamson's Sapsucker	X					X	
Willow Flycatcher	X				X	X	

[1] The criteria for inclusion on this list was priority status by a State or Federal agency (one of the first four columns), and regularly breeding in the Northern Rocky Mountains of Oregon and Washington (i.e., not peripheral or irregular breeders). The list does not include Federal or State ESA listed or recently delisted species such as Bald Eagle and Peregrine Falcon.
[2] Blue = focal species; Gray = responsibility species; Yellow = focal and responsibility species.
[3] USFWS BCC = U.S. Fish and Wildlife Service Birds of Conservation Concern (http://www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf) (USFWS 2008). The area encompassed by this USFWS list is BCR 10, which also includes significant area outside of Oregon and Washington.
[4] USFS/BLM Sensitive = U.S. Forest Service/Bureau of Land Management Sensitive Species (http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/). The area encompassed by this list is all of Oregon and Washington. X = USFS, Y = BLM.
[5] ODFW Strategy = Oregon Department of Fish and Wildlife Strategy Species for the Blue Mountains ecoregion in the State Wildlife Action Plan (http://www.dfw.state.or.us/conservationstrategy/contents.asp) (ODFW 2005).
[6] WDFW Strategy = Washington Department of Fish and Wildlife Strategy Species for the Blue Mountains, Canadian Rockies and Okanogan Highlands ecoregions (http://wdfw.wa.gov/wlm/cwcs/cwcs.htm). (WDFW 2005).
[7] IWJV Priority = Intermountain West Joint Venture Priority Landbirds (www.iwjv.org/landbirds-intermountain-west). The area encompassed by this list includes significant area outside Oregon and Washington.
[8] PIF CPLAN = Partners in Flight North American Landbird Conservation Plan Species of Continental Importance for the Intermountain West Avifaunal Biome (Rich et al. 2004) (http://www.partnersinflight.org/cont_plan/default.htm)
[9] WATCH LIST = The State of the Birds 2014 Watch List (Rosenberg et al. 2014). Red = Highest Priority; Yellow = Second Priority.

Table 9. *Landbird species with a high responsibility for conservation based on the percent of their range-wide population in the Northern Rocky Mountains of Oregon and Washington.*[1,2]

Species 3	Percent Population		
	BCR 10	BCR 10 Oregon	BCR 10 Washington
Calliope Hummingbird	61.8	5.5	5.7
Cassin's Finch	41.0	14.5	1.9
Cassin's Vireo	55.7	2.5	3.1
Clark's Nutcracker	40.1	6.0	0.3
Dusky Flycatcher	55.9	6.8	1.4
Lazuli Bunting	27.3	4.8	2.2
Mountain Chickadee	31.5	7.8	1.1
Red-breasted Nuthatch	25.4	3.6	1.5
Red-naped Sapsucker	61.9	3.3	2.4
Townsend's Warbler	39.0	3.6	1.5
Western Tanager	30.2	6.0	1.0
Williamson's Sapsucker	36.0	25.6	1.0

[1] www.rmbo.org/pifpopestimates/Database.aspx

[2] The arbitrary cut-off was >20% of the species continental population in BCR 10, and >5% of the continental population in Oregon and Washington within BCR 10. The rational for these percentages to represent responsibility is the large amount of area in BCR 10 outside Oregon and Washington and outside the scope of this document.

[3] Blue = focal species: Green = priority species; Pink = focal and priority species.

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.

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 landbirds were originally published in the PIF Continental Plan (Rich et al. 2004), and later updated in the PIF Population Estimates Database (PIF Science Committee 2013) with new data and to address some of the recommendations of the Thogmartin et al. (2006) peer review. The estimates were derived from a process described in Blancher et al. (2007) using relative abundance counts from BBS data. 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. Population estimates using the process stepped-down from the continental population estimates are provided for focal, priority, and responsibility species in Table 10.

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 on the amount and distribution of land cover types (i.e., habitat types for birds), and local and regional data on the population estimates of bird species in the habitat (i.e., bird densities by habitat type or condition). The IWJV has conducted these analyses for five sagebrush and grassland species (i.e., Brewer's Sparrow, Grasshopper Sparrow, Long-billed Curlew, Sagebrush Sparrow, Sage Thrasher) that are all priority species, however they all have <1.0 of their population in BCR 10 in Oregon and Washington. Thus, their conservation is better addressed elsewhere, and they are all considered as species to benefit rather than focal species in this document.

Table 10. *Population estimates of focal, priority, and responsibility species in Oregon and Washington portions of BCR 10 stepped-down from Partners in Flight continental population estimates.*[1]

Species	BCR 10		BCR 10 Oregon		BCR 10 Washington		Continental
	Pop. Est.[2]	%[3]	Pop. Est.[2]	%[3]	Pop. Est.[2]	%[3]	Pop. Est.[2]
Focal Species[4,5]							
Black-backed Woodpecker	30,000	3.8	8,000	1.0	600	0.1	800,000
Bobolink	70,000	0.9	9,000	0.1	300	0.0	8,000,000
Calliope Hummingbird	1,500,000	61.8	130,000	5.5	140,000	5.7	2,000,000
Chipping Sparrow	20,000,000	8.6	1,900,000	0.8	700,000	0.3	210,000,000
Clark's Nutcracker	90,000	40.1	14,000	6.0	800	0.3	230,000
Dusky Flycatcher	4,400,000	55.9	500,000	6.8	110,000	1.4	7,800,000
Flammulated Owl		12.5		3.6		2.0	12,000
Golden Eagle	14,000	4.9	1,500	0.5	70	0.0	130,000
Gray Flycatcher	50,000	1.9	30,000	1.2	300	0.0	3,000,000
Hermit Thrush	1,700,000	3.7	300,000	0.6	50,000	0.1	40,000,000
Lewis' s Woodpecker	8,000	11.6	2,000	3.3	500	0.7	70,000
Lincoln's Sparrow	5,000,000	6.4	70,000	0.1	600	0.0	70,000,000
MacGillivray's Warbler	7,000,000	61.4	200,000	1.9	100,000	0.8	12,000,000
Nashville Warbler	500,000	1.6	17,000	0.1	90,000	0.3	32,000,000
Olive-sided Flycatcher	200,000	15.3	15,000	0.9	3,000	0.2	1,700,000
Orange-crowned Warbler	5,100,000	6.3	90,000	0.1	160,000	0.2	80,000,000
Red-naped Sapsucker	1,200,000	61.9	70.000	3.3	50,000	2.4	2,000,000
Red-eyed Vireo	1,800,000	1.0	8,000	0.0	50,000	0.0	130,000,000
Savannah Sparrow	6,000,000	3.4	40,000	0.0	50,000	0.0	170,000,000
Townsend's Warbler	7,000,000	39.0	600,000	3.6	200,000	1.5	17,000,000
Vesper Sparrow	4,400,000	15.7	90,000	0.3	20,000	0.1	28,000,000
Warbling Vireo	14,000,000	28.1	200,000	0.4	180,000	0.4	49,000,000
Western Wood-pewee	1,900,000	20.8	200,000	2.7	130,000	1.4	8,000,000
White-headed Woodpecker	15,000	9.5	12,000	8.0	700	0.5	150,000
Williamson's Sapsucker	110,000	36.0	80,000	25.6	3,000	0.1	300,000
Willow Flycatcher	3,000,000	32.0	50,000	0.6	130,000	1.5	9,100,000
Yellow Warbler	6,200,000	6.5			300,000	0.3	90,000,000
Priority Species[4,5]							
Black Swift	20,000	12.2			200	0.1	70,000
Brewer's Sparrow	2,900,000	21.5	140,000	1.0			13,000,000
Cassin's Finch	1,200,000	41.0	400,000	14.5	50,000	1.9	2,900,000
Ferruginous Hawk	11,000	13.3					2,900,000
Grasshopper Sparrow	200,000	0.6	2,000	0.0	14,000	0.0	30,000,000
Great-gray Owl		5.4		0.1			90,000
Greater Sage-grouse		18.5					150,000
Green-tailed Towhee	600,000	14.9	40,000	0.9			4,100,000
Long-billed Curlew							
Loggerhead Shrike	80,000	1.4	1,600	0.0			4,900,000

Table 10. *Population estimates of focal, priority, and responsibility species in Oregon and Washington portions of BCR 10 stepped-down from Partners in Flight continental population estimates.*[1] *(continued)*

Species	BCR 10		BCR 10 Oregon		BCR 10 Washington		Continental
	Pop. Est.[2]	%[3]	Pop. Est.[2]	%[3]	Pop. Est.[2]	%[3]	Pop. Est.[2]
Mountain Quail	1,500	0.5	1,500	0.5			300,000
Northern Goshawk	40,000	8.5	5,000	1.0	200	0.1	200,000
Northern Waterthrush	1,100,000	5.9			11,000	0.1	19,000,000
Peregrine Falcon		2.3					
Prairie Falcon	7,000	8.2	180	0.2			70,000
Pileated Woodpecker	160,000	8.2	14,000	0.7	3,000	0.2	1,900,000
Pinyon Jay	20,000	3.2	200	0.0			760,000
Rufous Hummingbird	2,000,000	17.8	30,000	0.3	12,000	0.1	11,000,000
Sage Thrasher	1,200,000	20.9	17,000	0.3			5,900,000
Sagebrush Sparrow	500,000	10.9	1,400	0.0			4,000,000
Sharp-tailed Grouse	6,000	1.0					600,000
Short-eared Owl	20,000	0.8					600,000
Swainson's Hawk	20,000	3.6	300	0.1	300	0.0	540,000
Vaux's Swift	120,000	18.8	50,000	7.8	1,800	0.3	340,000
Responsibility Species[4,5]							
Cassin's Vireo	2,200,000	55.7	100,000	2.5			4,000,000
Lazuli Bunting	1,500,000	27.3	300,000	4.8	120,000	2.2	5,600,000
Mountain Chickadee	2,400,000	31.5	600,000	7.8	80,000	1.1	7,500,000
Red-breasted Nuthatch	5,000,000	25.4	700,000	3.6	300,000	1.5	20,000,000
Western Tanager	3,300,000	30.2	700,000	6.0	110,000	1.0	11,000,000

[1] www.rmbo.org/pifpopestimates/Database.aspx

[2] Pop. Est. = population estimate (heavily rounded)

[3] % = 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.).

[4] Colored shading of population estimates represents Data Quality. Green is the highest quality, followed by blue, yellow, orange, and red is the lowest quality. These are based on some combination of low sample size, high variance in the BBS counts, or an otherwise poorly sampled species (Blancher et al. 2013). Blank cells indicate no BBS data for that strata. Non-colored percent cells with no population estimate from BBS data indicate percent population was derived from other sources.

[5] Species are listed alphabetically within each category. Species that are included in more than one category are listed in the highest category in the following order – focal, priority, and responsibility.

The other primary value of population estimates (after conservation status) is to be able to assess population effects of changes in habitat through restoration or management. The IWJV has developed a decision support tool called HABPOPS (http://data.pointblue.org/partners/iwjv/) to facilitate this type of assessment for several species (Sidebar: *HABPOPS Mapping Tool*).

HABPOPS Mapping Tool

The HABPOPS Mapping Tool (data.pointblue.org/partners/iwjv/) is a Microsoft Access database created to help resource and land managers explore the potential population impact of management and restoration on several landbird species within the geography of the Intermountain West Joint Venture. It provides estimates of acres of habitat types and bird species populations within the region, and then provides a worksheet that calculates the changes in the species population based on the type and amount of management or restoration being implemented. At the current time, the process is available for five grassland and sagebrush species, Brewer's Sparrow, Grasshopper Sparrow, Long-billed Curlew, Sagebrush Sparrow, and Sage Thrasher.

BIOLOGICAL OBJECTIVES

Two types of landbird biological objectives (i.e., habitat and population) are presented at several scales. First, **regional landscape-level habitat objectives are presented to recognize the high priority of the following habitat conditions for landbirds throughout the region:**

- **the desired proportions of late-successional dry forest and mesic mixed conifer forest**
- **the amount of natural forest regeneration in post-wildfire habitat**
- **the extent and habitat restoration priorities in riparian woodland**

Secondly, habitat objectives are presented for 26 focal species and their associated habitat attributes at landscape and site scales to provide the specific desired conditions and structural components to support landbird conservation within each habitat type. Lastly, population objectives are presented for some of the 26 focal species as the ultimate bird conservation metric to assess focal species status.

In the following sections, biological objectives are described for each focal species and associated habitat attribute presented in Tables 4-7. Preceding these, there are some brief comments about the habitat or species, and a listing of the primary habitat associations for each species. This is followed by the habitat and population objectives (in bold with a ▶), and recommended habitat strategies to achieve the objectives. The habitat strategies are species-specific recommendations independent of the more general habitat strategies presented for each habitat type. Assumptions and data sources upon which the biological objectives are based are stated, along with suggestions for research or monitoring to address priority habitat information needs. Examples of priority and responsibility species most likely to benefit from habitat management or restoration for each focal species is presented in Appendix A (Sidebar: *Species to Benefit*).

For each focal species, development of biological objectives was based on habitat relationships information generally limited to Oregon, Washington, and Idaho. When limited information was available from this region, references were used from elsewhere in western North America.

It is important to note that the habitat objectives for each focal species are not only specific to the habitat attribute that a particular species is representing, but also for other habitat conditions essential to the species conservation. For example, in addition to the habitat objective for large snags that Lewis's Woodpecker represents in dry forest habitat, there are habitat objectives for canopy cover and shrub cover required to make the habitat suitable beyond large snags. These habitat objectives are provided to recognize that the species overall conservation may include important features beyond the habitat attributes they represent.

Species to Benefit

Species to benefit are those priority and responsibility species that have a strong breeding season habitat association with the habitat type and/or habitat attributes of the focal species, and would likely benefit from conservation directed towards the focal species and associated habitat attribute. The potential benefit is only appropriate if the site is within the range of the species to benefit, is large enough to meet the species area requirements, and other specific habitat attributes or conditions required by the species are available or being managed for. Thus, conservation of species to benefit can be enhanced by conservation of focal species, but is not dependent on or synonymous with conservation of focal species. The species to benefit list in Appendix A can provide a good source list for species to use as surrogates when the focal species is not appropriate for a site due to range, habitat conditions, elevation, etc.

REGIONAL HABITAT OBJECTIVES

Late-Successional Habitat in Dry Forest and Mesic Mixed Conifer Forest

- **Maintain all existing late-successional (mature and old-growth) forest (**Sidebar: *Late-Successional Forest: The highest Priority for Bird Conservation*)**.**
- **Maintain 20-30% of large landscapes (e.g., Level 4 ecoregions, multiple watersheds, national forests) as late-successional forest with >30% of the late-successional forest as old-growth.**
- **Where existing late-successional forest comprises <20% of large landscapes, initiate habitat restoration actions that emphasize where possible:**
  - **increasing net size of existing late-successional forest patches**
  - **providing connectivity between patches**
  - **providing likely refugia from wildfire based on landscape context**
- **Existing or projected late-successional forest should have a minimum area of 50 ha (125 ac) with low edge to interior ratio.**
- **Late-successional forest should have or be managed for the ecologically appropriate range of variability in habitat attributes as described below for the focal species for each habitat type.**

Assumptions/Data Sources: The objectives for percent of large landscapes as late-successional forest were developed based on Hann et al. (1997). It recognizes the long-term nature of restoration for late-successional forest by emphasizing the dedicated commitment to the establishment of late-successional dry forest, and having management actions initiated to move the forest towards that condition (e.g., understory thinning, prescribed burning). The objective for minimum area was developed based on professional judgment.

Natural Forest Regeneration in Post-Wildfire Habitat

- **Maintain 1-2% of large landscapes (e.g., Level 4 ecoregions, multiple watersheds, national forests) as post-wildfire habitat.**
- **Maintain >40% of post-wildfire habitat as naturally regenerating forest (i.e., unlogged) for >3 years.**
- **Where salvage logging is occurring, conduct selective removal and maintain larger-diameter snags (>53 cm [21 in] dbh) and patches of deciduous shrubs (>15% cover).**

Assumptions/Data Sources: The objective for percent of landscape as post-wildfire habitat was developed based on Hutto (1995), McCullough et al. (1998), and Saab et al. (2011). The objective for unlogged area as naturally regenerating forest was developed based on Hutto (1995) and Saab et al. (2011). The objective for retention of large snags was developed based on Saab et al. (2011).

Habitat Restoration in Riparian Woodland

- **Maintain >30% of the historical extent of each riparian system to the ecologically appropriate range of variability in habitat type and conditions as described below for the riparian woodland focal species.**
- **Where existing riparian woodland comprises <30% of the historical extent of each riparian system, initiate habitat restoration actions that emphasize where possible:**
  - **increasing net size of existing riparian woodland**
  - **providing connectivity between riparian woodland patches**
  - **maximizing restoration of degraded sites with existing structural attributes for focal species (e.g., large snags, dense native understory patches)**

Assumptions/Data Sources: The objective for maintaining a percent of the historical area of riparian woodland was developed based on professional judgment, and is intended to stimulate restoration actions at various locations within watersheds.

Late-Successional Forest: The Highest Priority for Bird Conservation

Late-successional forest, especially dry forest and mesic mixed conifer forest, has been significantly reduced from historic levels, primarily due to historic large-scale timber extraction and more recent losses to large-scale wildfires and insect infestations. The amount of late-successional forest and the number of remnant large- and medium-diameter trees are currently a fraction of those present historically (Hessburg et al., 1999, Wisdom et al., 2000). Further, wildlife species closely associated with late-successional forests have shown the largest population declines among all forest communities (Hann et al., 1997). **Achieving objectives for the amount, distribution, and condition of late-successional dry forest and mesic mixed conifer forest as described in this document is the highest priority for landbird conservation in the region.** Federal lands are likely to play the primary role in providing this habitat, however, opportunities on private lands are available through many incentive-based programs, and should be considered as an important component for achieving the regional objective for late-successional forest habitat for landbirds.

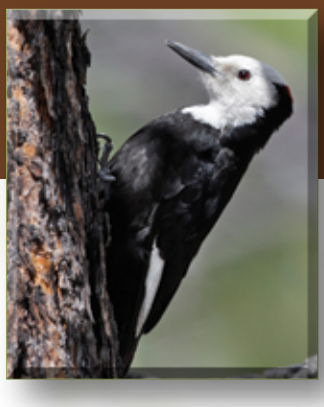
DRY FOREST

Habitat Issues:

- ✓ loss of late-successional forest and large diameter trees and snags from timber harvesting, particularly at lower elevations
- ✓ loss of large areas of forest from wildfires and insect infestations
- ✓ loss and degradation of properly functioning forest ecosystems where there is encroachment of urban and residential development, especially at lower elevations
- ✓ habitat degradation from fire suppression, particularly declines in characteristic herbaceous and shrub understories from increased density of small shade-tolerant trees
- ✓ high risk of loss of forests from large-scale fires due to high fuel loads in densely stocked understories
- ✓ lack of recruitment of young ponderosa pine due to factors such as fire suppression which has allowed understory encroachment of firs and exotics, and intensive grazing which can suppress development of young pines
- ✓ loss of snags and down wood from fuelwood cutting and salvage logging
- ✓ invasion of exotic plants contributing to alteration of understory conditions and increase in fuel loads
- ✓ fragmentation of forest tracts negatively impacts species with large area requirements such as White-headed Woodpecker
- ✓ hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (Brown-headed Cowbird), exotic nest competitors (European Starling), and domestic predators (cats), and may be subject to high levels of human disturbance
- ✓ restoration issues such as techniques (mowing, thinning, burning) and timing (spring/summer versus fall) that can negatively impact desired bird species
- ✓ some areas are among the most popular and intensively used recreation sites in the west
- ✓ increasing road network provides access that may increase levels of fuelwood cutting

Habitat Strategies:

- ➔ Institutionalize a policy of "no net loss" of dry forest habitat (i.e., discourage loss and conversion of habitat, but when unavoidable, mitigate with equal or greater restoration efforts).
- ➔ Maintain existing areas of moderate to high quality dry forest habitat, and actively manage to promote their sustainability.
- ➔ Initiate actions to enhance size and connectivity of existing quality dry forest patches (i.e., reduce fragmentation), especially in areas that are likely refugia from wildfire.
- ➔ Initiate actions to improve quality of degraded dry forest habitat and avoid or minimize future degradation of dry forest habitat (e.g., thinning, prescribed fire), especially in areas that are likely refugia from wildfire and where providing connectivity to other patches.
- ➔ Target for restoration excessively dense young to mature stands surrounding late-successional old growth to reduce the risk of fire spread into late-successional forest.
- ➔ Initiate actions to secure conservation commitments on private lands that enhance habitat connectivity or patch size or directly support focal species habitat requirements.
- ➔ Conduct habitat management and restoration activities outside the nesting season (April 15 - July 15).



Habitat Type: DRY FOREST
Habitat Attribute: LARGE PATCHES OF LATE-SUCCESSIONAL FOREST WITH HETEROGENEOUS CANOPY COVER
Focal Species: WHITE-HEADED WOODPECKER (Picoides albolarvatus)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for White-headed Woodpecker declined by 79% in the Blue Mountains and 98% in the Okanogan Highlands (Wisdom et al. 2000). Source habitats were completely eliminated in >40% of watersheds. There were moderately or strongly declining trends in source habitats in 78% of the ecoregions, and stable trends in 22%.

Habitat Associations:

- ✓ relatively large patches of forest for area requirements
- ✓ large trees for foraging (insects and seed cone production) and snag recruitment
- ✓ small to moderate canopy openings with large snags for nesting
- ✓ open understory with limited woody vegetation

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **in predominantly old-growth forest (>75%) provide contiguous suitable habitat patches >140 ha (350 ac)**
- ▶ **in 25-75% old-growth forest provide contiguous suitable habitat patches >280 ha (700 ac)**

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **>25 trees/ha (10/ac) >53 cm (21 in) dbh, and >2 of the trees >79 cm (31 in) dbh for foraging trees and replacement snags**
- ▶ **>3.6 snags/ha (1.4/ac) >20 cm (8 in) dbh with >50% >64 cm (25 in) dbh in a moderate to advanced state of decay**
- ▶ **canopy cover 10-40%**
- ▶ **shrub layer cover <30%**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >80 ha (198 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective and the objective for large trees were developed based on Oliver and Ryker (1990) and Dixon (1995). The objective for canopy cover was developed based on Latif et al. (2014). The objective for snags was developed based on Milne and Hejl (1989). The objectives for canopy and shrub cover was developed based on Wightman et al. (2010), Hollenbeck et al. (2011), Mellen-McLean et al. (2013), and Latif et al. (2014). The objective for target densities was developed based on Dixon (1995) and Lorenz et al. (2012).

Habitat Strategies:

- ➔ Target conservation efforts in areas of broken canopies and large snags.
- ➔ Eliminate or restrict fuelwood cutting (i.e., snag removal) in suitable habitat by closing roads or limiting permits.
- ➔ Manage for large diameter trees through wider tree spacing and reduction of competition (Kolb et al. 2007).
- ➔ Maintain all large, dominant pine-cone producing trees to provide seeds for foraging during the non-breeding season (Oliver and Ryker 1990).
- ➔ If snags are limiting and the habitat is suitable, create snags through appropriate methods (e.g., girdling, topping, fungal inoculation, beetle pheromone packets).

- ➔ Retain broken-topped snags, soft snags, leaning logs, and high stumps (>3 m [10 ft] tall) for potential nesting.
- ➔ Retain or provide downed logs for foraging sites.
- ➔ Manage for low shrub and down wood cover through prescribed fire and manual treatments to reduce populations of small mammals as nest predators (Kozma and Kroll 2011).
- ➔ Conduct uneven-aged forest management that provides for a mosaic of broken and closed canopies (Marshall et al. 1996, Rodrick and Milner 1991).

Habitat Information Needs:

1. What are the landscape features and area requirements that affect White-headed Woodpecker occurrence, abundance, or population viability in dry forest?
2. Is there a relationship between pine cone cycles and White-headed Woodpecker populations in dry forest?

Habitat Type: DRY FOREST
Habitat Attribute: INTERSPERSION OF HERBACEOUS OPENINGS AND PATCHES OF DENSE SAPLING/POLE TREES
Focal Species: FLAMMULATED OWL (*Otus flammeolus*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Flammulated Owl declined by 58% in the Blue Mountains and 88% in the Okanogan Highlands (Wisdom et al. 2000). There were moderately or strongly declining trends in source habitats in nearly 70% of watersheds. There were moderately or strongly declining trends in source habitats in 85% of the ecoregions, and moderately or strongly increasing trends in 8%. Flammulated Owl is unique among owls in a diet of arthropods, especially moths and beetles, and their long distance migrant status. They are a late arriving migrant that nests in cavities, so availability of cavities can be a limiting factor.

Habitat Associations:

- ✓ *broken and heterogeneous canopies*
- ✓ *grassland openings within forest for foraging*
- ✓ *moderate to large trees and snags for nest and roost sites*
- ✓ *small patches of dense thickets for roosting and calling*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >140 ha (350 ac)**

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **broken and open canopies with 20-50% canopy cover**
- ▶ **moderate to high snag density with >3 snags/ha (1.2/ac) >46 cm (18 in) dbh and > 1.8 m (6 ft) tall**
- ▶ **mean tree dbh 30-50 cm (12-20 in) with >20 trees/ha (8/ac) >53 cm (21 in) dbh to function as recruitment snags**
- ▶ **shrub layer cover 10-30% for production of insect prey**
- ▶ **at least one large (0.5 ha [1.2 ac]) or two smaller (0.2 ha-0.5 ha [0.5-1.2 ac]) dense thickets of sapling/pole trees for roosting habitat**
- ▶ **at least one large (1-2 ha [2.5-4.9 ac]) or two smaller (<1 ha [2.5 ac]) grassy openings for foraging habitat**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >12 ha (30 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for forest patch size was developed based on Goggans (1986). The objective for snags was developed based on Bull and Anderson (1978), Thomas (1979), Jones and Stokes Association Incorpated (1980), Goggans (1986), and Bull et al. (1990). The objectives for tree and snag sizes were developed based on (Goggans 1986) and are for current and future nest and roost sites. The objective for canopy cover was developed based on Goggans (1986) and Howie and Ritcey (1987). The objective for grassy openings for foraging sites was developed based on Howey and Ritcey (1987). The objective for dense thickets of young trees was developed based on professional judgment. The objective for target density was developed based on McCallum (1994) and Linkhart et al. (1998).

Habitat Strategies:

- Target conservation efforts near grassland or dry meadow openings.
- Conduct uneven-aged forest management that provides for a mosaic of broken and closed canopies (Marshall et al. 1996, Rodrick and Milner 1991).
- Manage for proximity of patches of dense trees for roosting and snags and snag-patches for nesting (Goggans 1986).
- In restoration efforts, leaves patches of dense sapling thickets to function as roost and cover sites.
- Where grassy openings in potential or suitable habitat are being encroached by shrubs and trees, initiate actions such as manual removal and prescribed fire to maintain these openings.
- Provide adequate snags that ensure cavity availability in May since it is the last arriving of the cavity-nesting migrants (Goggans 1986).
- If snags are limiting and the habitat is suitable, create snags through appropriate methods (e.g., fungal inoculation, topping, girdling, beetle pheromone packets).
- Eliminate or restrict fuelwood cutting (snag removal) in suitable habitat by closing roads and/or limiting permits.
- Eliminate or restrict pesticide use in known nest areas or suitable habitat to minimize reductions in prey.
- Use nest boxes as short-term habitat augmentation where restoration activities are occurring and snags are limiting.

Habitat Information Needs:

1. Thorough inventory of Flammulated Owl distribution and population size within dry forest.
2. What are the specifics of patch size, configuration, and abundance of grassy openings for Flammulated Owl foraging and clumped thickets of sapling/pole trees for roosting in dry forest?
3. Do restored (treated) sites attract Flammulated Owls and provide viable habitat in dry forest, and if so what are the treatment processes and conditions most effective in doing this?

Habitat Type: DRY FOREST
Habitat Attribute: SHORT-STATURED HERBACEOUS UNDERSTORY WITH SCATTERED SAPLING PINES
Focal Species: CHIPPING SPARROW (*Spizella passerina*)

Habitat/Species Comments:

Chipping Sparrow can respond favorably to dry forest restoration that creates an open canopy and an open, grassy ground cover with some areas of conifer regeneration including sapling trees. It also regularly breeds in subalpine forest.

Habitat Associations:

- ✓ *open canopy*
- ✓ *short-statured herbaceous ground cover for foraging*
- ✓ *moderate shrub layer cover (shrubs and small trees) for nesting and cover*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**
- **a heterogeneous landscape with a mix of understory conditions such that 10-30% of the landscape meets site-level conditions as described below**

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **short-statured herbaceous ground cover >50%**
- **shrub layer cover 20-50% (includes shrubs and small trees) with >20% of the shrub layer in regenerating sapling pines**
- **canopy cover 30-70%**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >0.7 ha (2 ac)/pair in suitable habitat**
- **Brown-headed Cowbird parasitism rates <10% within project areas**

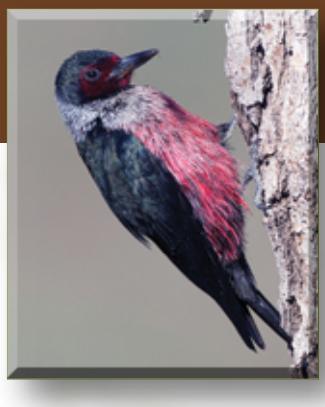
Assumptions/Data Sources: The landscape objective was developed based on Nott and Pyle (2012) to maintain the landscape in a mix of open herbaceous and dense understory shrub layer condition. The objective for an open canopy with a grassy understory and moderate shrub layer was developed based on positive associations with open canopy and grass/shrub understory (Sallabanks et al 2006), and positive associations with regenerating trees and bare ground (O'Connell et al. 1997). The objective for canopy cover was developed based on Swanson et al. (2004). The objective for target density was developed based on Middleton (1998). This species is highly susceptible to Brown-headed Cowbird parasitism, therefore it is appropriate to maintain parasitism at low levels (<10%).

Habitat Strategies:

- ➔ Eliminate or manage livestock grazing to ensure adequate herbaceous cover for foraging and development of regenerating seedlings for cover and nesting, and minimize nest disturbance of nest destruction from grazing animals.
- ➔ Eliminate or restrict pesticide use which may reduce insect prey base.
- ➔ Conduct thinning or partial overstory removal (non Dry Forest tree species) to provide suitable canopy and ground cover habitat.
- ➔ Avoid extensive limbing-up of ponderosa pine branches during restoration which reduces suitable nesting substrates.
- ➔ Target conservation areas distant from agriculture or open landscapes suitable for Brown-headed Cowbird.

Habitat Information Needs:

1. What are the features of ground cover (e.g., ratio of vegetation to bare ground, height of herbaceous vegetation) that affect Chipping Sparrow occurrence, abundance, or population viability in dry forest?
2. What are the levels and timing of grazing that are compatible with maintaining vegetative ground cover suitable for Chipping Sparrow in dry forest?
3. What are the aspects of grazing that attract Brown-headed Cowbirds and affect Chipping Sparrow productivity in dry forest (e.g., intensity, trampling/destruction of nests, proximity to agriculture)?



Habitat Type: DRY FOREST
Habitat Attribute: LARGE SNAGS
Focal Species: LEWIS'S WOODPECKER (*Melanerpes lewis*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Lewis's Woodpecker declined by 72% in the Blue Mountains and 95% in the Okanogan Highlands (Wisdom et al. 2000). The overall decline in source habitats (83%) was greatest among all species analyzed. There were moderately or strongly declining trends in source habitats in 100% of the ecoregions where the species occurred. Lewis's Woodpecker populations can fluctuate with natural or anthropogenic impacts on their prey base (Bock 1970). Their weak excavation morphology precludes them from excavating in hard snags or trees, so existing cavities, natural or created, or soft snags are necessary (Goodge 1972, Raphael and White 1984). They also regularly breed in riparian woodland.

Habitat Associations:

- ✓ *large soft snags for nesting*
- ✓ *large live trees in a state of partial or advanced decay*
- ✓ *open canopy and subcanopy for foraging*
- ✓ *moderate shrub cover for production of flying insect prey*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >80 ha (200 ac)**

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **canopy cover <30%**
- ▶ **shrub cover >40%**
- ▶ **>3 soft snags/ha (>1.2/ac) >53 cm (21 in) dbh with 1 soft snag/ha (0.4/ac) >81 cm (>32 in) dbh**
- ▶ **>2 trees/ha (0.8/ac) >53 cm (21 in) dbh**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >6 ha (15 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for tree and snag size were developed based on Galen (1989), Russell et al. (2006), and Saab et al (2009). The objectives for canopy and shrub cover were developed based on Sousa (1983) and Galen (1989). The objective for target density was developed based on Thomas et al. (1979).

Habitat Strategies:

- ➔ Conduct selective logging to increase suitability of habitat as along as sufficient large living and dead trees are retained.
- ➔ If snags are limiting and the habitat is suitable, create snags through appropriate methods (e.g., girdling, topping, fungal inoculation, beetle pheromone packets).
- ➔ Implement habitat augmentation through nest box programs as an interim measure where snags are currently limiting but are being managed for in the long-term.
- ➔ Retain all soft snags of sufficient size.

- ➔ Conduct prescribed burns and understory thinning to maintain existing late-successional trees and accelerate development of mid-successional stages to late-successional forest (Wisdom et al. 2000).
- ➔ Eliminate or restrict fuelwood cutting (snag removal) in suitable habitat by closing roads and/or limiting permits.
- ➔ Eliminate or restrict pesticide use near nesting pairs which may reduce insect prey base (Sousa 1983, Galen 1989).
- ➔ Eliminate or manage livestock grazing which may reduce shrub cover and reduce insect prey base.
- ➔ Conduct controlled underburning or other techniques to promote a shrubby understory for insect production, and minimize brush control and grazing that limit understory growth (Sousa 1983, Galen 1989, Saab and Dudley 1998).
- ➔ Consider local presence of European Starling when targeting conservation sites because high energetic costs of competition may reduce reproductive success and survivorship even when the outcome of competition is successful for Lewis' Woodpecker (Siddle and Davidson 1991,TashiroVierling 1994, Cooper et al. 1998).

Habitat Information Needs:

1. What are the thresholds of snag density that precipitate the use of nest boxes by Lewis's Woodpecker in dry forest?
2. What are the effects of pesticide use on Lewis's Woodpecker occurrence, abundance, or population viability in dry forest?

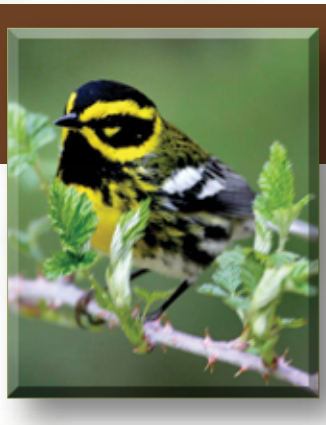
MESIC MIXED-CONIFER FOREST

Habitat Issues:

- ✓ loss of older forests and large diameter trees and snags from timber harvesting, particularly at lower elevations
- ✓ high risk of loss of extensive areas of forest from large-scale fires and insect infestations
- ✓ fragmentation of forest tracts due to timber harvesting or large-scale mortality events negatively impacts species with large area requirements
- ✓ invasion of exotic plants contributing to alteration of understory habitat and loss of native plant diversity
- ✓ hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (Brown-headed Cowbird), exotic nest competitors (European Starling), and domestic predators (cats), and may be subject to high levels of human disturbance
- ✓ restoration issues such as techniques (mowing, thinning, burning) and timing (spring/summer versus fall) that can negatively impact desired bird species
- ✓ loss of snags and down wood from fuelwood cutting and salvage logging
- ✓ some areas are among the most popular and intensively used recreation sites in the west
- ✓ increasing road network provides access that may increase levels of fuelwood cutting

Habitat Strategies:

- ➔ Institutionalize a policy of "no net loss" of mesic mixed conifer forest (Late-Successional) habitat (i.e., discourage loss and conversion of habitat, but when unavoidable, mitigate with equal or greater restoration efforts).
- ➔ Maintain existing areas of moderate to high quality mesic mixed conifer forest (Late-Successional) habitat, and actively manage to promote their sustainability.
- ➔ Initiate actions to enhance size and connectivity of existing quality mesic mixed conifer forest (Late-Successional) patches (i.e., reduce fragmentation), especially in areas that are likely refugia from wildfire.
- ➔ Initiate actions to improve quality of degraded mesic mixed conifer forest (Late-Successional) habitat and avoid or minimize further degradation of mesic mixed conifer forest (Late-Successional) habitat (e.g., selective harvests, thinning, prescribed fire), especially in areas that are likely refugia from wildfire and where providing connectivity to other patches.
- ➔ Target for forest health treatment of excessively dense young to mature stands surrounding late-successional old growth to reduce the risk of fire spread into late-successional forest.
- ➔ Initiate actions to secure conservation commitments on private lands that enhance habitat connectivity or patch size or directly support focal species habitat requirements.
- ➔ Conduct habitat management and restoration activities outside the nesting season (April 15 - July 15).



Habitat Type: MESIC MIXED CONIFER FOREST
Habitat Attribute: HIGH CANOPY COVER AND FOLIAGE VOLUME
Focal Species: TOWNSEND'S WARBLER (*Dendroica townsendii*)

Habitat/Species Comments:

Townsend's Warbler is one of the most sensitive species to timber harvesting activities that reduce canopy cover and/or fragment forest patches (Hutto 1995).

Habitat Associations:

- ✓ *late-successional forest*
- ✓ *dense, closed canopy with high foliage volume for nesting and foraging*
- ✓ *large contiguous patches of closed canopy forest for area requirements*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >300 ha (750 ac)**

***Sites:* Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **patches of closed canopy, late-successional mixed conifer forest >20 ha (50 ac)**
- ▶ **canopy cover >70%**

Population Objectives:

***Sites:* Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >0.8 ha (2 ac)/pair in suitable habitat**

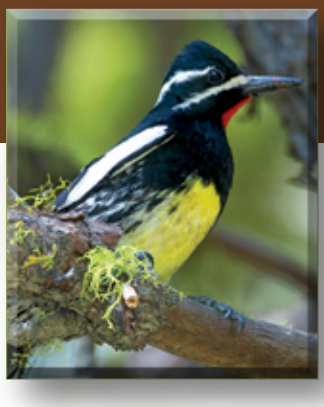
Assumptions/Data Sources: The landscape objective was developed based on a positive association with percent forest cover at landscape scale out to 1 km radius (O'Connell et al. 1997) and 4 km radius (Sallabanks et al. 2006). The objective for late-successional forest was based on positive association with medium to large trees (O'Connell et al. 1997) and high canopies (Sallabanks et al. 2006). The objective for patch size was developed based on a positive association with larger tracts (O'Connell et al. 1997), and positive association with no edge within 100 meters (Hutto 1995). The objective for canopy cover was developed based on positive association with high percent canopy cover or foliage volume (O'Connell et al. 1997), and especially forests dominated by grand fir (Mannan and Meslow 1984, Sallabanks et al. 2006). The objective for target density was developed based on Kissling (2003).

Habitat Strategies:

- ➔ Target conservation efforts where closed canopy forests are ecologically appropriate (e.g., north-facing slopes, wet sites).
- ➔ Designate large, unmanaged or lightly managed areas where overstory canopy cover is emphasized.
- ➔ Conduct management in young forests (e.g., thinning from below) that enhances development of late-successional forest with high canopy cover and foliage volume.
- ➔ Avoid habitat management that results in <70% canopy cover.
- ➔ Eliminate or restrict pesticide use which may reduce prey populations.

Habitat Information Needs:

1. Are there thresholds of light timber harvest that can support viable populations of Townsend's Warbler in mesic mixed conifer forest?
2. Do younger mesic mixed conifer forests with high canopy cover support viable populations of Townsend's Warbler or are they limited by foliage volume?



Habitat Type: MESIC MIXED CONIFER FOREST
Habitat Attribute: LARGE SNAGS
Focal Species: WILLIAMSON'S SAPSUCKER (*Sphyrapicus thyroideus*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Williamson's Sapsucker declined by 56%, with moderately or strongly declining trends in 85% of the ecoregions, and moderate or strongly increasing trends in the other 15% (Wisdom et al. 2000). Williamson's Sapsucker also regularly breeds in dry forest and aspen habitat. It is unique among woodpeckers as a long-distance migrant.

Habitat Associations:

- ✓ *late-successional forest*
- ✓ *moderately open to closed canopy*
- ✓ *large snags for nesting and roosting*
- ✓ *large live trees in a state of partial or advanced decay*
- ✓ *open understory with low shrub cover*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >160 ha (395 ac)**

***Sites:* Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **canopy cover 25-75%**
- ▶ **shrub cover <40%**
- ▶ **>4 hard snags/ha (>1.6 snags/ac) >50 cm (20 in) dbh with >1 snag/ha (0.4 snags/ac) >71 cm (28 in) dbh**
- ▶ **>4 live trees/ha (>1.6 live trees/ac) with heartwood decay >50 cm (20 in) dbh with >1 live tree/ha (0.4 live trees/ac) >71 cm (28 in) dbh**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >16 ha (40 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on Gyug et al. (2009) to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for canopy and shrub cover and snag and tree sizes were developed based on Sousa (1983), Madsen (1985), Bull et al. (1986), Manning and Cooper (1996), Neilsen-Pincus (2005), Gyug et al. (2010), and Drever et al. (2015). The objective for target densities was developed based on Gyug et al. (2009).

Habitat Strategies:

- ➔ Target conservation efforts within areas of late-successional western larch trees (Bull et al. 1986, Manning and Cooper 1996, Gyug et al. 2009).
- ➔ Retain blown out large living trees >100 cm (40 in) dbh regardless of landscape context.
- ➔ Retain known or suitable nesting and roosting snags from all harvest and salvage activities and restrict access for fuelwood cutters.
- ➔ Conduct selective logging to increase suitability of habitat as along as sufficient large living and dead trees are retained.

➔ If snags are limiting and the habitat is suitable, create snags through appropriate methods (e.g., girdling, topping, fungal inoculation, beetle pheromone packets).

➔ Eliminate or restrict fuelwood cutting (snag removal) in suitable habitat by closing roads or limiting permits.

Habitat Information Needs:

1. Can viable populations of Williamson's Sapsucker be maintained through rotations in managed mesic mixed conifer forests?
2. Are there landscape features or area requirements that affect Williamson's Sapsucker occurrence, abundance, or population viability in mesic mixed conifer forests?

Habitat Type: MESIC MIXED CONIFER FOREST
Habitat Attribute: PATCHES OF A DENSE UNDERSTORY SHRUB LAYER
Focal Species: ORANGE-CROWNED WARBLER (*Vermivora celata*) (Blue Mountains)
NASHVILLE WARBLER (*Oreothlypis ruficapilla*) (*okanogan highlands*)

Habitat/Species Comments:

Orange-crowned Warbler and Nashville Warbler also regularly breed in early successional harvested forests dominated by a shrub layer, and riparian habitats if a well-developed shrub layer is present.

Habitat Associations:

✓ *dense understory shrub layer for foraging*

✓ *extensive herbaceous ground cover for nesting*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

▶ **areas of suitable habitat >20 ha (50 ac)**

Sites: **Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

▶ **shrub layer cover >30%**

▶ **herbaceous ground cover >60%**

▶ **canopy cover 30-70%**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

▶ **mean target densities >0.3 ha (0.7 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for ground and shrub cover were developed based on a positive association with both (Sallabanks et al. 2006). The objective for canopy cover was developed based on professional judgment.

Habitat Strategies:

➔ Retain or 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.

- ➔ Eliminate or manage livestock grazing to ensure adequate herbaceous cover for nesting and shrub cover for foraging, and minimize nest disturbance or nest destruction from grazing animals.
- ➔ Eliminate or restrict pesticide use which may reduce insect prey base.

Habitat Information Needs:

1. Are there floristic specifics in the shrub layer (e.g., species composition, native versus non-native) that affect Orange-crowned Warbler/Nashville Warbler occurrence, abundance, or population viability in mesic mixed conifer forests?

Habitat Type: MESIC MIXED CONIFER FOREST
Habitat Attribute: FOREST EDGES AND OPENINGS WITH SCATTERED TREES
Focal Species: OLIVE-SIDED FLYCATCHER (*Contopus cooperi*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Olive-sided Flycatcher declined overall by 18% with a 64% decline in the Okanogan Highlands, but a >100% increase in the Blue Mountains (Wisdom et al. 2000). The overall trend in source habitat was nearly neutral, with moderately or strongly declining trends in 31% of the ecoregions where the species occurred, and moderately or strongly increasing trends in 54%. Olive-sided Flycatcher also is regularly associated with post-wildfire habitat.

Habitat Associations:

- ✓ *large areas of suitable habitat for area requirements*
- ✓ *forest edges and openings, especially juxtaposition of early and late-successional*
- ✓ *scattered large conifer trees and snags in open forests for foraging and nesting*
- ✓ *moderate shrub cover for production of flying insect prey*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >200 ha (500 ac)**

Sites: **Where ecologically appropriate in Mesic Mixed Conifer Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **trees and snags >51 cm (20 in) dbh**
- ▶ **>2.5 snags/ha (1 snag/ac) >12 m (40 ft) high, and >5.5 trees/ha (2 trees/ac) >12 m (40 ft) high**
- ▶ **patches with a mix of potential nest trees (live trees) within the context of potential foraging and singing perches (dead trees)**
- ▶ **tree foliage volume >50%**
- ▶ **canopy cover 5-30%**
- ▶ **shrub cover >40%**

Sites: **In Post-Wildfire habitat maintain:**

- ▶ **shrub-herbaceous (includes bare ground) cover ratio that is 30-70% for each parameter**
- ▶ **trees and snags >51 cm (20 in) dbh**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >15 ha (37 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on Altman (2000b) to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for tree size and amounts of tree, shrub, and herbaceous cover were developed based Altman (2000b). The target density objective was developed based on Altman (2000b).

Habitat Strategies:

- ➔ Eliminate or restrict fuelwood cutting (snag removal) in suitable habitat by closing roads or limiting permits.
- ➔ Eliminate or minimize pesticide use near nesting pairs which may reduce insect prey base.
- ➔ Eliminate or manage livestock grazing to ensure adequate shrub cover for the production of insect prey.
- ➔ Retain standing dead or diseased trees where they occur.
- ➔ Retain snags and large trees within selective harvests.
- ➔ If snags are limiting and the habitat is suitable, create snags through appropriate methods (e.g., girdling, topping, fungal inoculation, beetle pheromone packets).
- ➔ Conduct underburning or other techniques to promote a shrubby understory for insect production.
- ➔ Conduct selective logging to increase suitability of habitat as along as sufficient large living and dead trees are retained.

Habitat Information Needs:

1. Can viable populations of Olive-sided Flycatcher be maintained in harvested mesic mixed conifer forests (Altman 2000b)?
2. Are there issues related to prey type and availability under different habitat conditions that affect Olive-sided Flycatcher occurrence, abundance, or population viability in mesic mixed conifer forests?

RIPARIAN WOODLAND

Habitat Issues:

- ✓ habitat loss due to numerous factors such as inundation from impoundments, riverine recreational developments, gravel mining, clearing for agriculture, and cutting and spraying for eased access to water courses
- ✓ loss and degradation of properly functioning riparian ecosystems where there is encroachment of urban and residential development
- ✓ habitat alteration from 1) hydrological diversions (e.g., irrigation) and control of natural flooding regimes (e.g., dams) resulting in reduced stream flows and reduction of overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and 2) stream bank stabilization which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation
- ✓ habitat degradation from conversion of native riparian vegetation to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, indigo bush, and Russian olive
- ✓ habitat degradation from livestock overgrazing which can widen channels, raise water temperatures and reduce understory cover
- ✓ fragmentation and loss of large tracts necessary for area-sensitive species such as Yellow-billed Cuckoo and Red-eyed Vireo
- ✓ hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (Brown-headed Cowbird), exotic nest competitors (European Starling), and domestic predators (cats), and be subject to high levels of human disturbance
- ✓ high energetic costs associated with high rates of competitive interactions with European Starlings for cavities may reduce reproductive success of species such as Red-naped Sapsucker, Lewis' Woodpecker, and Tree Swallow, even when outcome of the competition is successful for these species
- ✓ recreational disturbances (e.g., outdoor recreational vehicles), particularly during nesting season, and particularly in high-use areas
- ✓ increased use of pesticides and herbicides associated with agricultural practices which may reduce insect food base

Habitat Strategies:

- ➔ Institutionalize a policy of "no net loss" of riparian woodland habitat (i.e., discourage loss and conversion of habitat, but when unavoidable, mitigate with equal or greater restoration efforts).
- ➔ Restore natural hydrological regimes to reclaim natural features such as oxbows, braided stream reaches, etc.
- ➔ Restore the dominance of large cottonwood trees where ecologically appropriate.
- ➔ Maintain existing areas of moderate to high quality riparian woodland habitat comprised of native species in naturally occurring diversity, and actively manage to promote their sustainability.
- ➔ Initiate actions to enhance size and connectivity of existing riparian woodland patches (i.e., reduce fragmentation).
- ➔ Initiate actions to avoid or minimize further degradation of riparian woodland habitat (e.g., reduce or eliminate livestock grazing).
- ➔ Initiate actions to improve quality of degraded riparian woodland habitat through appropriate management.
- ➔ Eliminate or minimize channelization of streams, creeks, and rivers which reduces the extent of riparian woodland habitat.
- ➔ Reduce the presence of non-native vegetation through a long-term, staggered restoration strategy that considers timing of actions (outside breeding season), the need to maintain some existing habitat for nesting and treat remaining patches when previously treated patches approach habitat suitability habitat, and let treated areas decompose naturally without mechanical assistance to maintain structure and allow for some continued use till restored habitat is suitable.
- ➔ Initiate actions to secure conservation commitments on private lands that enhance habitat connectivity or patch size or directly support focal species habitat requirements.
- ➔ Conduct habitat management and restoration activities outside the nesting season (April 15 - July 15).

Habitat Type: RIPARIAN WOODLAND
Habitat Attribute: MATURE FOREST WITH HIGH CANOPY AND SUBCANOPY COVER AND FOLIAGE VOLUME
Focal Species: RED-EYED VIREO (*Vireo olivaceus*) (Okanogan Highlands)
YELLOW WARBLER (*Dendroica petechia*) (Blue Mountains)

Habitat/Species Comments:

Red-eyed Vireo and Yellow Warbler are near-obligate species for riparian woodland.

Habitat Associations:

- ✓ mature woodland
- ✓ relatively large patches for area requirements
- ✓ few to no conifer trees
- ✓ closed canopy and subcanopy with high foliage volume for foraging and nesting
- ✓ moderate shrub cover for insect production
- ✓ distant from livestock grazing or agriculture to minimize Brown-headed Cowbird parasitism

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**
- ▶ **areas of suitable habitat >20 ha (50 ac) with minimum edge**

***Sites:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **canopy height >15 m (50 ft)**
- ▶ **canopy and subcanopy cover >70%**
- ▶ **conifer canopy cover <10%**
- ▶ **shrub layer cover >30% with >10% young cottonwoods**
- ▶ **riparian zone >50 m (160 ft) wide**
- ▶ **conifer canopy cover <10%**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >0.7 ha (1.7 ac)/pair in suitable habitat**
- ▶ **Brown-headed Cowbird parasitism rates <10% within project areas**

Assumptions/Data Sources: The landscape objective was developed based on greater abundance in interior of large forest patches than edges (Bushman and Therres 1988), and to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for canopy height, canopy and shrub cover, and riparian zone width were developed based on Bushman and Therres (1988). The objective for conifer cover was developed based on Campos et al. (2014). The objective for target density was developed based on Williamson (1971), Lowther et al. (1999) and Cimprich et al. (2000). Both species are highly susceptible to Brown-headed Cowbird parasitism (Ehlirch et al. 1988, Graham 1988, Burke and Nol 2000), therefore it is appropriate to maintain parasitism at low levels (<10%).

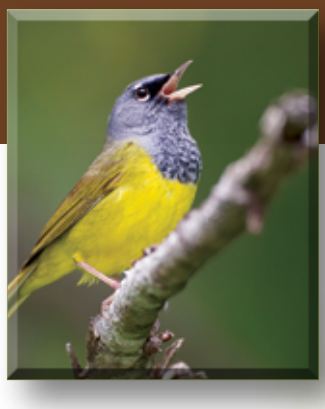
Habitat Strategies:

➔ Target conservation efforts where large patches of riparian woodland are hydrologically sustainable.

- ➔ Target conservation areas distant from agriculture or open landscapes suitable for Brown-headed Cowbird.
- ➔ Avoid habitat management that results in canopy openings >25% (Darveau et al. 1992).
- ➔ Avoid fragmentation which provides edge access for Brown-headed Cowbirds and potential reductions in nest success (Graber et al. 1985, Robbins et al. 1989, Donovan et al. 1995).
- ➔ Eliminate or manage livestock grazing to ensure a diverse shrub understory for insect production, replacement trees, and to minimize potential habitat for Brown-headed Cowbirds (Tewksbury et al. 2002).
- ➔ Eliminate or restrict pesticide use which may reduce prey base and has been shown to delay nest initiation thus potentially reducing productivity (Marshall et al. 2002).

Habitat Information Needs:

1. Are there thresholds for patch size or riparian zone width that affect Red-eyed Vireo/Yellow Warbler occurrence, abundance, or population viability in riparian woodland?



Habitat Type: RIPARIAN WOODLAND
Habitat Attribute: UNDERSTORY FOLIAGE AND STRUCTURE
Focal Species: MACGILLIVRAY'S WARBLER (*Geothlypis tolmiei*)

Habitat/Species Comments:

MacGillivray's Warbler also regularly breeds in the shrubby understory of mixed conifer forests and montane shrublands.

Habitat Associations:

- ✓ *relatively large, wide patches for area requirements*
- ✓ *dense understory cover for nesting and foraging*
- ✓ *distant from livestock grazing or agriculture to minimize Brown-headed Cowbird parasitism*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**
- ▶ **areas of suitable habitat >20 ha (50 ac) with minimum edge**

***Sites:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **tree canopy cover <40%**
- ▶ **shrub layer cover >50%**
- ▶ **herbaceous ground cover <25%**
- ▶ **riparian zone width >30 m (100 ft)**
- ▶ **unbroken tracts with the aforementioned conditions >0.2 km (1/8 mi) long**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >0.8 ha (2 ac)/pair in suitable habitat**
- ▶ **Brown-headed Cowbird parasitism rates <10% within project areas**

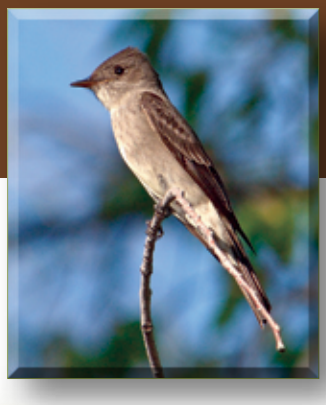
Assumptions/Data Sources: The landscape objective for low human habitation and agriculture was developed based on Tewksbury et al. (2002). The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for tree, shrub, and ground cover were developed based on Sallabanks et al. (2006). The objectives for riparian zone width and length were developed based on Casey (2000). The objective for target density was developed based on Cody and Smallwood (1996) and Pitocchelli (2013). This species is highly susceptible to Brown-headed Cowbird parasitism, therefore it is appropriate to maintain parasitism at low levels (<10%).

Habitat Strategies:

- ➔ Target conservation areas distant from agriculture or open landscapes suitable for Brown-headed Cowbird.
- ➔ Eliminate or restrict pesticide use which may reduce prey base (Taylor and Littlefield 1986).
- ➔ Eliminate or manage livestock grazing to ensure adequate shrub cover for nesting and foraging.

Habitat Information Needs:

1. Are there thresholds for patch size or riparian zone width that affect MacGillivray's Warbler occurrence, abundance, population viability, or Brown-headed Cowbird nest parasitism in riparian woodland?



Habitat Type: RIPARIAN WOODLAND
Habitat Attribute: BROKEN CANOPIES WITH HIGH HABITAT CONTRAST EDGE
Focal Species: WESTERN WOOD-PEWEE (*Contopus sordidulus*)

Habitat/Species Comments:

Western Wood-pewee also regularly breeds in several other open forest habitats, including aspen.

Habitat Associations:

- ✓ *mature woodland with tall trees for nesting*
- ✓ *few to no conifer trees*
- ✓ *open midstory for aerial foraging*
- ✓ *high contrast of edge and closed canopy*
- ✓ *dead trees or trees with dead limbs for foraging perches*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **agriculture comprises <50% of the landscape**

Sites: **Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- ▶ **canopy height >15 m (50 ft)**
- ▶ **canopy cover >45%**
- ▶ **conifer canopy cover <10%**
- ▶ **shrub cover <30%**
- ▶ **mean tree dbh >30 cm (12 in)**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >1.2 ha (3 ac)/pair in suitable habitat**

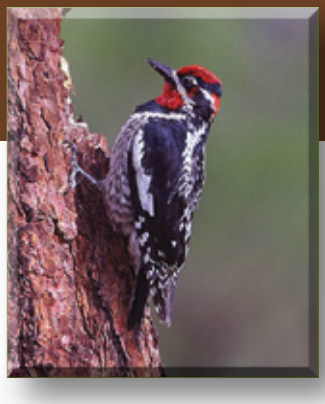
Assumptions/Data Sources: The landscape objective for limited agriculture was developed based on a negative association with grazing (Tewksbury et al. 2002). The objectives for canopy and shrub cover and tree size were developed based on Richardson (2007). The objective for target densities was developed based on Eckhardt (1976).

Habitat Strategies:

- ➔ Target conservation efforts where cottonwood trees are ecologically appropriate.
- ➔ Target conservation efforts where broken canopies and habitat edges are hydrologically sustainable.
- ➔ Eliminate or restrict pesticide use which may reduce prey populations.

Habitat Information Needs:

1. Are there understory habitat conditions (e.g., shrub cover, ground cover) that determine prey abundance and affect Western Wood-pewee occurrence, abundance, or population viability in riparian woodland?



Habitat Type: RIPARIAN WOODLAND
Habitat Attribute: LARGE SNAGS
Focal Species: RED-NAPED SAPSUCKER (*Sphyrapicus nuchalsi*)

Habitat/Species Comments:

Red-naped Sapsucker also regularly breeds in aspen habitat, and less frequently in mixed conifer forests (Simmons 2003).

Habitat Associations:

- ✓ *mature woodland dominated by hardwoods, especially cottonwood and aspen*
- ✓ *large snags or live trees with heartrot for nesting cavities*
- ✓ *moderate canopy cover*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- **areas of suitable habitat >120 ha (300 ac)**

***Sites:* Where ecologically appropriate in Riparian Woodland, maintain or initiate actions to provide the following conditions:**

- **canopy height >18 m (60 ft)**
- **canopy cover >40%**
- **mean tree dbh >54 cm (21 in)**
- **>10% cover of saplings in the understory for replacement trees**
- **>4 trees/ha (1.5/ac) and >4 snags/ha (1.5/ac) >13 m (43 ft) in height and 30 cm (12 in) dbh, especially aspen and cottonwood**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >12 ha (30 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objective for canopy height was developed based on Walters (1996) and McClelland and McClelland (2000). The objectives for trees and snags were developed based on Dobkin et al. (1995), Trombino (1998), and McClelland and McClelland (2000). The objective for canopy cover was developed based on Dobkin et al. (1995) and Sallabanks et al. (2006). The objective for target densities was developed based on McClelland (1977) and Walters (1996).

Habitat Strategies:

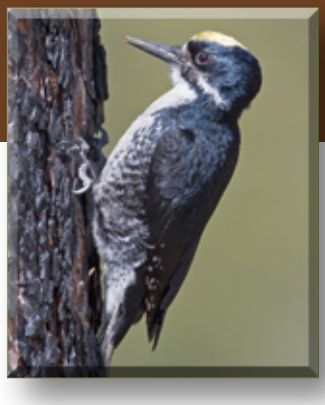
- ✓ Target conservation efforts where cottonwood or aspen are the ecologically appropriate dominant tree species.
- ✓ Eliminate or manage livestock grazing to ensure succession and recruitment of young trees (Dobkin et al. 1995).
- ✓ Retain all large standing dead or diseased trees in riparian woodland.

Habitat Information Needs:

1. What are the landscape requirements for Red-naped Sapsucker occurrence in riparian woodlands such as size of area or adjacency of coniferous or mixed forest?

UNIQUE HABITATS

There are numerous specific habitat issues and strategies associated with each of the 12 unique habitats. These are identified individually for each focal species in the following sections. However, many of the habitat strategies identified previously for the three priority habitats also are applicable for the unique habitats.



Habitat Type: UNIQUE HABITAT
Habitat: POST-WILDFIRE
Focal Species: BLACK-BACKED WOODPECKER (*Picoides arcticus*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Black-backed Woodpecker declined by 33%. There were moderately or strongly declining trends in 67% of the ecoregions where the species occurred, and moderately or strongly increasing trends in 25% (Wisdom et al. 2000). Black-backed Woodpeckers also regularly breed in lodgepole pine forests (Goggans et al. 1987), and to a lesser extent in ponderosa pine and mixed conifer forests if there is a high proportion of dead trees (Bull et al. 1986).

This use of post-fire habitat declines 3-5 years post-burn. Their low density in post-fire salvage-logged areas is more related to the reduction in food (wood boring beetles) than nest-site availability (Hutto and Gallo 2006).

Habitat Associations:

- ✓ *relatively large areas of burned forest for area requirements*
- ✓ *moderate to large trees in recently burned forest for nesting*
- ✓ *dead or dying trees infested with beetles for foraging*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Post-Wildfire, through natural events (i.e., wildfire) or management (i.e., prescribed burning), maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >3,000 ha (7,500 ac)**
- ▶ **1-2% of the landscape (i.e., large areas such as ecoregions, national forests) as post-wildfire**
- ▶ **>40% of the post-fire landscape as naturally regenerating (i.e., unsalvaged) for >3 years**

Sites: **Where salvage logging is occurring in Post-Wildfire, maintain or initiate actions to provide the following conditions:**

- ▶ **unsalvaged areas minimum patch size >40 ha (100 ac)**
- ▶ **in burns >40 ha (100 ac), salvage <50% of the standing and down dead**
- ▶ **maintain snag densities 15-30/ha (6-12/ac) >25 cm (10 in) dbh, and >20/ha (>8/ac) >48 cm (19 in) dbh**
- ▶ **retain all trees/snags >53 cm (20 in) dbh and >50% of those 30-51 cm (12-20 in) dbh, independent of logged or unlogged areas**
- ▶ **retained snags should be clumped rather than evenly spaced, with both hard and soft decay classes to lengthen the period that the site is suitable nesting habitat**
- ▶ **shrub understory cover >15%**

Population Objectives:

Sites: **Where ecologically appropriate in Post-Wildfire, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >200 ha (494 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on Goggans et al. (1987), Dudley and Saab (2007), and Bond et al. (2102) to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The landscape objectives for percent of the landscape as post-wildfire and naturally regenerating were developed based on Hutto (1995), McCullough et al. (1998), and Saab et al. (2011). The objectives for snag densities and size were developed based on Saab and Dudley (1998) and Haggard and Gaines (2001). The objective for target density was developed based on Goggans et al. (1987), Dudley and Saab (2007), and Tingley et al. (2014).

Habitat Strategies:

- ➔ Target for conservation efforts post-wildfire areas with broken-topped snags which provide an avenue for heartrot fungi (McClelland et al. 1979) and provide nest sites sooner after fire when other snags are not easily excavated due to case hardening (Saab and Dudley 1998).
- ➔ Eliminate or manage salvage logging with selective removal that retains snags in clumps rather than evenly spaced, retains both hard and soft snags, and retains large patches as unsalvaged (Saab and Dudley 1998).
- ➔ Minimize the impact to shrubs during management activities in post-wildfire habitat.
- ➔ Delay salvage logging for five years post-fire to maximize use of foraging resources and habitat suitability (Hutto 1995, Dixon and Saab 2000).

Habitat Information Needs:

1. What are the relative effects of different intensity post-fire snag removal treatments on Black-backed Woodpecker occurrence, abundance, or population viability in post-fire forests?
2. What are the effects of pesticide use and other efforts to reduce beetle populations in forests on Black-backed Woodpecker occurrence, abundance, or population viability in post-fire forests?

Habitat Type: UNIQUE HABITAT
Habitat: WHITEBARK PINE
Focal Species: CLARK'S NUTCRACKER (*Nucifraga columbiana*)

Habitat/Species Comments:

Whitebark pine occurs in the highest elevational forest zones (subalpine and timberline). Within the Interior Columbia River Basin, whitebark pine habitat has declined by 45% since the turn of the century (Keane 1995). Most of this loss occurred in the more productive, seral whitebark pine types, of which 98% has been lost. The declines have been associated with regeneration from fire suppression, climate change, and invasion of competing trees (Arno and Hoff 1990). Additionally, disease (white pine blister rust) and insect infestations (mountain pine beetles) can eliminate habitat areas, including mature trees. Clark's Nutcracker is dependent on pine cone seeds, and will undergo extensive movements when seed is unavailable.

Habitat Associations:

- ✓ *mature trees for seed production and nesting*
- ✓ *xeric exposed sites for caching of seeds for germination and pine regeneration*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Whitebark Pine, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >1,000 ha (2,500 ac)**

***Sites:* Where ecologically appropriate in Whitebark Pine, maintain or initiate actions to provide the following conditions:**

- ▶ **mature tree cover >30%**
- ▶ **regeneration tree cover >10%**

Assumptions/Data Sources: The landscape objective for patch size was developed based on Schaming (2016) to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for tree cover were developed based on professional judgment.

Habitat Strategies:

- ➔ Target conservation efforts in areas where whitebark pine is part of a mosaic of habitats with other cone-producing trees such as Douglas-fir (Schaming 2016).
- ➔ Eliminate or manage livestock grazing to ensure adequate regeneration of seedling trees.
- ➔ Maintain existing and reestablish pure and mixed stands of whitebark pine dominated by blister rust resistant trees with reduced potential of stand replacement fire.
- ➔ Adjacent habitat conditions that facilitate mountain pine beetle and blister rust should be reduced where possible to maintain existing whitebark pine sites from infestation.
- ➔ Reintroduce natural fire regimes into whitebark pine systems.

Habitat Information Needs:

1. What are the thresholds of amount and area of whitebark pine cover that are most conducive to Clark's Nutcracker occurrence, abundance, or viability?

Habitat Type: UNIQUE HABITAT
Habitat: SUBALPINE FOREST
Focal Species: HERMIT THRUSH (*Catharus guttatus*)

Habitat/Species Comments:

The relationship between shrub and herbaceous cover in subalpine forest is dependent on site conditions, especially moisture levels affected by variables such as elevation, aspect, and proximity to streams. Hermit Thrush also regularly breeds in the understory of mixed conifer forests.

Habitat Associations:

- ✓ *mature forest with shaded understory*
- ✓ *moderate to large patch size for occurrence*
- ✓ *moderate canopy cover with openings*
- ✓ *interspersion of herbaceous and shrub cover for foraging and nesting*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Subalpine Forest, maintain or provide the following conditions:**

- ▶ **Within 1,000 ha (2,500 ac) blocks, provide patch sizes of suitable habitat conditions in the following forest cover amounts for high suitability:**
  - ■ **>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 in Subalpine Forest, maintain or provide the following conditions:**

- **ratio of shrub-herbaceous (includes bare ground) cover 30–70%**
- **canopy cover 30-70%**

Population Objectives:

- **mean target densities >2 ha (5 ac)/pair in suitable habitat**

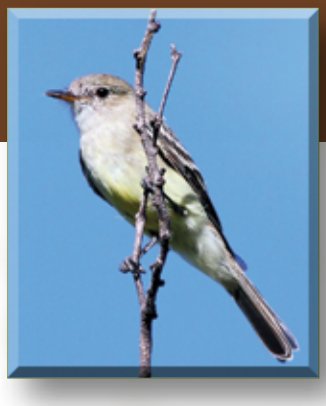
Assumptions/Data Sources: The landscape objectives for the relationship between patch size and forest cover were developed based on data from throughout western North America indicating the sensitivity of Hermit Thrush to forest fragmentation (Rosenberg et al. 2003). The site objectives for canopy cover and ratio of shrubs and herbaceous cover were developed based on (Mannan and Meslow 1984). The objective for target densities was developed based on Manuwal (1968).

Habitat Strategies:

- ➔ Target conservation efforts where broken canopies and heterogeneous understories are ecologically appropriate (e.g., where there is diverse topography, soil, and moisture regimes).
- ➔ Eliminate or manage livestock grazing to develop and promote the long-term persistence and balance of herbaceous and shrub communities.
- ➔ Eliminate or restrict pesticide use which may reduce insect prey base.
- ➔ 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 fuels reduction is occurring as part of wildfire management, maintain enough patchy shrub cover to meet the percent shrub cover objective.

Habitat Information Needs:

1. What are the threshold and most suitable ratios of shrub and herbaceous cover for Hermit Thrush occurrence, abundance, or population viability in subalpine forest?
2. Are Hermit Thrush sensitivities to forest fragmentation in western North America (Rosenberg et al. 2003) applicable to the subalpine forests of eastern Oregon and Washington?
3. What are the range of spatial patterns of patches in subalpine forest that promote Hermit Thrush occurrence, abundance, or population viability while effectively reducing fire risk?
4. What are the effects of fuels reduction on Hermit Thrush occurrence, abundance, or population viability in subalpine forest?



Habitat Type: UNIQUE HABITAT
Habitat: JUNIPER WOODLAND
Focal Species: GRAY FLYCATCHER (*Empidonax wrightii*)

Habitat/Species Comments:

Juniper removal/control is being conducted extensively where invasive juniper has encroached on sagebrush habitats, especially in association with Greater Sage Grouse conservation areas. Gray Flycatcher also regularly breeds in big sagebrush and open pine woodlands.

Habitat Associations:

- ✓ *mid and late-successional woodland*
- ✓ *sparsely vegetated ground and an open understory for aerial foraging space*
- ✓ *distant from livestock grazing or agriculture to minimize Brown-headed Cowbird parasitism*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Juniper Woodland, maintain or initiate actions to provide the following conditions:**

- **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**

Sites: **Where ecologically appropriate in Juniper Woodland, maintain or initiate actions to provide the following conditions:**

- **mid or late-successional juniper trees with 5-15 trees/ha (2-6 trees/ac) and >1 tree/ha (0.4 trees/ac) >53 cm (21 in) dbh**
- **canopy cover 10-40% with no areas <5% or >70% cover**
- **shrub layer (i.e., shrubs and sapling junipers) cover 5-20%**
- **herbaceous ground cover 50-80%**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >3.0 ha (7 ac)/pair in suitable habitat**
- **Brown-headed Cowbird parasitism rates <10% within project areas**

Assumptions/Data Sources: The objectives for tree size and quantity were developed based on Holmes et al. (2007). The objectives for canopy cover were developed based on Gashwiler (1977), Reinkensmeyer (2000), and East Cascades Bird Conservancy (2007). The objectives for shrub and ground cover were developed based on Altman and Woodruff (2012). The objective for target density was developed based on Altman and Woodruff (2012). This species is highly susceptible to Brown-headed Cowbird parasitism, therefore it is appropriate to maintain parasitism at low levels (<10%).

Habitat Strategies:

- ➔ Target conservation efforts distant from agriculture or open landscapes suitable for Brown-headed Cowbird.
- ➔ Target conservation efforts where late-successional juniper is the ecologically appropriate condition (e.g., slopes near rocky outcrops).
- ➔ Retain all mature and old-growth juniper trees where ecologically appropriate (i.e., non-invasive sites).
- ➔ Ensure there is no inappropriate removal of older, naturally occurring juniper during sagebrush restoration that targets invasive juniper.
- ➔ Eliminate or manage livestock grazing to ensure adequate levels of shrub and ground cover.
- ➔ Eliminate or restrict pesticide use which may reduce flying insect prey populations.
- ➔ Where juniper management is occurring, manual cutting and removal of juniper trees is preferable to chaining or mechanical efforts to minimize effects on vegetation and soils.

Habitat Information Needs:

1. What are the levels of grazing that can maintain Gray Flycatcher occurrence, abundance, or population viability in juniper woodland?
2. Are there landscape factors, patch size, or area requirements that limit Gray Flycatcher occurrence, abundance, or population viability in juniper woodland?

Habitat Type: UNIQUE HABITAT
Habitat: ASPEN
Focal Species: WARBLING VIREO (*Vireo gilvus*)

Habitat/Species Comments:

Most of the aspen in the Pacific Northwest is in older age classes and in critical need of regeneration. Older sites are usually less vigorous and least likely to regenerate successfully, and many aspen trees are being crowded out by competing conifers. Effective fire suppression over the past 50 years has permitted competition and disease to reduce clone vigor to levels lower than would be expected under natural conditions. Compounding the situation, fire suppression has drastically reduced fire induced regeneration in recent years resulting in few young aged sites. Warbling Vireo also regularly breeds in riparian woodland.

Habitat Associations:

- ✓ *mature trees for nesting*
- ✓ *young trees for recruitment*
- ✓ *few to no conifer trees*
- ✓ *distant from livestock grazing or agriculture to minimize Brown-headed Cowbird parasitism*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Aspen, maintain or initiate actions to provide the following conditions:**

- ▶ **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**
- ▶ **areas of suitable habitat >20 ha (50 ac)**

Sites: **Where ecologically appropriate in Aspen, maintain or initiate actions to provide the following conditions:**

- ▶ **canopy height >15 m (50 ft)**
- ▶ **canopy cover >50%**
- ▶ **conifer canopy cover <10%**
- ▶ **shrub cover <30%**

Population Objectives:

Sites: **Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >1.3 ha (3 ac)/pair in suitable habitat**
- ▶ **Brown-headed Cowbird parasitism rates <10% within project areas**

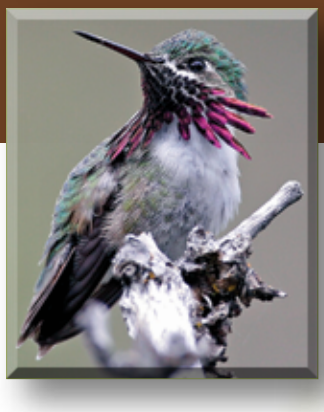
Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objective for canopy cover was developed based on Dobkin et al. (1995) and Richardson (2007). The objectives for canopy height and shrub cover were developed based on Richardson (2007). The objective for limited conifer canopy cover was developed based on Richardson and Heath (2005). The objective for target density was developed based on Gardali and Ballard (2000). This species is highly susceptible to Brown-headed Cowbird parasitism, therefore it is appropriate to maintain parasitism at low levels (<10%).

Habitat Strategies:

- ➔ Target conservation areas distant from agriculture or open landscapes suitable for Brown-headed Cowbird.
- ➔ Implement the use of prescribed fire in restoration to stimulate aspen regeneration.
- ➔ Eliminate or manage livestock grazing to ensure succession and recruitment of young aspen.
- ➔ Eliminate or restrict pesticide use which may reduce prey base.
- ➔ Manage encroaching conifers to ensure dominance of aspen and retention of ecological function.

Habitat Information Needs:

1. Are there differences in Warbling Vireo occurrence, abundance, or population viability in successional stages of aspen?



Habitat Type: UNIQUE HABITAT
Habitat: MONTANE SHRUBLAND
Focal Species: CALLIOPE HUMMINGBIRD (*Selasphorus calliope*)

Habitat/Species Comments:

Montane shrublands 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. Mesic or xeric shrubs are dominant, ranging from 20-100% cover. Calliope Hummingbird also regularly breeds in riparian woodland and forest edges and understory dominated by shrubs, including regrowth areas after logging or fire. It may be adversely impacted if climate change alters blooming phenology.

Habitat Associations:

- ✓ *dense shrub patches for nesting*
- ✓ *flowering shrubs/trees for foraging*
- ✓ *mosaic of edges, openings, and patches of shrubland*

Habitat Objectives:

***Sites:* Where ecologically appropriate in Montane Shrubland, maintain or initiate actions to provide the following conditions:**

- ▶ **shrub cover >60%**
- ▶ **tree cover <25%**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >0.3 ha (0.7 ac)/pair in suitable habitat**

Assumptions/Data Sources: The objectives for shrub cover and canopy cover were developed based on professional judgment. The objective for target density was developed based on Calder and Calder (1994).

Habitat Strategies:

- ➔ Target conservation efforts where flowering trees and shrubs are the ecologically appropriate and dominant flora.
- ➔ Eliminate or manage livestock grazing to ensure adequate shrub and flowering plant cover.
- ➔ Protect productive flowering shrublands from encroaching trees and destructive recreation.

Habitat Information Needs:

1. What are the ratios and thresholds for the tree, shrub, and herbaceous mosaic of cover that supports Calliope Hummingbird occurrence, abundance, or population viability in montane shrublands?
2. What is the floral composition of montane shrublands necessary for Calliope Hummingbird occurrence, abundance, or population viability?
3. Does the floral composition of seral shrublands used by the species in a managed forest adequately mimic natural shrubland habitats in providing the nectar and insect resources needed by Calliope Hummingbird?

Habitat Type: UNIQUE HABITAT
Habitat: RIPARIAN SHRUB
Focal Species: WILLOW FLYCATCHER (*Empidonax trallii*)

Habitat/Species Comments:

Riparian shrub occurs both in association with riparian woodland and independently where conditions are not suitable for large tree growth. Willow Flycatcher is obligate to riparian habitat including both riparian shrub and shrub within or adjacent to riparian woodland.

Habitat Associations:

- ✓ *moderate to high shrub cover and volume for nesting and foraging*
- ✓ *moderate patch size for occurrence*
- ✓ *distant from agriculture and livestock grazing to minimize Brown-headed Cowbird parasitism*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Riparian Shrub, maintain or initiate actions to provide the following conditions:**

- ▶ **<10% hostile habitat (i.e., agricultural lands with moderate to heavy grazing pressure or other areas supporting Brown-headed Cowbird populations)**
- ▶ **>5 km (3 mi) from high-use Brown-headed Cowbird areas**
- ▶ **>1 km (0.6 mi) from urban/residential areas**
- ▶ **>8 ha (20 ac) patches of suitable habitat**

Sites: Where ecologically appropriate in Riparian Shrub, maintain or initiate actions to provide the following conditions:

- ▶ **shrub layer cover 40-80%, especially willow cover**
- ▶ **shrub layer height >1.4 m (5 ft)**
- ▶ **tree canopy cover <20%**
- ▶ **conifer cover <10%**
- ▶ **dense shrub patches >20 m sq (70 ft sq) in size and interspersed with openings of herbaceous vegetation**

Population Objectives:

Sites: Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:

- ▶ **mean target densities >0.7 ha (1.7 ac)/pair in suitable habitat**
- ▶ **Brown-headed Cowbird parasitism rates <10% within project areas**

Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for percent cover and shrub height were developed based on Taylor (1986) and Sanders and Edge (1998). The objectives for interspersion

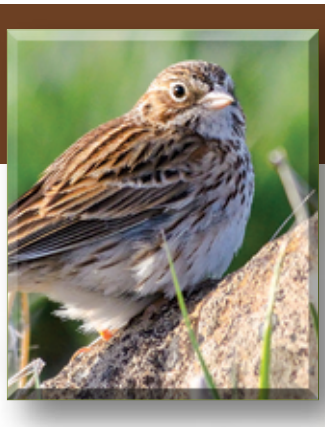
of openings was developed based on Harris et al. (1988) and Sanders and Flett (1988). The objective for shrub patch size was developed based on Serena (1982) and Harris et al. (1988). The objective for target density was developed based on Sanders and Flett (1988). This species is highly susceptible to Brown-headed Cowbird parasitism, therefore it is appropriate to maintain parasitism at low levels (<10%).

Habitat Strategies:

- ➔ Target conservation efforts distant from agriculture or open landscapes suitable for Brown-headed Cowbird.
- ➔ Target conservation efforts where riparian shrub is ecologically appropriate and hydrologically sustainable.
- ➔ Restore riparian shrub habitat and increase width of riparian zone by planting appropriate riparian shrubs in areas with adequate hydrology.
- ➔ Eliminate or minimize channelization of streams, creeks, and rivers which reduces the extent of riparian shrub habitat.
- ➔ Eliminate or manage livestock grazing to ensure adequate shrub cover for nesting (Taylor 1984), and minimize nest disturbance or destruction from grazing animals.
- ➔ Eliminate or restrict pesticide use which may reduce insect prey base (Taylor and Littlefield 1986).

Habitat Information Needs:

1. Are there patch size or landscape components (e.g., percent conifer forest, percent agriculture) that affect Willow Flycatcher occurrence, abundance, or population viability in riparian shrub?



Habitat Type: UNIQUE HABITAT
Habitat: SAGEBRUSH-STEPPE
Focal Species: VESPER SPARROW (*Pooecetes gramineus*)

Habitat/Species Comments:

Within the Interior Columbia Basin, source habitats for Vesper Sparrow declined overall by 38%, with moderately or strongly declining trends in source habitats in 85% of the ecoregions and stable trends in the other 15% (Wisdom et al. 2000). Vesper Sparrow also regularly breeds in upland grasslands.

Habitat Associations:

- ✓ *mosaic of structurally diverse herbaceous vegetation for nesting, foraging, and cover*
- ✓ *areas of sparsely vegetated ground (i.e., bare ground) for foraging*
- ✓ *scattered shrub or tall herbaceous cover for perching and singing*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Sagebrush-Steppe, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >20 ha (50 ac)**

Sites: **Where ecologically appropriate in Sagebrush-Steppe, maintain or initiate actions to provide the following conditions:**

- ▶ **shrub cover 10-25%**
- ▶ **forb cover >10%**
- ▶ **grass height 15-30 cm (6-12 in)**

Population Objectives:

Sites: **Where ecologically appropriate in Sagebrush-Steppe, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >1.2 ha (3 ac)/pair in suitable habitat**

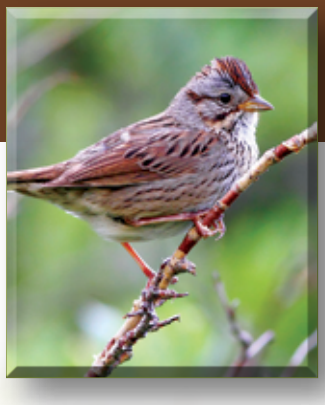
Assumptions/Data Sources: The landscape objectives for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objective for shrub cover was developed based on Weins and Rotenberry (1981). The objectives for ground and forb cover were developed based on Weins (1969) and Jones and Cornely (2002). The objective for target densities was developed based on Reed (1985, 1986).

Habitat Strategies:

- ➔ Eliminate or manage livestock grazing to ensure adequate vegetative cover for nesting and foraging and to minimize nest disturbance or nest destruction from grazing animals.
- ➔ Eliminate or restrict recreational vehicle use during the breeding season to avoid nest disturbance or nest destruction.
- ➔ Eliminate or restrict pesticide use which may reduce prey populations.
- ➔ When conducting sagebrush management, maintain cover amounts as described above.

Habitat Information Needs:

1. What are the thresholds of patch size for Vesper Sparrow occurrence, abundance, or population viability in sagebrush-steppe?
2. What are the impacts to Vesper Sparrow nest success under different sagebrush management techniques (e.g., chemical treatments, mechanical treatments)?



Habitat Type: UNIQUE HABITAT
Habitat: ALPINE/MONTANE WET MEADOW
Focal Species: LINCOLN'S SPARROW (*Melospiza lincolnii*)

Habitat/Species Comments:

Alpine/montane wet meadows occur above treeline or at higher elevations in the forest where the hydrology is suitable for a wet herbaceous community. Alpine 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. Lincoln's Sparrows are near-obligate to alpine/montane wet meadows for nesting habitat.

Habitat Associations:

- ✓ *wet or mesic conditions*
- ✓ *dense herbaceous vegetation for nesting and foraging*
- ✓ *scattered or patchy shrubs and/or small trees for singing*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Alpine/Montane Wet Meadow, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >20 ha (50 ac)**

***Sites:* Where ecologically appropriate in Alpine/Montane Wet Meadow, maintain or initiate actions to provide the following conditions:**

- ▶ **tree cover <15%**
- ▶ **shrub cover <15%**
- ▶ **shrub height <3 m (100 in) tall**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- ▶ **mean target densities >1.0 ha (2.5 ac)/pair in suitable habitat**

Assumptions/Data Sources: The landscape objective for patch size was developed based on professional judgment to encourage management for small populations (e.g., >10 pairs) rather than individual pairs. The objectives for tree and shrub cover were developed based on professional judgment. The objective for shrub height was developed based on Wortman and Wunder (1997) and Stephens and Anderson (2003). The objective for target densities was developed based on Ammon (1995) and Wortman and Wunder (1997).

Habitat Strategies:

- ➔ Eliminate or restrict human access and recreational vehicle use during the breeding season to minimize nest disturbance or nest destruction.
- ➔ Eliminate or manage livestock grazing to ensure adequate vegetative structure and volume for nesting birds (Cicero 1997).
- ➔ Eliminate or restrict pesticide use which may reduce prey base.
- ➔ Manage tree/shrub invasion at edge of meadows to maintain patch size and minimize effects on water table.
- ➔ Avoid runoff and sedimentation into meadows due to logging or road building.

Habitat Information Needs:

1. Are there minimum patch sizes of alpine/wet meadows for Lincoln Sparrow occurrence, abundance, or population viability?
2. Are there acceptable thresholds of livestock grazing that can support Lincoln Sparrow occurrence, abundance, or population viability in alpine/wet meadows?

Habitat Type: UNIQUE HABITAT
Habitat: UPLAND GRASSLANDS
Focal Species: SAVANNAH SPARROW (*Passerculus sandwichensis*)

Habitat/Species Comments:

Upland grasslands occur at all elevations within the forest matrix and also in lower elevations below the forest zone. Savannah Sparrow also regularly breeds in irrigated agricultural fields.

Habitat Associations:

- ✓ *large areas of suitable habitat for area requirements*
- ✓ *low to none shrub and tree cover*
- ✓ *low bare ground cover*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Upland Grasslands, maintain or initiate actions to provide the following conditions:**

- ▶ **areas of suitable habitat >100 ha (247 ac)**

***Sites:* Where ecologically appropriate in Upland Grasslands, maintain or initiate actions to provide the following conditions:**

- ▶ **grass cover >40%**
- ▶ **forb cover 10-30%**
- ▶ **shrub/tree cover <10%**
- ▶ **bare ground <10%**
- ▶ **a mosaic of herbaceous cover conditions (e.g., height and species composition)**

Population Objectives:

- **mean target densities > 0.5 ha (1.2 ac)/pair in suitable habitat**

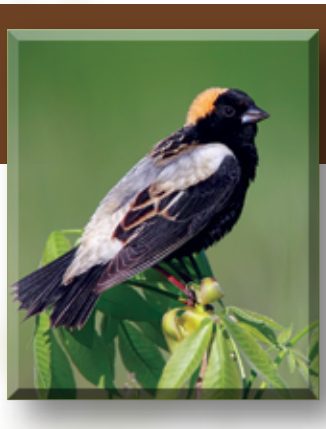
Assumptions/Data Sources: The landscape objective was developed based on Vickery et al. (1994) and Washington Department of Fish and Wildlife (1995). The habitat objectives for ground, shrub, and tree cover were developed based on professional judgment. The objective for target densities was developed based on multiple sources in Wheelwright and Rising (1993).

Habitat Strategies:

- ➔ Eliminate or manage livestock grazing to ensure adequate herbaceous vegetation for nesting and foraging, and to minimize nest disturbance or destruction from grazing animals.
- ➔ Eliminate or restrict pesticide use which may reduce prey base.
- ➔ Eliminate or restrict human disturbance from recreational activities during the nesting season.
- ➔ Manage tree/shrub invasion at edge of meadows to maintain patch size and minimize effects on water table.

Habitat Information Needs:

1. Are there thresholds of patch size for Savannah Sparrow occurrence, abundance, or population viability in upland grasslands?



Habitat Type: UNIQUE HABITAT
Habitat: LOWLAND WET MEADOWS
Focal Species: BOBOLINK (*Dolichonyx oryzivorus*)

Habitat/Species Comments:

Lowland wet meadow habitats in an otherwise arid landscape support a unique suite of landbirds. Irrigated agricultural fields have likely increased the amount of this habitat. Bobolink is a semi-colonial species that nests on the ground (Marshall et al. 1996, Smith et al. 1997).

Habitat Associations:

- ✓ *wet or mesic conditions*
- ✓ *dense, tall herbaceous vegetation for nesting*
- ✓ *heavy forb cover for nesting*
- ✓ *thick litter cover on ground*
- ✓ *little to no bare ground*
- ✓ *little to no woody vegetation*
- ✓ *large areas of suitable habitat*

Habitat Objectives:

Landscapes: **Where ecologically appropriate in Lowland Wet Meadows, maintain or initiate actions to provide the following conditions:**

- **areas of suitable habitat >45 ha (112 ac)**

Sites: **Where ecologically appropriate in Lowland Wet Meadows, maintain or initiate actions to provide the following conditions:**

- **tree/shrub cover <10%**
- **forb cover >10%**
- **bare ground <10%**

Population Objectives:

***Sites:* Where ecologically appropriate in Dry Forest, maintain or initiate actions to provide the following conditions:**

- **mean target densities >1.2 ha (2 ac)/pair in suitable habitat**

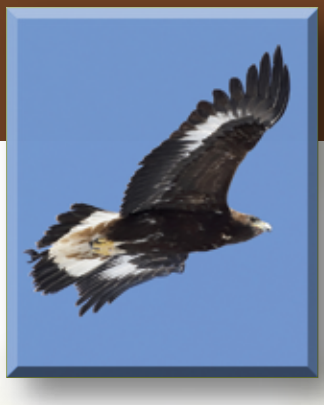
Assumptions/Data Sources: The landscape objective for patch size was developed based on Helzer and Zelinski (1999). The objectives for tree/shrub cover were developed based on Sample (1989) and Bollinger and Gavin (1992). The objective for bare ground was developed based on Schneider (1998). The objective for target densities was developed based on Martin (1967), Weins (1969), Raim (1975), and Bollinger (1988).

Habitat Strategies:

- ➔ Target conservation efforts in wet meadows near riparian habitat and irrigated agriculture fields to expand suitable habitat.
- ➔ Target conservation efforts adjacent to or near existing colonies because high site fidelity reduces the likelihood of establishment of colonies at other locations.
- ➔ Eliminate or restrict human access and recreational vehicle use during the breeding season to minimize nest disturbance or nest destruction (Dechant et al. 1999).
- ➔ Eliminate or manage livestock grazing to ensure adequate vegetative structure and composition for nesting birds.
- ➔ Eliminate or restrict pesticide use which may reduce prey base.
- ➔ Control tree/shrub invasion to maintain patch size and minimize effects on water table.
- ➔ Modify farming operations where nesting occurs in cultivated fields to minimize nest losses during operations.

Habitat Information Needs:

1. Is Brown-headed Cowbird nest parasitism an issue for Bobolink productivity in lowland wet meadows, and if so what are the local and landscape factors contributing to it?
2. Are irrigated agricultural fields functioning as source habitats, and what are the parameters and thresholds that result in Bobolink occurrence, abundance, or population viability?



Habitat Type: UNIQUE HABITAT
Habitat: CLIFFS AND ROCK OUTCROPS
Focal Species: GOLDEN EAGLE (*Aquila chrysaetos*)

Habitat/Species Comments:

Steep canyon walls and cliffs offer protective nesting and roosting habitat, and perches for hunting. Golden eagles are limited by availability of the combination of sheer cliffs (also use large trees for nesting) for nesting and high prey densities (i.e., small mammals) in open landscapes for foraging. They generally avoid forests, agricultural areas, and residential/urban areas.

Habitat Associations:

- ✓ *large expanses of habitat for area requirements*
- ✓ *cliff ledges for nesting*
- ✓ *juxtaposition of suitable nesting cliffs with surrounding habitat essential for foraging*
- ✓ *adequate food and cover for prey base of small to mid-sized mammals*

Habitat Objectives:

***Landscapes:* Where ecologically appropriate in Cliffs and Rock Outcrops, maintain or initiate actions to provide the following conditions:**

- **suitable habitat and populations of mammalian prey, especially jackrabbits, within 7 km (4.4 mi) of nest sites**

Assumptions/Data Sources: The landscape objective for area of prey habitat was developed based on Cooperrider et al. (1986).

Habitat Strategies:

- Target conservation efforts based on the juxtaposition of nesting cliffs and large areas of open landscapes where high densities of small and medium-sized mammal prey populations occur or can be managed for, particularly jackrabbits.
- Eliminate or restrict pesticide use which can accumulate in prey.
- Avoid siting of energy developments within 10 km (6 mi) of nesting sites.
- Maintain disturbance-free buffer zones of 1 km (0.6 mile) around nest locations (DeLong 2004).
- Provide artificial nesting structure where nesting sites are limited or have been eliminated and suitable foraging habitat is available.

Habitat Information Needs:

1. What are the specifics of prey habitat suitability (e.g., shrub cover, ground cover, native versus non-native vegetation) that affect Golden Eagle occurrence, abundance, or population viability?

IMPLEMENTATION

There are numerous considerations for implementation to achieve the habitat and population objectives presented in this document. **Because of the diversity of landbird species and habitats in the Northern Rocky Mountains, conservation will require a complex array of conditions within variable landscape patterns. Implementation also will likely require the need for areas that function naturally with limited or no management intervention (e.g., some federal lands), and areas where desired landbird habitat conditions will need to be achieved by incorporating a wide range of habitat management and restoration activities within a working landscape of various land uses (e.g., forestry, agriculture, grazing, recreational).**

Management and restoration goals will need to be carefully designed and coordinated among various landowners and land management agencies and organizations to ensure efficiencies and cost effectiveness, and to integrate the diverse values and goals of land managers and landowners with that of bird conservation. The habitat and population objectives in this document 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). In particular, the conceptual implementation emphasis in this document is three-fold:

- initiate conservation actions in accordance with the ecological potential of the site (i.e., within the framework of potential vegetation and ecosystem processes)
- emphasize conservation within both strategic priority areas and where opportunities exist (i.e., receptive land owners and land managers)
- emphasize conservation that is integrated across multiple scales such that habitat conditions for one or a few focal species are nested within a landscape that provides a mosaic of conditions for other focal species

Ecologically Appropriate

Meeting the goal of healthy landbird populations begins with the maintenance and restoration of properly functioning ecosystems comprised of priority and unique habitats. The emphasis on setting habitat objectives was for the most desirable habitat conditions for focal species in areas where those conditions are ecologically appropriate.

Avoiding Square Pegs and Round Holes: Be Ecologically Appropriate

As part of the planning and implementation process, it is essential to understand the ecological capacity or "potential native vegetation" of the site to support particular habitat conditions or bird species. This includes a suite of biotic and abiotic factors that cannot be manipulated such as soil type, aspect, slope, local weather, etc. Thus, knowing what is possible or ecologically appropriate is essential before any design or management is conducted. If the potential native vegetation is not readily known, the assistance of a professional ecologist can be beneficial. Understanding these factors should guide how to strategize habitat management or restoration. Once the potential native vegetation for the site is known, an evaluation can be conducted to determine the focal species or suites of species that have habitat requirements that a site can reasonably provide.

A large-scale example of the importance of the concept of ecological appropriateness is current versus historic mixed conifer forest. Much of the current mixed conifer forest exists in areas historically dominated by dry forest. These sites, although potentially meeting habitat conditions for mixed conifer forest focal species, are degraded and converted dry forest habitat. They should be targeted for management and restoration of dry forest conditions and focal species, which have been reduced across the landscape, and are ecologically appropriate and desirable within natural or managed disturbance regimes.

The emphasis on setting habitat objectives was for the most desirable habitat conditions for focal species in areas where those conditions are ecologically appropriate.

Thus, throughout the habitat objectives the phrase "where ecologically appropriate" is used as a reminder that it is essential to consider the ecological appropriateness of the site to support the habitat attribute before initiating the management or restoration (Sidebar: Avoiding Square Pegs and Round Holes: Be Ecologically Appropriate).

Scale and Landscape Considerations

Habitat 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, in mesic mixed conifer forest, the objective to provide high canopy closure and foliage volume for Townsend's Warbler is counter to the objective to provide forest edges and opening for Olive-sided Flycatcher. Likewise, in dry forest, the objective for patches of dense trees for Flammulated Owl roosting and calling is in direct conflict with the objectives for open, savannah forest for Lewis's Woodpecker. The recognition of ecological appropriateness and the integration of design and management in a complementary manner across the landscape can accommodate conflicting objectives. This will require cooperative decisions by appropriate land managers at the appropriate scale on the proportion and spatial distribution of the area desired in particular habitat conditions.

Conversely, even at smaller scales, some biological objectives for multiple focal species can be achieved simultaneously through a combination of management actions. For example, combining variable-spaced or patchy thinning with retention of old-growth trees can support to varying degrees White-headed Woodpecker, Flammulated Owl, and Chipping Sparrow in dry forest habitat, or Olive-sided Flycatcher and Williamson's Sapsucker in mesic mixed conifer forest.

It also will be important to consider where habitat conservation networks are necessary to conserve landbird populations. Although the connectivity of habitats that function as corridors may not be essential for mobile animals like birds, the connectivity may be particularly important for area-sensitive species such as White-headed Woodpecker in dry forest and Red-eyed Vireo in riparian woodland when it results in an expansion of the area of suitable habitat.

Regional Prioritization

This document encourages habitat management for all focal species and habitat types. However, for those making decisions on allocation of resources at regional scales, the highest priorities for landbird conservation include:

- Protection of all remaining late-successional forest
- Restoration of dry forest habitat
- Management for appropriate natural regeneration of post-wildfire habitat
- Restoration of riparian woodland and riparian shrub habitat

Conservation Design

Because of the complexities of scale, species, and ownerships as described above, 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., National Forest Plans) 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 the habitat and population objectives in this document. However, bird conservation partners can use the objectives in multiple ways as part of the development of spatially-explicit landscapes for bird conservation (Sidebar: Using Focal Species as Conservation Tools).

Using Focal Species as Conservation Tools

There are two primary ways to use focal species as a tool for landbird conservation. First, the specifics of their habitat associations (e.g., canopy cover, shrub cover, tree size) can be used in the planning process to set prescriptive habitat objectives for a site or landscape. Secondly, the occurrence or abundance of focal species can be used as a metric to track positive progress of habitat management or restoration towards the habitat objectives they represent. It is important to recognize that although the presence or abundance of a focal species can be used as a positive indicator of success or effectiveness of habitat management or restoration, the absence of these species during monitoring does not necessarily indicate the opposite - failure. There are many reasons why a species may not occur at a site independent of the habitat condition. However, the absence or low abundance of a focal species can be a red flag for further attention to those habitat conditions.

Timing of Activities

One of the basic tenets of landbird conservation is that reproduction can be negatively affected by land use or management during the breeding season (i.e., April 15 – July 15 for most landbirds). In many cases, avoidance of these dates can be followed (i.e., the actions are not time-sensitive). However, there are some instances where conflict may not be avoidable for desired habitat management results (e.g., spraying invasive species before going to seed). Thus, it is important to evaluate the timing of the management actions (i.e., essential versus convenient), and if there are reasonable alternatives. One alternative when management actions are deemed necessary during the breeding season is to conduct bird monitoring prior to the actions to determine if focal, priority, or responsibility species are nesting. If so, spatial modifications to the proposed management can often be implemented.

Opportunities for Participation

Implementation of landbird conservation activities as described in this document will require a broad range of partnerships, an extensive amount of cooperation, and considerable financial resources. However, there are opportunities for participation at many levels from a small landowner who provides habitat for one focal species, to detailed, complex multi-agency/organization multi-species conservation efforts within large-scale management units such as ecoregions.

As described earlier, 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 Northern Rocky Mountains of the IWJV, and the limited amount of resources available for bird and habitat conservation, the IWJV partnership is focusing its current efforts for landbirds on sagebrush and riparian habitats within the landscape of its traditional focus on wetland habitats. Thus, coniferous forest habitats are not a current focus of the IWJV. However, where sagebrush and riparian habitats are embedded within tracts of coniferous forest, there are opportunities to work with IWJV bird conservation partners to provide added value by including adjacent coniferous forest habitat management for landbirds.

In 2012, the U.S. Forest Service adopted "managing for resilience" as the third principle of its climate change response strategy. The final rule (Federal Register, April 9, 2012) emphasized collaboration in the forest planning process through public involvement and dialogue, and the use of the best available scientific information to inform decisions on the protection of land, water, and wildlife. To facilitate this process, Collaborative Forest Cooperatives were established throughout the region to provide stakeholders an opportunity to recommend and participate in forest management activities (Sidebar: Collaborative Forest Cooperatives).

Collaborative Forest Cooperatives

Congress established the Collaborative Forest Landscape Restoration Program in 2009 to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes to reduce the risk of large-scale wildfire and benefit rural communities. Furthermore, these projects were expected to encourage "ecological, economic, and social sustainability" and serve as demonstrations for effective restoration techniques and forest product utilization. By requiring collaboration, the idea was to address and resolve any conflicts on land management by bringing together public and private land managers, conservation interests, and tribes to benefit forest ecosystems and rural economies through accelerated landscape-scale forest restoration. There are numerous collaborative forest cooperatives in Oregon and Washington including several in the Northern Rocky Mountains (e.g., Northeast Washington Forestry Coalition, Wallowa-Whitman Forest Collaborative, Blue Mountains Forest Partners).

MONITORING AND ADAPTIVE MANAGEMENT

When habitat management actions are undertaken as described in this document, monitoring 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. 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 assess 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).

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

Monitoring results also should 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).

Focal Bird Species and Effectiveness Monitoring

By monitoring both birds and vegetation before and after restoration, we can evaluate whether a project has achieved its intended outcome and guide further restoration actions if needed. While, the ultimate metric of the success of the habitat management or restoration actions should be the assessment of the vegetative conditions created to support focal species, the response of focal species provides us with additional understanding of ecological change. The use of a suite of focal species representing a range of the habitat conditions will provide a more robust measure of effectiveness than a single species. The presence or density of a suite of focal bird species can be used as a positive indicator of the "effectiveness or success" of habitat management or restoration activities at a site, but should not be used as the primary metric for effectiveness because of the potential for factors beyond habitat to affect bird species. There are many reasons why a bird species may not occur at a site with seemingly appropriate habitat, such as proximity and status of its nearest populations and the ability of those populations to provide recruitment into the site, or that our knowledge of the targeted habitat conditions for the species is incomplete or inaccurate. Thus, it is possible that habitat management or restoration can be successful in achieving the desired habitat conditions, but still not support the targeted focal species. While the absence or low density of some focal species might not indicate failure, it should prompt further evaluation of restoration effectiveness and/or species ecology. From a bird conservation perspective, understanding what is limiting populations in restored oak habitat is critical to both inform future restoration and refine our knowledge of the habitat needs of focal species.

LITERATURE CITED

Agee, J. K. 1993. Fire ecology of Pacific Northwest forests. Island Press, Covelo, CA. 493 pages.

Agee, J.K. and C.N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management 211:83-96.

Allen, C.D., M. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingel. 2002. Ecological restoration of southwestern ponderosa pine ecosystems: a broad perspective. Ecological Applications 12:1418–1433.

Altman, B. 1994. Neotropical migratory landbird monitoring project directory. Oregon-Washington Partners in Flight working document. www.orwapif.org/monitoring-reports.

Altman, B. 2000a. Conservation strategy for landbirds in the northern Rocky Mountains of eastern Oregon and Washington. Version 1.0. Oregon-Washington Partners in Flight. www.orwapif.org/conservation-plans.

Altman, B. 2000b. Olive-sided flycatcher nest success and habitat relationships in post-fire and harvested forests of western Oregon, 1997-1999. Avifauna Northwest unpublished report submitted to U.S. Fish and Wildlife Service, Regional Office, Portland.

Altman, B. and J. Hagar. 2007. Rainforest birds: a land manager's guide to breeding bird habitat in young conifer forests in the Pacific Northwest. U.S. Geological Survey, Scientific Investigations Report 2006-5304. 60 pages.

Altman, B. and K. Woodruff. 2012. Conservation assessment for gray flycatcher (*Empidonax wrightii*). U.S. Department of Agriculture, Forest Service Region 6, and U.S. Department of Interior, Bureau of Land Management, Oregon and Washington Interagency Special Status and Sensitive Species Program.

Ammon, E.M. 1995. Lincoln's sparrow (*Melospiza lincolnii*). *In* A. Poole and F. Gill (editors), The Birds of North America, Number 191. The Birds of North America Incorporated, Philadelphia, PA.

Andelman, S.J. and A. Stock. 1994. Management, research, and monitoring priorities for conservation of neotropical migratory landbirds that breed in Oregon state. Washington Natural Heritage Program, Washington Department of Natural Resource, Olympia.

Arno, S.F. and R.J. Hoff. 1990. *Pinus albicaulis* whitebark pine. Pages 268-279 *in* Burns, R.M. and Honkala, B.H. (technical coordinators), Silvics of North America. Volume 1. Conifers. U.S. Department of Agriculture, Forest Service, Agricultural Handbook 654. Washington, DC.

Aubry, K.B. 2007. Changing perceptions of the role of managed forests as wildlife habitat in the Pacific Northwest. Pages 3-18 *in* T.B. Harrington and G.E. Nicholas (technical editors), Managing for wildlife habitat in west-side production forests. U.S. Department of Agriculture, Forest Service General Technical Report PNW-GTR-695. Portland, OR.

Baker, W.L., T.T. Veblen, and R.L. Sherriff. 2007. Fire, fuels and restoration of ponderosa pine-Douglas-fir forests in the Rocky Mountains, USA. Journal of Biogeography 34:251-269.

Barnett, T.P., D.W. Pierce, H.G. Hidalgo, C. Bonfils, B.D. Santer, T. Das, G. Bala, A.W. Wood, T. Nozawa, A.A. Mirin, D.R. Cayan, and M.D. Dettinger. 2008. Human-induced changes in the hydrology of the western United States. Science 319:1080–1083.

Berlanga, H., J.A. Kennedy, T.D. Rich, M.C. Arizmendi, C.J. Beardmore, P.J. Blancher, G.S. Butcher, A.R. Couturier, A.A. Dayer, D.W. Demarest, W.E. Easton, M.Gustafson, E. Iñigo-Elias, E.A. Krebs, A.O. Panjabi, V. Rodriguez Contreras, K.V. Rosenberg, J.M. Ruth, E. Santana Castellón, R. Ma. Vidal, and T. Will. 2010. Saving Our Shared Birds: Partners in Flight Tri-National Vision for Landbird Conservation. Cornell Lab of Ornithology: Ithaca, NY. www.savingoursharedbirds.org.

Beissinger, S.R., J.M. Reed, J.M. Wunderle, Jr., S.K. Robinson, and D.M. Finch. 2000. Report of the AOU conservation committee on the Partners in Flight species prioritization plan. Auk 117:549-561.

Beschta, R., J.J. Rhodes, J.B. Kauffman, R.E. Gresswell, G.W. Minshall, J.R. Karr, D.A. Perry, F.R. Hauer, and C.A. Frissell. 2004. Postfire management on forested public lands of the Western United States. Conservation Biology 18:957–967.

Bettinger, P.K., J. Boston, J. Sessions, and W.C. McComb. 2001. Integrating wildlife species habitat goals and quantitative land management planning processes. Pages 567-579 *in* D.H Johnson and T.A. O'Neil (managing directors), Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis.

Blancher, P.J., K.V. Rosenberg, A.O. Panjabi, B. Altman, J. Bart, C.J. Beardmore, G.S. Butcher, D.W. Demarest, R. Dettmers, E.H. Dunn, W. Easton, W.C. Hunter, E.E. Inigo-Elias, D.N. Pashley,

C.J. Ralph, T.D. Rich, C.M. Rustay, J.M. Ruth, and T.C. Will. 2007. Guide to the Partners in Flight Population Estimates Database. Partners in Flight Technical Series No. 5. http://www.partners inflight.org/.

Blancher, P.J., K.V. Rosenberg, A.O. Panjabi, B. Altman, A.R. Couturier, W.E. Thogmartin and the Partners in Flight Science Committee. 2013. Handbook to the Partners in Flight Population Estimates Database, Version 2.0. PIF Technical Series No 6. http://www.partnersinflight.org/pubs/ts/.

Block, W.M., D.M. Finch, and L.A. Brennan. 1995. Single-species versus multiple-species approaches for management. Pages 461-476 *in* T.E. Martin and D.M. Finch (editors), Ecology and management of neotropical migratory birds. Oxford University. Press, New York.

Bock, C.E. 1970. The ecology and behavior of the Lewis' woodpecker (*Asyndesmus lewis*). University of California Publications in Zoology 91. 100 pages.

Bock, C.E., V.A. Saab, T.D. Rich, and D.S. Dobkin. 1993. Effects of livestock grazing on Neotropical migratory landbirds in western North America. Pages 296-309 *in* Status and management of Neotropical migratory birds, D. M. Finch and P. W. Stangel (editors). U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station General Technical Report RM-229, Fort Collins, CO. 422 pages.

Bollinger, E.K. 1988. Breeding dispersion and reproductive success of Bobolinks in an agricultural landscape. Ph.D. Dissertation. Cornell University, Ithaca, New York. 189 pages.

Bollinger, E.K. and T.A. Gavin. 1992. Eastern Bobolink populations: ecology and conservation in an agricultural landscape. Pages 497-506 *in* J.M. Hagan, III and D.W. Johnston (editors), Ecology and conservation of Neotropical migrant landbirds. Smithsonian Institute Press, Washington, DC.

Bond, M.L., R.B. Siegel, and D.L. Craig (editors). 2012. A Conservation Strategy for the Black-backed Woodpecker (*Picoides arcticus*) in California. Version 1.0. The Institute for Bird Populations and California Partners in Flight. Point Reyes Station, California.

Bonfils, C., B.D. Santer, D.W. Pierce, H.G. Hidalgo, G. Bala, T. Das, T.P. Barnett, D.R. Cayan, C. Doutriaux, A.W. Wood, A. Mirin, and T. Nozawa. 2008. Detection and attribution of temperature changes in the mountainous western United States. Journal of Climate 21:6404–6424.

Bosworth, D. 2006. Investing in the future: ecological restoration and the U.S. Forest Service. Journal of Forestry 105:208-211.

Bryce, S.A. and J.M. Omernik. 1997. Section 2–level IV ecoregions of the Blue Mountains ecoregion of Oregon, Washington, and Idaho. Pages 24-55 *in* S.E. Clarke, and S.A. Bryce (editors), Hierarchical subdivisions of the Columbia Plateau and Blue Mountains ecoregions, Oregon and Washington. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR- 395. Portland, OR.

Bull, E. and R.G. Anderson. 1978. Notes on flammulated owl in northeastern Oregon. Murrelet 59:26-28.

Bull, E.L., S.R. Peterson, and J.W. Thomas. 1986. Resource partitioning among woodpeckers in northeastern Oregon. U.S. Department of Agriculture, Forest Service, Research Note PNW-444.

Bull, E.L., A.L. Wright, and M.G. Henjum. 1990. Nesting habitat of flammulated owls in Oregon. Journal of Raptor Research 24:52-55.

Bunnell, F.L., L.L. Kremsater, and R.W. Wells. 1997. Likely consequences of forest management on terrestrial, forest-dwelling vertebrates in Oregon. Report M-7 of the Centre for Applied Conservation Biology, University of British Columbia. 130 pages.

Burke, D.M. and E. Nol. 2000. Landscape and fragment size effects on reproductive success of forest breeding birds in Ontario. Ecological Applications 10:1749-1761.

Busacca, A.J. 1991. Loess deposits and soils of the Palouse and vicinity. Pages 216-228 *in* V.R. Baker, B.N. Bjornstad, and others, Quaternary geology of the Columbia Plateau, *in* R.B. Morrison (editor), Quaternary nonglacial geology - conterminous U.S. Geological Society of America DNAG Geology of North America, Version K-2.

Bushman, E.S. and G.D. Therres. 1988. Habitat management guidelines for forest interior breeding birds of coastal Maryland. Maryland Department of Natural Resources, Wildlife Technical Publication 88-1. Annapolis, MD.

Busing, R.T. and S.L. Garman. 2002. Promoting old-growth characteristics and long-term wood production in Douglas-fir forests. Forest Ecology and Management 160:161-175.

Calder W.A. and L.L. Calder. 1994. Calliope Hummingbird (*Selasphorous calliope*). In A. Poole and F. Gill (editors), The Birds of North America, Number 135. The Birds of North America Incorporated, Philadelphia, PA.

Carter, L.M. 2003. U.S. national assessment of the potential consequences of climate variability and change. Educational Resources Regional Paper: Great Plains. U.S. Climate Change Research Program, Washington, DC. http://www.usgcrp.gov/usgcrp/nacc/education/greatplains/default.htm.

Casey, D. 2000. Partners in Flight Bird Conservation Plan: Montana. Version 1.1. Montana Partners in Flight. 279 pages. http://www.partnersinflight.org/bcps/plan/MTPIFPlanv1.1.pdf.

Casey, D. 2013. Chapter 7: Landbirds. *In* 2013 Implementation Plan – Strengthening Science and Partnerships. Intermountain West Joint Venture, Missoula, MT.

Cicero, C. 1997. Boggy meadows, livestock grazing, and interspecific interactions: influences on the insular distribution of montane Lincoln's sparrows (*Melospiza lincolnii alticola*). Great Basin Naturalist 57:104-115.

Cimprich, D.A., F.R. Moore and M.P. Guilfoylet. 2000. Red-eyed Vireo (*Vireo olivaceus*). In A. Poole and F. Gill (editors), The Birds of North America, Number 527. The Birds of North America, Incorporated, Philadelphia, PA.

Clarke, S.E. and S.A. Bryce (editors). 1997. Hierarchical subdivisions of the Columbia Plateau and Blue Mountains Ecoregions, Oregon and Washington. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-395, Portland, OR. 115 pages.

Cody, M.L. and J.A. Smallwood. 1996. Long-term studies of vertebrate communities. Academic Press, San Diego.

Coggins, V. 2003. Sharp-tailed Grouse. Pages 183-184 in D.B. Marshall, M.G. Hunter, and A.L. Contreras (editors), Birds of Oregon: A General Reference. Oregon State University Press, Corvallis.

Cooper, J.M., C. Siddle, and G. Davidson. 1998. Status of the Lewis's Woodpecker (*Melanerpes lewis*) in British Columbia. Report commissioned by the Wildlife Branch, Ministry of Environment, Lands and Parks, Wildlife Working Report WR9. Victoria, British Columbia.

Cooperrider, A.Y.; R.J. Boyd, and H.R. Stuart (editors). 1986. Inventory and monitoring of wildlife habitat. U.S. Department of the Interior, Bureau of Land Management Service Center, Denver, CO. 858 pages.

Courtney, S.P., A.B. Carey, M.L. Cody, K. Engel, K.E. Fehring, J.F. Franklin, M.R. Fuller, R.J. Gutierrze, J.F. Lehmkuhl, M.A. Hemstrom, P.F. Hessburg, S.L. Stephens, L.A. Sztukowski, and L. Young. 2008. Scientific review of the draft northern spotted owl recovery plan. Sustainable Ecosystems Institute, Portland, OR. 157 pages.

Covington, W.W. and M.M. Moore. 1994. Post settlement changes in natural fires regimes and forest structure: ecological restoration of old growth ponderosa pine forests. Pages 153-181 in R.N. Sampson and D.L. Adams (editors), Assessing forest ecosystem health in the Inland West. The Haworth Press. 461 pages.

Crist, M.R., T.H. DeLuca, B. Wilmer, and G.H. Aplet. 2009. Restoration of low elevation dry forests of the northern Rocky Mountains: a holistic approach. The Wilderness Society, Washington, DC.

Darveau, M., J.L. DesGranges, and G. Gauthier. 1992. Habitat use by three breeding insectivorous birds in declining maple forests. Condor 94:72-82.

Daubenmire, R. 1988. Steppe vegetation of Washington. Washington Agricultural Experiment Station Technical Bulletin. Washington State University, Cooperative Extension, Pullman. 131 pages.

DeLong, J.P. 2004. Effects of management practices on grassland birds: Golden Eagle. Northern Prairie Wildlife Research Center, Jamestown, ND. http://www.npwrc.usgs.gov/resource/literatr/grasbird/goea/goea.htm.

Dixon, R.D. 1995. Density, nest-site and roost-site characteristics, home-range, habitat-use, and behavior of white-headed woodpeckers: Deschutes and Winema National Forests, Oregon. Oregon Department of Fish and Wildlife, Nongame Wildlife Program, Report Number 93-3-01.

Dixon, R.D. and V.A. Saab. 2000. Black-backed woodpecker (*Picoides arcticus*). *In* A. Poole and F. Gill (editors), The Birds of North America, Number 509. The Birds of North America Incorporated, Philadelphia, PA. 20 pages.

Dobkin, D.S., A.C. Rich, J.A. Pretare, and W.H. Pyle. 1995. Nest site relationships among cavity-nesting birds of riparian and snowpocket aspen woodlands in the northwestern Great Basin. Condor 97:694-707.

Donovan, T.M., F.R. Thompson, J. Faaborg, and J.R. Probst. 1995. Reproductive success of migratory birds in habitat sources and sinks. Conservation Biology 9:1380-1395.

Drever, M.C., L.W. Gyug, J. Nielsen, A.K. Stuart-Smith, I.P. Ohanjanian, and K. Martin. 2015. Using field data and GIS-derived variables to model occurrence of Williamson's Sapsucker nesting habitat at multiple spatial scales. PLoS One 10(7): e0130849. doi:10.1371/journal.pone.0130849.

Dudley, J.G. and V.A. Saab. 2007. Home range size of black-backed woodpeckers in burned forests of Southwestern Idaho. Western North American Naturalist 67:593–600.

Earnst, S.L., D.S. Dobkin, and J.A. Ballard. 2012. Changes in avian and plant communities of aspen woodlands over 12 years after livestock removal in the Northwestern Great Basin. Conservation Biology 26:862-72.

East Cascades Bird Conservancy, 2007. Crooked River National Grassland 2007 point count surveys and Gray Flycatcher study fourth year summary. Unpublished report

submitted to U.S. Department of Agriculture, Forest Service, Crooked River National Grassland.

Eckhardt, R.C. 1976. Polygyny in the western wood peewee. Condor 78:561-561.

Economic Assessment Team. 2012. National forest health restoration: An economic assessment of forest restoration on Oregon's eastside national forests. Prepared for Governor John Kitzhaber. Prepared by Mason, Bruce, and Girard Incorporated, Forest Economics Institute, Institute for Natural Resources, Oregon State University, and Northwest Economic Research Center, Portland State University. 84 pages.

Erhlich, P., Dobkin, D., and D. Wheye. 1988. The Birders Handbook: A Field Guide to the Natural History of North American Birds. Simon and Schuster, New York, NY.

Fontaine, J.B. and P.L. Kennedy. 2012. Avian and small mammal response to fire severity and fire surrogate treatments in U.S. fire-prone forests: a meta-analysis. Ecological Applications 22:1547-1561.

Franklin, J.F. 1989. Toward a new forestry. American Forests 37-44.

Franklin, J.F. 1993. Preserving biodiversity: species, ecosystems, or landscapes? Ecological Applications 3:202-205.

Franklin, J.F. and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. U.S. Department of Agriculture, Forest Service, General Technical Report, Portland, OR. PNW-8. 417 pages.

Franklin, J.F. and K.N. Johnson. 2012. A restoration framework for federal forests in the Pacific Northwest. Journal of Forestry 110:429-439.

Franklin, J.F. and R. Vanpelt. 2004. Spatial aspects of structural complexity in old-growth forests. Journal of Forestry 102:22-27.

Funk, J., S. Saunders, T. Sanford, T. Easley, and A. Markham. 2014. Rocky Mountain forests at risk: confronting climate-driven impacts from insects, wildfires, heat, and drought. Report from the Union of Concerned Scientists and the Rocky Mountain Climate Organization. Cambridge, MA.

Gaines, W.L., M. Haggard, J.F. Lehmkuhl, A.L. Lyons, and R.J. Harrod. 2007. Short-term response of land birds to ponderosa pine restoration. Restoration Ecology 15:666-674.

Gaines, W., M. Haggard, J. Begley, J.Lehmkuhl, and A. Lyons. 2010. Short-term effects of thinning and burning restoration treatments on avian community composition, density, and nest survival in the eastern Cascades dry forests, Washington. Forest Science 56:88-99.

Galen, C. 1989. A preliminary assessment of the status of the Lewis' woodpecker in Wasco County, Oregon. Oregon Department of Fish and Wildlife, Nongame Wildlife Program Technical Report 88-3-01. 23 pages.

Gardali, T. and G. Ballard. 2000. Warbling Vireo (*Vireo gilvus*). In A.Poole and F. Gill (editors), The Birds of North America, Number 551. The Birds of North America Incorporated, Philadelphia, PA.

Garrett, K.L., M.G. Raphael, and R.D. Dixon. 1996. White-headed woodpecker (*Picoides albolarvatus*). *In* A. Poole and F. Gill (editors), The Birds of North America, Number 252. The Birds of North America Incorporated, Philadelphia, PA. 20 pages.

Gashwiler, J.S. 1977. Bird populations in four vegetation types in central Oregon. U.S. Fish and Wildlife Service, Special Scientific Report – Wildlife, Number 205.

Ghalambor, C. 2003. Conservation Assessment of the Pygmy Nuthatch in the Black Hills National Forest, South Dakota and Wyoming. U.S. Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5226898.pdf.

Gillen, R.L., W.C. Krueger, and R.F. Miller. 1984. Cattle distribution on mountain rangeland in northeastern Oregon. Journal of Range Management 37:549-553.

Goggans, R. 1986. Habitat use by flammulated owls in northeastern Oregon. M.S. Thesis, Oregon State University, Corvallis.

Goggans, R., R.D. Dixon, and C.S. Seminara. 1987. Habitat use by three-toed and black-backed woodpeckers. U.S. Department of Agriculture, Deschutes National Forest, Oregon Department of Fish and Wildlife, Nongame Wildlife Program, Technical Report 87-3-02.

Goodge, W.R. 1972. Anatomical evidence for phylogenetic relationships among woodpeckers. Auk 89:65-85.

Graber, J.W., R.R. Graber, and E.L. Kirk. 1985. Illinois birds: vireos. Biological Notes 68. Illinois Natural History Survey, Urbana.

Graham, D.S. 1988. Responses of five host species to cowbird parasitism. Condor 90:588-591. Gyug, L.W., S. Wilson, C. Steeger and I. Ohanjanian. 2010. Williamson's Sapsucker (*Sphyrapicus thyroideus*) nest productivity in relation to tree densities in British Columbia. British Columbia Birds 10.

Gyug, L.W., C. Steeger, and I. Ohanjanian. 2009. Williamson's Sapsucker (*Sphyrapicus thyroideus*) nest tree characteristics and densities in British Columbia. Canadian Journal of Forest Research 39:2319-2331.

Hagar, J.C., W.C. McComb, and C.C. Chambers. 1995. Effects of forest practices on wildlife. Chapter 9 *in* R.L. Beschta, J.R. Boyle, C.C. Chambers [and others]. Cumulative effects of forest practices in Oregon: literature and synthesis. Oregon State University, Corvallis.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1988. The status and distribution of the Willow Flycatcher in the Sierra Nevada: results of the 1986 survey. California Department of Fish and Game, Wildlife Management Division, Administrative Report 88-1. 32 pages.

Hann, W.J., J.L. Jones, M.G. Karl, P.F. Hessburg, R.E. Keane, D.G. Long, J.P. Manakis, C.H. McNicoll, S.G. Leonard, R.A. Gravenmier, and B.G. Smith. 1997. Landscape dynamics of the basin. Pages 337-1055 *in* T.M. Quigley and S.J. Arbelbide (technical editors), An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins: Volume 2. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-405. Portland, OR.

Hannon, S.J. and C. McCallum. 2004. Using the focal species approach for conserving biodiversity in landscapes managed for forestry. Department of Biological Sciences, University of Alberta Sustainable Forest Management Network.

Haggard, M. and W.L. Gaines. 2001. Effects of stand-replacement fire and salvage logging on a cavity-nesting bird community in eastern Cascades, Washington. Northwest Science 75:387-396.

Hall, F.C. 1973a. Plant communities of the Blue Mountains of eastern Oregon and southeastern Washington. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region Area Guide 3-1. 62 pages.

Hall, F.C. 1973b. Plant communities of the Blue Mountains of eastern Oregon and southeastern Washington. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region Area Guide 3-2. 51 pages.

Helzer, C.J. and D.E. Jelinski. 1999. The relative importance of patch area and perimeter-area ratio to grassland breeding birds. Ecological Applications 9:1448-1458.

Henjum, M.G., Wildlife Society, Eastside Forests Scientific Panel. 1994. Interim protection for late-successional forests, fisheries, and watersheds: national forests east of the Cascade Crest, Oregon, and Washington. *In* J.R. Karr and E.W. Chu (editors), Wildlife Society Technical Review Volume 94 Issue 2. 245 pages.

Hessburg, P.F., R.G. Mitchell, and G.M. Filip. 1994. Historical and current roles of insects and pathogens in eastern Oregon and Washington forested landscapes. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR- 327, Portland, OR. 72 pages.

Hessburg, P.F., B.G. Smith, S.G. Kreiter, C.A. Miller, R.B. Salter, C.H. McNicholl, and W.J. Hann. 1999. Historical and current forest and range landscapes in the Interior Columbia River Basin and portions of the Klamath and Great Basins. Part 1: linking vegetation patterns and landscape vulnerability to potential insect and pathogen disturbances. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-458, Portland, OR, 357 pages.

Hessburg, P., J. Agee, and J.F. Franklin. 2005. Dry forests and wildland fire of the inland northwest USA: contrasting the landscape ecology of the presettlement and modern era. Forest Ecology and Management 211:117-139.

Hessburg, P.F., K.M. James, and R.B. Salter. 2007. Re-examining fire severity relations in pre-management era mixed conifer forests: inferences from landscape patterns of forest structure. Landscape Ecology 22:5-24.

Heyerdahl, E.K., L.B. Brubaker, and J.K. Agee. 2001. Spatial controls of historical fire regimes: a multiscale example from the interior west, USA. Ecology 82:660-678.

Hidalgo, H.G., T. Das, and M.D. Dettinger. 2009. Detection and attribution of streamflow timing changes to climate change in the western United States. Journal of Climate 22:3838-3855.

Hollenbeck, J.P., V.A. Saab, and R.W. Frenzel. 2011. Habitat suitability and nest survival of white-headed woodpeckers in unburned forests of Oregon. Journal of Wildlife Management 75:1061–1071.

Holmes, A.L. 2007. Short-term effects of a prescribed burn on songbirds and vegetation in mountain big sagebrush. Western North American Naturalist 67:292-298.

Hostetler, J.A., T.S. Sillett, and P.P. Marra. 2015. Full-annual-cycle population models for migratory birds. The Auk 132:433-449.

Howie, R.R. and R. Ritcey. 1987. Distribution, habitat selection, and densities of flammulated owls in British Columbia. Pages 249-254 *in* R.W. Nero, R.J. Clark, R.J. Knapton, and R.H. Hamre (editors), Biology and conservation of northern forest owls. U.S. Department of Agriculture, Forest Service, General Technical Report RM-142.

Huff, M.H., N.E. Seavy, J.D. Alexander, and C.J. Ralph. 2005. Fire and birds in the maritime Pacific Northwest. Studies in Avian Biology 30:46-62.

Hutto, R.L. 1995. Composition of bird communities following stand-replacement fires in northern Rocky Mountain (USA) conifer forests. Conservation Biology 9:1041-1058.

Hutto, R.L. and S.M. Gallo. 2006. The effects of postfire salvage logging on cavity-nesting birds. Condor 108:817-831.

Hutto, R.L., A.D. Flesch, and M.A. Fylling. 2014. A bird's-eye view of forest restoration: Do changes reflect success? Forest Ecology and Management 327:1-9.

IWJV 2005. Intermountain West Joint Venture 2005 Implementation Plan. Intermountain West Joint Venture, Missoula, MT.

IWJV 2013. Intermountain West Joint Venture 2013 Implementation Plan: Strengthening Science and Partnerships. Intermountain West Joint Venture, Missoula, MT.

Jackson, M.M, S.E. Gergel, and K. Martin. 2015. Effects of climate change on habitat availability and configuration for an endemic coastal alpine bird. PLoS ONE 10(11): 10(11): e0142110. doi:10.1371/journal.pone.0142110.

Jensen, H.P., D. Rollins, and R.L. Gillen. 1990. Effects of cattle stock density on trampling loss of simulated ground nests. Wildlife Society Bulletin 18:71-74.

Johnson, D.H. and T.A. O'Neil (managing directors). 2001. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis. 768 pages.

Johnson, K.N. and J.F. Franklin. 2009. Restoration of the federal forests of the Pacific Northwest: strategies and management implications. www.cof.orst.edu/cof/fs/PDFs/JohnsonRestoration_Aug15_2009.

Johnson, C.G. Jr., R.R. Clausnitzer, P.J. Mehringer, and C.D. Oliver. 1994. Biotic and abiotic processes of eastside ecosystems: the effects of management on plant community ecology, and on stand and landscape vegetation dynamics. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-322, Portland, OR. 66 pages.

Johnson, K.N., J.F. Franklin, and D.L. Johnson. 2008. A plan for the Klamath Tribes' management of the Klamath Reservation Forest. Report to the Klamath Tribes. www.klamathtribes.org/information/background/documents/Klamath_Plan_Final_May_2008.pdf.

Jones, S.L. and J.E. Cornely. 2002. Vesper sparrow (*Pooecetes gramineus*). *In* A. Poole and F. Gill (editors), The Birds of North America, Number 624. The Birds of North America Incorporated, Philadelphia, PA.

Jones and Stokes Association Incorporated. 1980. Wildlife species accounts: life histories and habitat relationships of species commonly found in old growth conifer forests of western Oregon, western Washington, and northwestern California. Unpublished report prepared for Northwest Timber Association and Western Forest Industries Association.

Keane, R.E. 1995. A coarse scale assessment of whitebark pine in the Interior Columbia River Basin. Nutcracker Notes 5:5-6. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Missoula, MT.

Kennedy, P.L. and J.B. Fontaine. 2009. Synthesis of knowledge on the effects of fire and fire surrogates on wildlife in US dry forests. Oregon State University Agricultural Experiment Station Special Report 1096:1-132.

Kissling, M. 2003. Effects of forested buffer width on breeding bird communities in coastal forests of Southeast Alaska with a comparison of avian sampling techniques. M.S. Thesis, University of Idaho, Moscow.

Klahr P., R. Moseley, B. Butterfield, M. Bryer, D. VanderSchaaf, C. Harris, J. Kagan, S. Cooker, B. Hall, and B. Hargrove. 2000. Middle Rockies - Blue Mountains ecoregional conservation plan. The Nature Conservancy. Ketchum, Idaho. www.conserveonline.org.

King, D. and D.M. Finch. 2013. The effects of climate change on terrestrial birds of North America. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. www.fs.usda.gov/ccrc/topics/wildlife/birds.

Kolb, T.E., J.K. Agee, P.Z. Fule, N.G. McDowell, K. Pearson, A. Sala, and R.H. Waring. 2007. Perpetuating old ponderosa pine. Forest Ecology and Management 249:141–157.

Kotliar, N.B., S. Hejl, R.L. Hutto, V.A. Saab, C.P. Melcher, and M.E. McFadzen. 2002. Effects of fire and postfire salvage logging on avian communities in conifer-dominated forests of the western United States. Studies in Avian Biology 25:49-64.

Krueper, D.J. 1993. Effects of land use practices on western riparian systems. Pages 321-330 in D.M. Finch and P.W. Stangel (editors), Status and management of neotropical migratory birds. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report GTR-RM-229, Fort Collins, CO. 422 pages.

Küchler, A.W. 1966. Analyzing the physiognomy and structure of vegetation. Annals of the Association of American Geographers 56:112–127.

Lambeck, R.J. 1997. Focal species: a multi-species umbrella for nature conservation. Conservation Biology 11:849-856.

Larson, A.J. and D. Churchill. 2012. Tree spatial patterns in fire-frequent forests of western North America, including mechanisms of pattern formation and implications for

designing fuel reduction and restoration treatments. Forest Ecology and Management 267:74–92.

Latif, Q.S., V.A. Saab, K. Mellen-McLean, and J.G. Dudley. 2014. Evaluating habitat suitability models for nesting white-headed woodpeckers in unburned forest. Journal of Wildlife Management 79:263–273.

Lehmkuhl, J.F., C.O. Loggers, and J.H. Creighton. 2002. Wildlife considerations for small diameter timber harvesting. Pages 85-92 *in* D.M. Baumgartner, L.R. Johnson, and E.J. DePuit (editors), Small diameter timber: resource management, manufacturing, and markets. Washington State University Cooperative Extension, Pullman.

Linkhart, B.D., R.T. Reynolds, and R.A. Ryder. 1998. Home range and habitat of breeding Flammulated Owls in Colorado. Wilson Bulletin 110:342–351.

Lorenz, T., J. Kozma, and J. Millard. 2012. White-headed woodpecker space use in central Washington: 2012 annual report. Unpublished report to U.S. Fish and Wildlife Service. Portland, OR. 12 pages.

Lowther, P.E., C. Celada, N.K. Klein, C.C. Rimmer, and D.A. Spector. 1999. Yellow Warbler (*Dendroica petechia*). *In* A. Poole and F. Gill (editors), The Birds of North America, Number 454. The Birds of North America, Incorporated, Philadelphia, PA.

Madsen, S.J. 1985. Habitat use by cavity-nesting birds in the Okanogan National Forest, Washington. M.S. Thesis, University of Washington, Seattle. 113 pages.

Maginnis, S. and W. Jackson. 2007. What is FLR and how does it differ from current approaches? Pages 5-20 in J. Rietbergen-McCracken, S. Maginnis, and A. Sarre (editors), The forest landscape restoration handbook. Earthscan, London, UK.

Mannan, R.W. and E.C. Meslow. 1984. Bird populations and vegetation characteristics in managed and unmanaged old-growth forests, northeastern Oregon. Journal of Wildlife Management 48:1219-1238.

Manning, E.T. and J.M. Cooper. 1996. An assessment of woodpecker foraging, home range and patch utilization at Wallace Creek, British Columbia: Progress Report (Year 1 – 1996). Prepared for British Columbia Ministry of Environment, Penticton, B.C.

Manuwal, D.A. 1968. Breeding bird populations in the coniferous forests of western Montana. M.S. Thesis, University of Montana, Missoula.

Marra, P.P., C.E. Studds, and M. Webster. 2010. Migratory connectivity. Pages 455-461 in M.D. Breed and J. Moore (editors), Encyclopedia of animal behavior. Academic Press, Oxford, U.K.

Marshall, D.B., M. Chilcote, and H. Weeks. 1996. Species at Risk: sensitive, threatened, and endangered vertebrates of Oregon. Oregon Department of Fish and Wildlife, Portland. Second edition.

Marshall, D.B., M.G. Hunter, and A.L. Contreras. 2003. Birds of Oregon: a general reference. Oregon State University Press, Corvallis. 768 pages.

Marshall, M.R., R.J. Cooper, J.A. Dececco, J. Strazanac, and L. Butler. 2002. Effects of experimentally reduced prey abundance on the breeding ecology of the red-eyed vireo. Ecological Monographs 12:261-280.

Martin, S.G. 1967. Breeding biology of the Bobolink. M.S. Thesis. University of Wisconsin, Madison. 122 pages.

Martin, T.G. and S. McIntyre. 2007. Impacts of livestock grazing and tree clearing on birds of woodland and riparian habitats. Conservation Biology 21:504-14.

Martin, T.G., I. Chadès, P. Arcese, P.P. Marra, H.P. Possingham, and D.R. Norris. 2007. Optimal conservation of migratory species. PLOS One 2:e751.

Marzluff, J.M., M.G. Raphael, and R. Sallabanks. 2000. Understanding the effects of forest management on avian species. Wildlife Society Bulletin 28:1132-1143.

Mawdsley, J.R., R. O'Malley, and D.S. Ojima. 2009. A review of climate change adaptation strategies for wildlife management and biodiversity conservation. Conservation Biology 23:1080-1089.

McAllister, K.R. 1995. Washington state recovery plan for the upland sandpiper. Washington Department of Fish and Wildlife, Olympia. 50 pages.

McCallum, D. A. 1994. Flammulated Owl (*Otus flammeolus*). *In* A. Poole, and F. Gill (editors), The Birds of North America, Number 93. The Birds of North America Incorporated, Philadelphia, PA.

McClelland, B.R. 1977. Relationships between hole-nesting birds, forest snags, and decay in western larch/Douglas fir forests of the northern Rocky Mountains. Ph.D. Dissertation. University of Montana, Missoula.

McClelland, B.R., and P.T. McClelland. 2000. Red-naped sapsucker nest trees in northern Rocky Mountain old-growth forest. Wilson Bulletin 112:44-50.

McClelland, B.R., S.S. Frissel, W.C. Fischer, and C.H. Halvorson. 1979. Habitat management for hole-nesting birds in forests of western larch and Douglas-fir. Journal of Forestry 77:480-483.

McCullough, D.G., R.A. Werner, and D. Newmann. 1998. Fire and insects in northern and boreal forest ecosystems of North America. Annual Review of Entomology 43:107-127.

McIver, J.D. and L. Starr. 2001. A literature review on the environmental effects of postfire logging. Western Journal of Applied Forestry 16:159–168.

Medin, D.E. 1985. Densities and nesting heights of breeding birds in an Idaho Douglas-fir forest. Northwest Science 59:45-52.

Mellen-McLean, K., B. Wales, and B. Bresson. 2013. A conservation assessment for the white-headed woodpecker (*Picoides albolarvatus*). U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management. 41 pages.

Middleton, A.L. 1998. Chipping Sparrow (*Spizella passerina*). *In* A. Poole, and F. Gill (editors), The Birds of North America, Number 334. The Birds of North America Incorporated, Philadelphia, PA.

Millar, C.I., N.L. Stephenson, and S.L. Stephens. 2007. Climate change and forests of the future: managing in the face of uncertainty. Ecological Applications 17:2145-2151.

Milne, K.A. and S.J. Hejl. 1989. Nest-site characteristics of white-headed woodpeckers. Journal of Wildlife Management 53:50-55.

Mutch, R.W., S.F. Arno, J.K. Brown, C.E. Carlson, R.D. Ottmar, and J.L. Peterson. 1993. Forest health in the Blue Mountains: a management strategy for fire-adapted ecosystems: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, General Technical Report PNW-GTR-310.

Munger, T.T. 1917. Western yellow pine in Oregon. U.S. Department of Agriculture Bulletin 418. Washington, DC. 48 pages.

Langham, G., J. Schuetz, C. Soykan, C. Wilsey, T. Auer, G. LeBaron, C. Sanchez, and T. Distler. 2014. Audubon's birds and climate change report: a primer for practitioners: version 1.2. National Audubon Society, NY.

Nelson, K.S., E.M. Gray, and J.R. Evans. 2011. Finding solutions for bird restoration and livestock management: comparing grazing exclusion levels. Ecological Applications 21:547-54.

Nielsen-Pincus, N. 2005. Nest site selection; nest success, and density of selected cavity nesting birds in northeastern Oregon with a method for improving accuracy of density estimates. M.S. Thesis. University of Idaho, Moscow. 96 pages.

Norris, D.R., P.P. Marra, T.K. Kyser, T.W. Sherry, and L.M. Ratcliffe. 2004. Tropical winter habitat limits reproductive success on the temperate breeding grounds in a migratory bird. Biological Sciences 271:59–64.

North American Bird Conservation Initiative, U.S. Committee. 2010. The State of the Birds 2010 Report on Climate Change. United States of America, U.S. Department of the Interior, Washington, DC.

Noss, R.F. 1983. A regional landscape approach to maintain diversity. BioScience 33:700-706.

Noss, R., J. Franklin, W. Baker, and D.T. Schoen-Nagel. 2006. Managing fire-prone forests in the western United States. Frontiers in Ecology and the Environment 4:481–487.

Nott, P. and P. Pyle. 2012. Landscape management guidelines for breeding landbirds of the Pacific Northwest. A report to the U.S. Department of Agriculture, Forest Service Region 6. The Institute for Bird Populations, Point Reyes Station, CA.

Nott, M.P, D.F. DeSante, P. Pyle, and N. Michel. 2005. Pacific Northwest forest bird population declines: formulating population management guidelines from landscape-scale ecological analyses of MAPS data from avian communities on seven national forests in the Pacific Northwest. A report to the U.S. Department of Agriculture, Forest Service Region 6, NFWF project #2002-0232-000. Institute for Bird Populations, Point Reyes Station, CA.

O'Connell, M.A., J.G. Hallett, and D.K. Beutler. 1997. Bird populations in managed forests of northeastern Washington. *In* J.G. Hallett and M.A. O'Connell (editors), Wildlife use of managed forests: a landscape perspective. Vol. 3: East-side Studies, Research Results. Timber, Fish, and Wildlife Program.

Oliver, W.W. and R.A. Ryker. 1990. Ponderosa pine. Pages 413-424 *in* R.M. Burns and B.H. Honkala (technical coordinators), Silvics of North America: Volume 1, Conifers. U.S. Department of Agriculture, Forest Service Handbook 654.

Oregon Department of Fish and Wildlife. 2005. Oregon Conservation Strategy. Oregon Department of Fish and Wildlife, Salem. http://www.dfw.state.or.us/conservation strategy/.

Panjabi, A.O., E.H. Dunn, P.J. Blancher, W.C. Hunter, B. Altman, J. Bart, C.J. Beardmore, H. Berlanga, G.S. Butcher, S.K. Davis, D.W. Demarest, R. Dettmers, W. Easton, H. Gomez de Silva Garza, E.E. Inigo-Elias, D.N. Pashley, C.J. Ralph, T.D. Rich, K.V. Rosenberg, C.M. Rustay, J.M. Ruth, J.S. Wendt, and T.C. Will. 2005. The Partners in Flight Handbook on Species Assessment. Version 2005. Partners in Flight Technical Series No. 3. http://www.rmbo.org/pubs/downloads/Handbook2005.pdf.

Partners in Flight Science Committee. 2012. Species Assessment Database, version 2012. Available at http://rmbo.org/pifassessment.

Partners in Flight Science Committee. 2013. Population Estimates Database, version 2013. Available at http://rmbo.org/pifpopestimates.

Pashley, D.N., C.J. Beardmore, J.A. Fitzgerald, R.P. Ford, W.C. Hunter, M.S. Morrison, and K.V. Rosenberg. 2000. Partners in Flight: conservation of the landbirds of the United States. American Bird Conservancy, The Plains, VA.

Perry, D.A., P. Hessburg, C. Skinner, T.A. Spies, S.L. Stephens, A.H. Taylor, J.F. Franklin, B. McComb, and G. Riegel. 2011. The ecology of mixed severity fire regimes in Washington, Oregon, and northern California. Forest Ecology and Management 262:703–717.

Peters, R.L. 1992. Conservation of biological diversity in the face of climate change. *In* R.L. Peters and T.E. Lovejoy (editors), Global Warming and Biological Diversity. Yale University Press, New Haven, CN.

Peterson, A.T. 2003. Projected climate change effects on Rocky Mountain and Great Plains birds: generalities of biodiversity consequences. Global Change Biology 9:647-655.

Pilliod, D.S., E.L. Bull, J.L. Hayes, and B.C. Wales. 2006. Wildlife and invertebrate response to fuel reduction treatments in dry coniferous forests of the Western United States: a synthesis. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-173. Fort Collins, CO. 34 pages.

Pitocchelli, J. 2013. MacGillivray's Warbler (*Geothlypis tolmiei*). *In* A. Poole, and F. Gill (editors), The Birds of North America, Number 159. The Birds of North America Incorporated, Philadelphia, PA.

Pryce, B., P. Iachetti, G. Wilhere, K. Ciruna, J. Floberg, R. Crawford, R. Dye, M. Fairbarns, S. Farone, S. Ford, M. Goering, M. Heiner, G. Kittel, J. Lewis, D. Nicolson, and N. Warner. 2006. Okanagan Ecoregional Assessment, Volume 1 – Report. Prepared by Nature Conservancy of Canada, The Nature Conservancy of Washington, and the Washington Department of Fish and Wildlife with support from the British Columbia Conservation Data Centre, Washington Department of Natural Resources Natural Heritage Program, and NatureServe. Nature Conservancy of Canada, Victoria, British Columbia.

Quigley, T.M., R.W. Haynes, and R.T. Graham (technical editors). 1996. Integrated scientific assessment for ecosystem management in the interior Columbia basin and portions of the Klamath and Great Basins. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR-382. Portland, OR. 303 pages.

Raim, A.J. 1975. Territory and mating system in the Bobolink, *Dolichonyx oryzivorus*. M.A. Thesis. Western Michigan University. 90 pages.

Raphael, M.G. and M. White. 1984. Use of snags by cavity-nesting birds in the Sierra Nevada. Wildlife Monograph 86:1-66.

Reinkensmeyer, D.P. 2000. Habitat associations of bird communities in shrub-steppe and western juniper woodlands. M.S. Thesis, Oregon State University, Corvallis.

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, and T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan: Ithaca, NY, Cornell Lab of Ornithology. http://www.partnersinflight.org/cont_plan/.

Richardson, T.W. 2007. Avian use, nest-site selection, and nesting success in Sierra Nevada aspen. Ph.D. Dissertation. University of Nevada, Reno. 135 pages.

Richardson, T.W. and S.K Heath. 2005. Effects of conifers on aspen-breeding bird communities in the Sierra Nevada. Transactions of the Western Section of The Wildlife Society 40:68-81.

Robbins, C.S., D. Bystrak, and P.H. Geissler. 1986. The Breeding Bird Survey: its first 15 years, 1965-1979. U.S. Department of the Interior, U.S. Fish and Wildlife Service Research Publication 157.

Robbins, C.S., J.R. Sauer, R. Greenburg, and S. Droege. 1989. Population declines in North American birds that migrate to the neotropics. Proceedings of the Natural Academy of Sciences 86:7658-7662.

Rockwell, S.M., C.I. Bocetti, and P.P. Marra. 2012. Carry-over effects of winter climate on spring arrival date and reproductive success in an endangered migratory bird, Kirtland's Warbler (*Setophaga kirtlandii*). *The Auk* 129:744-752.

Rodrick E. and R. Milner (technical editors). 1991. Management recommendations for Washington's priority habitats and species. Washington Department of Fish and Wildlife, Olympia.

Rosenberg, K.V. 2004. Association of Fish and Wildlife Agencies Partners in Flight Landbird Reports. http://fishwildlife.org/allbird_landbird.html.

Rosenberg, K.V., R.S. Hames, R.W. Rohrbaugh, Jr., S. Barker Swarthout, J.D. Lowe, and A.A. Dhondt. 2003. A land manager's guide to improving habitat for forest thrushes. The Cornell Lab of Ornithology, Ithaca, NY.

Rosenberg, K.V., D. Pashley, B. Andres, P.J. Blancher, G.S. Butcher, W.C. Hunter, D. Mehlman, A.O. Panjabi, M. Parr, G. Wallace, and D. Wiedenfeld. 2014. The State of the Birds 2014 Watch List. North American Bird Conservation Initiative, U.S. Committee. Washington, DC. 4 pages.

Rosenberg, K.V., J.A. Kennedy, R. Dettmers, R.P. Ford, D. Reynolds, J.D. Alexander, C.J. Beardmore, P.J. Blancher, R.E. Bogart, G.S. Butcher, A.F. Camfield, A. Couturier, D.W. Demarest, W.E. Easton, J.J. Giocomo, R.H. Keller, A.E. Mini, A.O. Panjabi, D.N. Pashley, T.D. Rich, J.M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee.

Rumsey, C., M. Wood, B. Butterfield, P. Comer, D. Hillary, M. Bryer, C. Carroll, G. Kittel, K.J. Torgerson, C. Jean, R. Mullen, P. Iachetti, and J. Lewis. 2003. Canadian Rocky Mountains Ecoregional Assessment, Volume One: Report. Nature Conservancy of Canada, Victoria, B.C. www.conserveonline.org.

Russell, R.E., V.A. Saab, J. Dudley, and J.J. Rotella. 2006. Snag longevity in relation to wildfire and postfire salvage logging. Forest Ecology and Management 232: 179–187.

Saab, V.A. and J.G. Dudley. 1997. Bird responses to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho. U.S. Department of Agriculture, Forest Service, Progress Report 94-96, Study Number 4202-1-7-711. Intermountain Research Station, Boise, Idaho.

Saab, V.A. and J. Dudley. 1998. Responses of cavity-nesting birds to stand replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Research Paper RMRS-RP-11. Ogden, Utah.

Saab, V.A., R.E. Russell, and J.G. Dudley. 2007. Nest densities of cavity-nesting birds in relation to postfire salvage logging and time since wildfire. Condor 109:97–108.

Saab, V.A., R.E. Russell, and J.G. Dudley. 2009. Nest-site selection by cavity-nesting birds in relation to postfire salvage logging. Forest Ecology and Management 257:151-159.

Saab, V.A., Q.S. Latif, M.M. Rowland, T.N. Johnson, A.D. Chalfoun, S.W. Buskirk, J.E. Heyward, and M.A. Dresser. 2014. Ecological consequences of mountain pine beetle outbreaks for wildlife in western North American forests. Forest Science 60:539-559.

Saab, V.A., R.E. Russell, J. Rotella, and J.G. Dudley. 2011. Modeling nest survival of cavity-nesting birds in relation to postfire salvage logging. The Journal of Wildlife Management 75:794–804.

Sallabanks, R., and J.D. McIver. 1998. Response of breeding bird communities to wildfire in the Oregon Blue Mountains: the first three years following the Twin Lakes Fire, 1995 - 1997. Pages 85-89 *in* Fire and Wildlife in the Pacific Northwest: Research, Policy, and Management. Proceedings of the Symposium, Spokane, WA. April 6-8, 1998.

Sallabanks, R., P.J. Heglund, J.B. Haufler, B.A. Gilbert, and W. Wall. 1999. Forest fragmentation of the inland west: issues, definitions, and potential study approaches for forest birds. Pages 187–199 *in* J.A. Rochelle, L.A. Lehmann, and J. Wisniewski (editors), Forest wildlife and fragmentation: management and implications. Brill, Leiden, The Netherlands.

Sallabanks, R., B.G. Marcot, R.A. Riggs, E.B. Arnett, and C.A. Mehl. 2001. Wildlife of eastside (interior) forests and woodlands. Pages 213-238 *in* D.H. Johnson and T.A. O'Neil (editors), Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis.

Sallabanks, R., J.B. Haufler, and C.A. Mehl. 2006. Influence of forest vegetation structure on avian community composition in west-central Idaho. Wildlife Society Bulletin 34:1079–1093.

Sallabanks, R., J.B. Haufler, and C.A. Mehl. 2006. Influence of forest vegetation structure on avian community composition in west-central Idaho. Wildlife Society Bulletin 34:1079–1093.

Salwasser, H. 2001. Single species, multiple species, or ecosystem management: a perspective on approaches to wildlife conservation. Pages 624-627 *in* D.H. Johnson and T.A. O'Neil (managing directors), Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis.

Sample, D.W. 1989. Grassland birds in southern Wisconsin: habitat preference, population trends, and response to land use changes. M.S. Thesis. University of Wisconsin, Madison. 588 pages.

Sampson, R.N., D.L. Adams, S.S. Hamilton, S.P. Mealey, R. Steele, and D. Van DeGraaff. 1994. Pages 3-10 in R.N. Sampson and D.L. Adams (editors), Assessing forest ecosystem health in the Inland West. The Haworth Press. 461 pages.

Sanders, T.A. and W.D. Edge. 1998. Breeding bird community composition in relation to riparian vegetation structure in the western United States. Journal of Wildlife Management 62:461–473.

Sanders, S.D. and M.A. Flett. 1988. Ecology of a Sierra Nevada population of Willow Flycatchers (*Empidonax traillii*), 1986-1987. California Department of Fish and Game, Wildlife Management Division, Administrative Report 88-3. 34 pages.

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr., and W.A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.

Schaming, T.D. 2016. Clark's Nutcracker breeding season space use and foraging behavior. PLoS ONE 11(2): e0149116. doi:10.1371/journal.pone.0149116.

Schneider, N.A. 1998. Passerine use of grasslands managed with two grazing regimes on the Missouri Coteau in North Dakota. M.S. Thesis. South Dakota State University, Brookings. 94 pages.

Serena, M. 1982. The status and distribution of the Willow Flycatcher (*Empidonax traillii*) in selected portions of the Sierra Nevada, 1982. California Department of Fish and Game, Wildlife Management Division, Administrative Report 82-5. 28 pages.

Siddle, C. and G. Davidson. 1991. Status of the Lewis' woodpecker in British Columbia. Report commissioned by Wildlife Branch, Ministry of Environment, Victoria, BC.

Simmons, J. 2003. Red-naped Sapsucker. Pages 356–358 *in* D.B. Marshall, M.G. Hunter, and A.L. Contreras (editors), Birds of Oregon: A General Reference. Oregon State University Press, Corvallis.

Sloan, J.P. 1998. Historical density and stand structure of an old-growth forest in the Boise Basin of Central Idaho. *In* L.A. Brennan and T.L. Pruden (editors), Fire in ecosystem management: shifting the paradigm from suppression to prescription. Proceedings of the Tall Timbers Fire Ecology Conference, Number 20. Tall Timbers Research Station, Tallahassee, FL.

Society for Ecological Restoration International Science and Policy Working Group. 2004. The SER International Primer on Ecological Restoration. www.ser.org and Tucson: Society for Ecological Restoration International. http://www.ser.org/pdf/primer3.pdf

Smith, M.R., P.W. Mattocks, Jr., and K.M. Cassidy. 1997. Breeding birds of Washington State. Volume 4 in Washington State Gap Analysis - Final Report (K.M. Cassidy, C.E. Grue, M.R. Smith, and K.M. Dvornich, editors). Seattle Audubon Society Publications in Zoology No 1, Seattle, WA. 538 pages.

Sousa, P.J. 1983. Habitat Suitability Index Models: Lewis' Woodpecker. U.S. Department of the Interior, Fish and Wildlife Service, Biological Services Program.

Spies, T., M. Hemstrom, A. Youngblood, and S. Hummel. 2006. Conserving old growth forest diversity in disturbance-prone landscapes. Conservation Biology 20:356–362.

Steele, R. 1994. The role of succession in forest health. Pages 183-190 in R. N. Sampson and D. L. Adams (editors), Assessing forest ecosystem health in the Inland West. The Haworth Press. 461 pages.

Stephens, R.M. and S.H. Anderson. 2003. Lincoln's Sparrow (*Melospiza lincolnii*): a technical conservation assessment. U.S. Department of Agriculture, Forest Service, Rocky Mountain Region. http://www.fs.fed.us/r2/ projects/scp/assessments/lincolnssparrow.pdf.

Stephens, S.L. and L.W. Ruth. 2005. Federal forest-fire policy in the United States. Ecological Applications 15:532–542.

Swanson, H.M., B. Kinney, and A. Cruz. 2004. Breeding biology of the chipping sparrow in ponderosa pine forests of the Colorado Front Range. Wilson Bulletin 116:246- 251.

Tashiro¬Vierling, K.Y. 1994. Population trends and ecology of the Lewis's Woodpecker (*Melanerpes lewis*) in southeastern Colorado. M.A. Thesis, University of Colorado, Boulder.

Taylor, D.M. 1986. Effects of cattle grazing on passerine birds nesting in riparian habitat. Journal of Range Management 39:254-258.

Taylor, D.M. and C.D. Littlefield. 1986. Willow Flycatcher and Yellow Warbler response to cattle grazing. American Birds 40:1169-1173.

Tewksbury, J., A.E. Black, N. Nur, V.A. Saab, B.D. Logan, and D.S. Dobkin. 2002. Effects of anthropogenic fragmentation and livestock grazing on western riparian bird communities. Studies in Avian Biology 25:158–202.

Thogmartin, W.E., F.P. Howe, F.C. James, D.H. Johnson, E.R. Reed, J.R. Sauer, and F.R. Thompson III. 2006. A review of the population estimation approach of the North American landbird conservation plan. The Auk 12: 892-904.

Thomas, J.W. (editor). 1979. Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington. U.S. Department of Agriculture, Forest Service, Agricultural Handbook 553. Washington DC.

Thomas, J.W., R.G. Anderson, C. Maser, and E.L. Bull. 1979. Snags. Pp. 60-77 *in* Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington (J.W. Thomas, editor). U.S. Department of Agriculture, Forest Service, Agricultural Handbook 553. Washington DC.

Tingley, M.W., R.L. Wilkerson, M.L. Bond, C.A. Howell, and R.B. Siegel. 2014. Variation in home-range size of Black-backed Woodpeckers. Condor 116:325-340.

Trombino, C.L. 1998. Species interactions in the hybrid zone between Red-breasted (*Sphyrapicus ruber*) and Red-naped (*Sphyrapicus nuchalis*) sapsuckers: fitness consequences, reproductive character displacement, and nest site selection. Ph.D. Dissertation, Northern Illinois University, Dekalb.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern, 2008. United States Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pages.

U.S. Forest Service. 2014. Blue Mountains National Forests Proposed Revised Land Management Plan: Malheur, Umatilla, and Wallowa-Whitman National Forests. Volume 1, U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. www.fs.usda.gov/goto/BlueMtnsPlanRevision.

Van Horne, B. 1983. Density as a misleading indicator of habitat quality. Journal of Wildlife Management 47:893-901.

Vickery, P.D., M.L. Hunter, Jr., and S.M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8:1087-¬1097.

Walters, E.L. 1996. Habitat and space use of the Red-naped Sapsucker, *Sphyrapicus nuchalis*, in the Hat Creek valley, south-central British Columbia. M.S. Thesis, University of Victoria, BC.

Washington Department of Fish and Wildlife. 2005. Washington's Comprehensive Wildlife Conservation Strategy. Washington Department of Fish and Wildlife, Olympia. http://wdfw.wa.gov/conservation/cwcs/.

Wheelwright, N.T. and J.D. Rising. 2008. Savannah Sparrow (Passerculus sandwichensis). In A. Poole, and F. Gill (editors), The Birds of North America, Number 45. The Birds of North America Incorporated, Philadelphia, PA.

Wiens, J.A. and J.T. Rotenberry. 1981. Habitat associations and community structure of birds in shrubsteppe environments. Ecological Monographs 51:21-41.

Wiens, J.A. 1969. An approach to the study of ecological relationships among grassland birds. Ornithological Monographs 8:1¬93.

Wiens, J.A., G.D. Hayward, R.S. Holthausen, and M.J. Wisdom. 2008. Using surrogate species and groups for conservation planning and management. BioScience 58:241-252.

Wightman, C. S., V. A. Saab, C. Forristal, K. Mellen-McLean, and A. Markus. 2010. White-headed woodpecker nesting ecology after wildfire. Journal of Wildlife Management 74:1098–1106.

Williamson, P. 1971. Feeding ecology of the Red-eyed Vireo (*Vireo olivaceus*) and associated foliage gleaning birds. Ecological Monographs 41:129-152.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: broad-scale trends and management implications. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-485. Portland, OR.

Wortman-Wunder, E. 1997. Territory size in Lincoln's sparrows (*Melospiza lincolnii*). The Southwestern Naturalist 42:446-453.

Youngblood, A., T. Max, and K. Coe. 2004. Stand structure in east-side old-growth ponderosa pine forests of Oregon and northern California. Forest Ecology and Management 99:191–217.

Appendix A. *Priority and responsibility species most likely to benefit from habitat management or restoration directed towards focal species and associated habitat attributes.* [1,2]

Forest Stage/ Habitat Attribute	Large patches..	Inter-spersed herb…	Herb underst…	Large snags, open…	Canopy closure and foliage	Forest edges, openings	Patches dense understory	Large Snags	Canopy and subcan closure. . . .	Broken Canopies High. . . .	Patches Understory Foliage. . .	Large Snags
Dry Forest	**WHWO** **FLOW** **GRFL** **WISA** CAFI PIJA Cavi weta	**FLOW** **CHSP** **WHWO** **GRFL** GGOW dufl	**CHSP** **GRFL** dufl	**LEWO** **FLOW** **WHWO** **WISA** PIWO PYNU moch								
Mesic Mixed Conifer Forest					**TOWA** **EVNGR** **NOGO** Rbnu weta	**OSFL** **BBWO** **CHSP** **WWPE** CAFI CHSP CLNU EVGR GGOW RNSA Cavi Rbnu weta	**NAWA (OH)** **OCWA (BM)** **HETH** **MGWA** **. . . . CAHU**	**WISA** **OSFL** **RNSA** GGOW PIWO CASW Moch rbnu				
Riparian Woodland									**REVI (OH)** **YEWA (BM)** **WAVI**	**WWPE** **RNSA** **WIFL** **CAHU** lazb	**MGWA** **WIFL** CAHU MOQU NOWA RUHU	**RNSA** **LEWO** **WISA** PIWO vasw

Forest Stage/ Habitat Attribute	Lowlad Wet meadow	Alpine Montane meadow	Aspen	Sub Alpine Forest	Cliffs Rock Ourcrop	Riparian Shrub	Juniper Woodland	Montane Shrubland	Sagebrush Steppe	Post-Wildfire	Upland Grassland	White Park Pine
Unique habitats	**BOBO** SAVS SEOW	**LISP** **VESP** BLSW BRSP CAHU GTTO lazb	**WAVI** **FLOW** **LEWO** **MGWA** **REVI** **RNSA** **WHWO** **WISA** **WWPE** RYHU dufl	**HETH** **BBWO** **CHSP** **CLNU** **DUFL** **OSFL** **TOWA** CAFI GGOW NOGO Cavi Rbnu weta	**GOEA** PEFA PRFA	**WIFL** CAHU MGWA MOQU NOWA RUHU STGR WAVI lazb	**GRFL** **CHSP** PIJA GTTO LOSH SWHA Dufl moch	**CAHU** **MGWA** GTTO RUHU Dufl lazb	**VESP** BRSP FEHA GOEA GSSA GTTO LBCU LOSH PRFA SAGR SATH SWHA	**BBWO** **CLNU** **OSFL** **LEWO** **WWPW** labu	**SAVS** **VESP** FEHA GGOW GRSP LBCU LOSH SWHA UPSA BOBO	**CLNU** **WISA** CAFI moch rbnu

[1] Includes only priority and responsibility species that have a strong breeding season habitat association with the habitat type and/or habitat attribute and would likely benefit 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 species to benefit, is large enough to meet the species area requirements, and other specific habitat attributes or conditions required by the species are also available or being managed for. 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 conditions, elevation, etc.**

[2] Species to Benefit designations:
Caps, Bold, and Underline = Focal species for a different habitat attribute in the same habitat type.
Caps and Bold = Focal species in a different habitat type.
Caps = Priority species not designated as focal species.
Lower Case = Responsibility species not designated as focal or priority species.
Species are listed alphabetically within the aforementioned order of status, and not by degree of potential benefit. If species are designated in more than one category, it is listed as the highest category in the following order – focal, priority, responsibility.

BBWO = Black-backed Woodpecker
BLSW = Black Swift
BOBO = Bobolink
BRSP = Brewer's Sparrow
CAFI = Cassin's Finch
CAHU = Calliope Hummingbird
CAVI = Cassin's Vireo
CHSP = Chipping Sparrow
CLNU = Clark's Nutcracker
DUFL = Dusky Flycatcher
EVGR = Evening Grosbeak
FEHA = Ferruginous Hawk
FLOW = Flammulated Owl
GGOW = Great-gray Owl
GOEA = Golden Eagle
GRFL = Gray Flycatcher
GRSP = Grasshopper Sparrow
GTTO = Green-tailed Towhee
GRSG = Greater Sage Grouse
HETH = Hermit Thrush
LAZB = Lazuli Bunting
LBCU = Long-billed Curlew
LEWO = Lewis's Woodpecker
LISP = Lincoln's Sparrow
LOSH = Loggerhead Shrike
MGWA = MacGillivray's Warbler
MOCH = Mountain Chickadee
MOQU = Mountain Quail
NAWA = Nashville Warbler
NOGO = Northern Goshawk
NOWA = Northern Waterthrush
OCWA = Orange-crowned Warbler
OSFL = Olive-sided Flycatcher
PEFA = Peregrine Falcon
PIJA = Pinyon Jay
PIWO = Pileated Woodpecker
PRFA = Prairie Falcon
PYNU = Pygmy Nuthatch
RBNU = Red-breasted Nuthatch
REVI = Red-eyed Vireo
RNSA = Red-naped Sapsucker
RUHU = Rufous Hummingbird
SAGS = Sage Sparrow
SATH = Sage Thrasher
SAVS = Savannah Sparrow
SEOW = Short-eared Owl
STGR = Sharp-tailed Grouse
SWHA = Swainson's Hawk
TOWA = Townsend's Warbler
UPSA = Upland Sandpiper
VASW = Vaux's Swift
VESP = Vesper Sparrow
WAVI = Warbling Vireo
WETA = Western Tanager
WHWO = White-headed Woodpecker
WIFL = Willow Flycatcher
WISA = Williamson's Sapsucker
WWPE = Western Wood-pewee
YWAR = Yellow Warbler

Appendix B. *Landbird species projected short-term population response to forest restoration and management in dry forests.* [1]

Habitat Management Action	Decreasing Crown Density		Understory Thinning (Below Canopy)		Surface Fuels Reduction (Shrubs and Ground)		Increasing Height to Crown (Limbing Up)	Big Tree Retention	Snag Retention or Creation
Species [2]	Heavy [3]	Light [3]	Heavy [3]	Light [3]	Heavy [3]	Light [3]			
Cassin's Finch	-	o	-	o	+	o	+/o	+	o
Cassin's Vireo	-	o	-	o/-	o	o	o/-	o	o
Chipping Sparrow	+	+	+	o	-	o	-	o	o
Dusky Flycatcher	+	+	+	+	-	-	-	o	o
Flammulated Owl	-	+	o	+	+	+	o/-	+	+
Gray Flycatcher	-	o	o	+	+	+	o/-	o	o
Great-gray Owl	+/o	+/o	+	+	+	+/o	+/o	+	+
Lewis's Woodpecker	+	+	+	+	-	-	+/o	+	+
Mountain Chickadee	-	-	o/-	o	o	o	o	+	+
Pileated Woodpecker	-	o	o	o	o	o	+/o	+	+
Pinyon Jay	-	o	+	o	+	+	+/o	+	o
Pygmy Nuthatch	o	+	o	+	o	o	+/o	+	+
Western Tanager	+	+	-	o	o	o	o/-	o	o
White-headed Woodpecker	o	+	+	+	+	o	+/o	+	+
Williamson's Sapsucker	o	+	+	+	+	+	+/o	+	+

[1] Response is the direct short-term potential response to the action, not indirect or long-term consequences. Response is subjectively projected based on review of several studies (e.g., Sallabanks et al. 2005, Pilliod et al. 2006, Gaines et al. 2007, Lyons et al. 2008, Gaines et al. 2010, Hutto et al. 2014), knowledge of species desired habitat conditions, and knowledge of resulting habitat conditions from the prescribed habitat management or restoration. Landbird species listed here are only those focal, priority, or responsibility species highly associated with dry forest.

[2] Colors indicate the species status in this document: Blue = focal species; Green = priority species; Red = responsibility species; Pink = focal and priority species; Gray = priority and responsibility species; Yellow = focal, priority, and responsibility species

[3] The categories Heavy and Light were used to provide recognition that degrees of the habitat management or restoration action can result in different responses by the species. There are insufficient empirical data to present this information in quantitative metrics. In general, Heavy = low retention of the parameter, Light = higher retention of the parameter. The categories (+ = positive, o = neutral, and - = negative) indicate the projected directional effect of the species response. More than one category indicates greater uncertainty or likely variability in the species response.

Appendix C1. Habitat relationships and biological objectives for focal species in Dry Forest habitats of the Northern Rocky Mountains Bird Conservation Planning Region of eastern Oregon and Washington.

Conservation Focus	Focal Species	Key Habitat Relationships			
		Vegetative	Vegetation Structure	Patch size	Special Considerations
large patches of old forest with large trees and snags	white-headed woodpecker	ponderosa pine	>25 trees/ha (10/ac) >53 cm (21 in) dbh with >2 trees >79 cm (31 in) dbh; 10-40% canopy closure; >3.6 snags/ha (1.4/ac) >20 cm (8 in) dbh with >50% >64 cm (25 in)	>140 ha (350 ac) or >280 ha (700 ac)	large high-cut stumps; patch size smaller for old-growth forest
old forest with grassy openings and dense thickets	flammulated owl	ponderosa pine, Douglas-fir	>10 snags/40 ha (100 ac) >30 cm (12 in) dbh and >1.8 m (6 ft) tall; >20 trees/ha (8/ac) >53 cm (21 in) dbh	>140 ha (350 ac)	thicket patches for roosting; grassy openings for foraging
open understory with regenerating pines	chipping sparrow	ponderosa pine, Douglas-fir, grand fir	10-30% canopy cover; 20-60% shrub cover with >20% sapling cover, especially pines		non-agriculture/grazing landscape due to cowbird parasitism
patches of burned old forest	Lewis' woodpecker	ponderosa pine	>2% of the landscape as post-fire old forest; >50% of post-fire landscape as unsalvaged; in salvage - retain all trees/snags >51 cm (20 in) dbh and >50% of those 30-51 cm (12-20 in); salvage <50% of dead and down; in old forest >13% shrub cover and ~ 59 snags/ha (24 ac) >23 cm (9 in)		soft snags for excavation; pesticide spraying may reduce insect prey base

[a] preferred tree species

Appendix C2. Habitat relationships and biological objectives for focal species in Mesic Mixed Conifer(late-successional) habitats of the Northern Rocky Mountains Landbird Conservation Planning Region of eastern Oregon and Washington.

Conservation Focus	Focal Species	Key Habitat Relationships			
		Vegetative Composition[a]	Vegetation Structure	Patch size	Special Considerations
large snags	Vaux's swift	grand fir, Douglas-fir	snags >68 cm (27 in) dbh and >25 m (82 ft) tall and in different stages of decay (including some hollow snags)		recruitment snags (live trees) with signs of defects (e.g., broken tops): proximity to riparian areas
overstory canopy closure	Townsend's warbler	grand fir, Douglas-fir	late successional forest dominated by grand fir (Blue Mountains) of Dopuglas-fir (Glaciated Mountains); > 50% canopy closure	>40 ha (100 ac)	
structurally diverse; multi-layered	varied thrush	Douglas-fir, grand fir	multiple tree layers with mixed species composition including >25% deciduous cover; high canopy closure (>60%)	>30 ha (75 ac)	area sensitive, avoids edges: needs dense leaf litter layer for foraging
dense shrub layer - understory or openings	MacGillivray's warbler	Douglas-fir	dense shrub layer dominated by native species with >40% cover and/or >670 stems/ha (270/ac); tree canopy cover <25%; herbaceous ground cover <25%		cowbird host; extensive grazing detrimental
edge and openings created by fire	olive-sided flycatcher	grand fir, ponderosa pine	>2% of the landscape as post-fire old forest; >40% of post-fire landscape as unsalvaged; in salvage, salvage <50% of dead and down; retain all trees/snags >51 cm (20 in) dbh and >40% 30-51 cm (12-20 in) dbh		patches of mix of live and dead; pesticide spraying may reduce insect prey availability

[a] Preferred species

Appendix C3. Habitat relationships and biological objectives for focal species in Riparian habitats of the Northern Rocky Mountains Landbird Conservation Planning Region of eastern Oregon and Washington.

Conservation Focus	Focal Species	Key Habitat Relationships			
		Vegetative Composition[a]	Vegetation Structure	Patch size	Special Considerations
Woodland - large snags	Lewis' woodpecker	cottonwood	>2 snags/ha (0.8/ac) >41 cm (16 in) dbh; >2 trees/ha (0.8 ac) >53 cm (21in) dbh; canopy cover 10-40%; shrub cover 30-80%		dependent on insect food supply; competition from starlings detrimental
Woodland - canopy foliage	red-eyed vireo	cottonwood, aspen	canopy closure >60%; riparian zone of mature deciduous trees >50m (160 ft) wide; >10% of the shrub layer should be young cottonwoods		frequent cowbird host
Woodland - understory shrub layer	veery	cottonwood, aspen	dense, contiguous understory of native vegetation with cover in the shrub layer >40%; riparian zone width >30 m (100 ft); unbroken tracts with the aforementioned conditions >1/8 mi long		common cowbird host; negatively impacted by grazing
Shrub - willow/alder shrub patches	willow flycatcher	willow, alder	dense patches of native vegetation in the shrub layer >10 m sq (35 ft) in size and interspersed with openings of herbaceous vegetation; shrub layer cover 40-80%; shrub layer height >1 m (3 ft) high; tree cover <30%	>8 ha (20 ac)	frequent cowbird host; sites >1 km (0.6 mi) from urban/residential areas and >5 km (3 mi) from high-use cowbird areas

[a] Preferred species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