Appendix A: Assessment Tools

Interactive Biodiversity Information System

IBIS is an informational resource developed by the Northwest Habitat Institute (NHI) to promote the conservation of Northwest fish, wildlife, and their habitats through education and the distribution of timely, peer-reviewed scientific data.

IBIS contains extensive information about Pacific Northwest fish, wildlife, and their habitats, but more noteworthy, IBIS attempts to reveal and analyze the relationships among these species and their habitats. NHI hopes to make the IBIS web site a place where students, scientists, resource managers or any other interested user can discover and analyze these relationships without having to purchase special software (such as geographic information systems) or hassle with the integration of disparate data sets. IBIS will, however, provide downloadable data for users who desire to perform more advanced analyses or to integrate their own data sets with IBIS data. Finally, NHI sees IBIS as not only a fish, wildlife, and habitat information distribution system but also as a peer-review system for species data. We acknowledge that in a system as extensive as IBIS, there are going to be errors as well as disagreement among scientists regarding the attributes of species and their relationships. NHI encourages IBIS users to provide feedback so we may correct errors and discuss discrepancies.

The IBIS web site is in the early stages of development, however, NHI staff, with the support of many project partners, has been developing the data for over five years. The IBIS database was initially developed by NHI for Oregon and Washington during the Wildlife-Habitat Types in Oregon and Washington project. IBIS data is currently being refined and extended to include all of Idaho, Oregon, Washington, and the Columbia River Basin portions of Montana, Nevada, Utah and Wyoming. IBIS will eventually include species range maps, wildlife-habitat maps, extensive species-habitat data queries, and interactive wildlife-habitat mapping applications allowing dynamic spatial queries for the entire Pacific Northwest as previously defined.

Internet Access:
The IBIS Internet Home Page can be accessed via the World Wide Web at:
http://www.nwhi.org/ibis/home/ibis.asp

Questions about IBIS may be directed to:

The Northwest Habitat Institute
P.O. Box 855
Corvallis, OR 97339
Phone:(541)753-2199
Fax:(541)753-2440
habitat@nwhi.org

Washington Priority Habitats and Species List

The Priority Habitats and Species (PHS) List is a catalog of those species and habitat types identified by the Washington Department of Fish and Wildlife (WDFW) as priorities for management and preservation. Because information on fish, wildlife, and their habitats is dynamic, the PHS List is updated periodically.

The PHS List is a catalog of habitats and species considered to be priorities for conservation and management. Priority species require protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or tribal importance that are vulnerable. Priority habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. A Priority habitat may consist of a unique vegetation type or dominant plant species, a described successional stage, or a specific structural element.

There are 18 habitat types, 140 vertebrate species, 28 invertebrate species, and 14 species groups currently on the PHS List. These constitute about 16 percent of Washington's approximately 1,000 vertebrate species and a fraction of the state's invertebrate fauna.

Mapping of priority habitats and species was initiated in 1990 and includes about two-thirds of Washington's 43 million acres. The remaining third generally involves federal and tribal lands. Mapping consists of recording locational and descriptive data in a Geographic Information System (GIS). These GIS databases represent WDFW's best knowledge of fish and wildlife resources and occurrences. It is important to note, however, that priority species or priority habitats may occur in areas not currently known to WDFW biologists or in areas for which comprehensive surveys have not been conducted. Site-specific surveys may be necessary to rule out the presence of priority habitats or species on individual sites.

Included in the PHS system of databases are WDFW's PHS Points and Polygon Databases, StreamNet, and the Wildlife Heritage Database. Other information sources include the Department of Natural Resources Aquatic Lands Division database on kelp beds and the U.S. Fish and Wildlife Service's information on the National Wetlands Inventory (NWI).

Questions and requests for additional PHS information may be directed to:

Priority Habitats and Species
WDFW Habitat Program
600 Capitol Way N.
Olympia WA 98501-1091

Internet Access:

The PHS internet home page can be accessed via the World Wide Web at:
www.wa.gov/wdfw/hab/phspage.htm
For information on rare plants and plant communities, contact:

Washington Department of Natural Resources
Natural Heritage Program
P.O. Box 47016

Olympia, WA 98504-7016
(360) 902-1667
www.wa.gov/dnr/htdocs/fr/nhp

Washington GAP Analysis Program

The Washington GAP Analysis Program (GAP) is a nation-wide program currently administered by the Biological Resources Division of the US Geological Survey (BRD-USGS; formerly the National Biological Service [NBS]). The overall goal of GAP Analysis is to identify elements of biodiversity that lack adequate representation in the nation's network of reserves (i.e., areas managed primarily for the protection of biodiversity). GAP Analysis is a coarse-filter approach to biodiversity protection. It provides an overview of the distribution and conservation status of several components of biodiversity, with particular emphasis on vegetation and terrestrial vertebrates. Digital map overlays in a Geographic Information System (GIS) are used to identify vegetation types, individual species, and species-rich areas that are unrepresented or underrepresented in existing biodiversity management areas. GAP Analysis functions as a preliminary step to more detailed studies needed to establish actual boundaries for potential additions to the existing network of reserves.

The primary filter in GAP Analysis is vegetation type (defined by the Washington GAP Analysis Project as the composite of actual vegetation, vegetation zone, and ecoregion). Vegetation types are mapped and their conservation status evaluated based on representation on biodiversity management areas, conversion to human-dominated landscapes, and spatial context. Vegetation is used as the primary filter in GAP Analysis because vegetation patterns are determinants of overall biodiversity patterns (Levin 1981, Noss 1990, Franklin 1993). It is impractical to map the distributions of all plants and animals, but GAP Analysis makes the assumption that if all vegetation types are adequately represented in biodiversity management areas, then most plant and animal species will also be adequately represented. The second major GAP Analysis filter is composed of information on the distribution of individual species. This filter can be used to identify individual species that lack adequate protection and, when individual species maps are overlaid, areas of high species richness. In most states, including Washington, vertebrates are the only taxa mapped because there is relatively little information available for other taxa, and because vertebrates currently command the most attention in conservation issues.

The following are general limitations of GAP Analysis; specific limitations for particular datasets are described in the appropriate sections:

GAP Analysis data are derived from remote sensing and modeling to make general assessments about conservation status. Any decisions based on the data must be supported by ground-truthing and more detailed analyses.

GAP Analysis is not a substitute for the listing of threatened and endangered species and associated recovery efforts. A primary argument in favor of GAP Analysis is that it is proactive in recognizing areas of high biodiversity value for the long-term maintenance of populations of native species and natural ecosystems before individual species and plant communities become threatened with extinction. A goal of GAP Analysis is to reduce the rate at which species require listing as threatened or endangered.

The static nature of the GAP Analysis data limits their utility in conservation risk assessment. Our database provides a snapshot of a region in which land cover and land ownership are dynamic and where trend data would be especially useful.
GAP Analysis is not a substitute for a thorough national biological inventory. As a response to rapid habitat loss, GAP Analysis is intended to provide a quick assessment of the distribution of vegetation and associated species before they are lost and to provide focus and direction for

local, regional, and national efforts to maintain biodiversity. The process of improving knowledge in systematics, ecology, and distribution of species is lengthy and expensive. That process must be continued and expedited in order to provide the detailed information needed for a comprehensive assessment of the nation's biodiversity.

GAP Analysis is a coarse-filter approach. The network of Conservation Data Centers (CDC) and Natural Heritage Programs established cooperatively by The Nature Conservancy and various state agencies maintain detailed databases on the locations of rare elements of biodiversity. Conservation of such elements is best accomplished through the fine-filter approach of the above organizations. It is not the role of GAP to duplicate or disseminate Natural Heritage Program or CDC Element Occurrence Records. Users interested in more specific information about the location, status, and ecology of populations of such species are directed to their state Natural Heritage Program or CDC.

Internet Access:

The Washington GAP Analysis Internet Home Page can be accessed via the World Wide Web at: http://www.fish.washington.edu/naturemapping/waGAP/public_html/index.html

Questions about the Washington GAP Analysis Project may be directed to:

Washington Cooperative Fish and Wildlife Research Unit
University of Washington Box 355020
Seattle, WA 98195-5020
(206)543-6475

Partners in Flight

Partners in Flight was launched in 1990 in response to growing concerns about declines in the populations of many land bird species, and in order to emphasize the conservation of birds not covered by existing conservation initiatives. The initial focus was on Neotropical migrants, species that breed in the Nearctic (North America) and winter in the Neotropics (Central and South America), but the focus has spread to include most landbirds and other species requiring terrestrial habitats. The central premise of Partners in Flight (PIF) has been that the resources of public and private organizations in North and South America must be combined, coordinated, and increased in order to achieve success in conserving bird populations in this hemisphere. Partners in Flight is a cooperative effort involving partnerships among federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals. All Partners in Flight meetings at all levels are open to anyone interested in bird conservation and we eagerly seek your contribution.

Partners in Flight's goal is to focus resources on the improvement of monitoring and inventory, research, management, and education programs involving birds and their habitats. The PIF strategy is to stimulate cooperative public and private sector efforts in North America and the Neotropics to meet these goals.

Bird Conservation Planning Information
One of the primary activities being conducted by Partners in Flight - U.S. is the development of bird conservation plans for the entire continental United States.

The Flight Plan
The guiding principles for PIF bird conservation planning can be found in the Partners in Flight bird conservation strategy, The Flight Plan. It is composed of four parts:
(1) setting priorities
(2) establishing objectives
(3) conservation action
(4) evaluation.

Physiographic Areas
The spatial unit chosen by Partners in Flight for planning purposes is the physiographic area. There are 58 physiographic areas wholly or partially contained within the contiguous United States and several others wholly or partially in Alaska. Partners in Flight bird conservation plans in the West use state boundaries as their first sorting unit for planning, with each plan internally arranged by physiographic area or habitat type.

Integrated Bird Conservation
A common spatial language can greatly enhance the potential for communication among conservation initiatives. Under the auspices of the North American Bird Conservation Initiative (NABCI), Partners in Flight worked with the North American Waterfowl Management Plan, the Unites States Shorebird Conservation Plan, and the North American Waterbird Conservation Plan, as well as with counterparts in Mexico and Canada, to develop a standard map of planning regions to be shared by all initiatives. These Bird Conservation Regions are intended to serve as planning, implementation, and evaluation units for integrated bird conservation for the entire continent. Future revisions of PIF Bird Conservation Plans will begin to utilize Bird Conservation Regions as the planning units, facilitating integration with planning efforts of the other initiatives.

Species Assessment
An important component in The PIF Flight Plan is the identification of priority species. PIF recognized that existing means of setting conservation priorities did not capture the complexities and needs of birds. The PIF Species Assessment process uses the best of traditional methods modified by our knowledge of bird biology to create a scientifically credible means of prioritizing birds and their habitat. It is a dynamic method that uses several criteria to rank a species' vulnerability. Numerical scores are given for each criterion, with higher scores reflecting higher vulnerability. The most vulnerable species are those with declining population trends, limited geographic ranges, and/or deteriorating habitats.

PIF Watch List
The Partners in Flight Watch List was developed using the Species Assessment to highlight those birds of the continental United States, not already listed under the Endangered Species Act, that most warrant conservation attention. There is no single reason why all of these birds are on the list. Some are relatively common but undergoing steep population declines; others are rare but actually increasing in numbers. The Watch List is not intended to drive local conservation agendas, which should be based on priorities identified within each physiographic area.

Species Account Resources
Species accounts that synthesize scientific literature on the life histories and effects of management practices on particular bird species are available from a variety of sources.

Bird Conservation Plans Summary Document
The development of Bird Conservation Plans is a complicated process. More detailed information about the PIF Bird Conservation Planning Process and PIF Bird Conservation Plans is provided in the recent PIF publication - Partners in Flight: Conservation of the Land Birds of the United States.

Internet Access:
The Partners in Flight Internet Home Page can be accessed via the World Wide Web at:
http://www.partnersinflight.org/

National Wetland Inventory

The National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. The National Wetlands Inventory Center information is used by Federal, State, and local agencies, academic institutions, U.S. Congress, and the private sector. The NWIC has mapped 90 percent of the lower 48 states, and 34 percent of Alaska. About 44 percent of the lower 48 states and 13 percent of Alaska are digitized. Congressional mandates require the NWIC to produce status and trends reports to Congress at ten-year intervals. In addition to status and trends reports, the NWIC has produced over 130 publications, including manuals, plant and hydric soils lists, field guides, posters, wall size resource maps, atlases, state reports, and numerous articles published in professional journals.

The NWI National Center in St. Petersburg, Florida, includes a state-of-the-art computer operation which is responsible for constructing the wetlands layer of the National Spatial Data Infrastructure. Digitized wetlands data can be integrated with other layers of the NSDI such as natural resources and cultural and physical features, leading to production of selected color and customized maps of the information from wetland maps, and the transfer of digital (computer-readable) data to users and researchers world-wide. Dozens of organizations, including Federal, State, county agencies, and private sector organizations such as Ducks Unlimited, have supported conversion of wetland maps into digital data for computer use. Statewide databases have been built for 9 States and initiated in 5 other States. Digitized wetland data are also available for portions of 37 other States. Once a digital database is constructed, users can obtain the data at no cost over the Internet, or through the U.S. Geological Survey for the cost of reproduction.

NWI maintains a MAPS database of metadata containing production information, history, and availability of all maps and digital wetlands data produced by NWI. This database is available over the Internet.

The Emergency Wetlands Resources Act requires that NWI archive and disseminate wetlands maps and digitized data as it becomes available. The process prescribed by Office of Management and Budget (OMB) Circular A-16, "Coordination of Surveying, Mapping, and Related Spatial Data", provides an avenue for increased NWI coordination activities with other Federal agencies to reduce waste in government programs. As chair of the Federal Geographic Data Committee's Wetlands Subcommittee, the NWI Project Leader is responsible for promoting the development, sharing, and dissemination of wetlands related spatial data. The Secretary of the Interior chairs the Federal Geographic Data Committee. NWI continues to coordinate mapping activities under 36 cooperative agreements or memoranda of understanding. NWI is involved in training and providing technical assistance to the public and other agencies.

NWI maps and digital data are distributed widely throughout the country and the world. NWI has distributed over 1.7 million maps nationally since they were first introduced. Map distribution is accomplished through Cooperator-Run Distribution centers.

Users of NWI maps and digital data are as varied as are the uses. Maps are used by all levels of government, academia, Congress, private consultants, land developers, and conservation organizations. The public makes extensive use of NWI maps in a myriad of applications including planning for watershed and drinking water supply protection; siting of transportation corridors; construction of solid waste facilities; and siting of schools and other municipal

buildings. Resource managers in the Service and the States are provided with maps which are essential for effective habitat management and acquisition of important wetland areas needed to perpetuate migratory bird populations as called for in the North American Waterfowl and Wetlands Management Plan; for fisheries restoration; floodplain planning; and endangered species recovery plans. Agencies from the Department of Agriculture use the maps as a major tool in the identification of wetlands for the administration of the Swampbuster provisions of the 1985 and 1990 Farm Bills. Regulatory agencies use the maps to help in advanced wetland identification procedures, and to determine wetland values and mitigation requirements. Private sector planners use the maps to determine location and nature of wetlands to aid in framing alternative plans to meet regulatory requirements. The maps are instrumental in preventing problems from developing and in providing facts that allow sound business decisions to be made quickly, accurately, and efficiently. Good planning protects the habitat value of wetlands for wildlife, preserves water quality, provides flood protection, and enhances ground water recharge, among many other wetland values.

Additional sources of data are maintained by the Service to complement the information available from the maps themselves. The Service maintains a National List of Vascular Plant Species that Occur in Wetlands. This list is referenced in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, and in the Natural Resources Conservation Service's procedures to identify wetlands for the Swampbuster provision of the Farm Bill. The recent report on wetlands by the National Academy of Sciences found the National List to be scientifically sound and recommended that the Service continue development of the list. The Service has developed a protocol to allow other agencies and private individuals to submit additions, deletions, or changes to the list. The National List and Regional Lists are available over the Internet through the NWI Homepage.

NWI digital data have been available over the Internet since 1994. In the first year alone 93,000 data files were distributed through anonymous file transfer protocol (FTP) access to wetland maps digital line graph (DLG) data. To date, over 250,000 electronic copies of wetland maps are in the hands of resource managers and the general public. One-third of the digital wetlands files downloaded off Internet went to government agencies at Federal, State, Regional, and local levels. Other users include commercial enterprises, environmental organizations, universities, and the military. Users from 25 countries from Estonia to New Zealand to Chile obtained NWI maps from the Internet. This excellent partnership provides information to any government, private, or commercial entity that requires assistance to address issues throughout the world.

The National Wetlands Inventory Internet Home Page can be accessed via the World Wide Web at: http://wetlands.fws.gov/

Ecoregional Conservation Assessment

Ecoregional Conservation Assessments (ECAs) are the product of a partnership between TNC and WDFW. Other major contributors to ECAs are the natural heritage programs in Washington and Oregon. Ecoregional Conservation Assessments also have benefited from the participation of many other scientists and conservation experts as team members and expert reviewers. ECAs use an approach developed by TNC (Groves *et al*. 2000; Groves *et al.* 2002; Groves 2003) and other scientists (Possingham *et al*. 2000; McDonnell *et al*. 2002) to establish long-term conservation priorities within the natural boundaries of ecoregions. "First iteration' or first edition assessments have been completed for over 45 of the 81 ecoregions in the U.S., and for several others outside the U.S, with the objective of completing assessments throughout the U.S. (and in many parts of Canada and other countries) by 2008. The Nature Conservancy is leading a number of these assessments, while others are led by partner organizations or agencies using the same basic methodology.

Overview of the ECA Process

The ECA process follows the basic steps described below. An ECA may devise innovations where necessary to address specific data limitations or other challenges they confronted.

1. Identify conservation targets – Conservation targets are those elements of biodiversity – plants, animals, plant communities, habitat types, etc. – that are included in the analysis. Targets are selected to represent the full range of biodiversity in the ecoregion and to include any species of special concern.

Robert Jenkins, working for TNC in the 1970s, developed the concept of 'coarse filter' and 'fine filter' conservation targets for use in conservation planning (Jenkins 1996; Noss 1987). This approach hypothesizes that conservation of all communities and ecological systems (coarse filter targets) will also conserve the majority of species that occupy them. This coarse filter strategy is a way to compensate for the lack of detailed information on the vast number of poorly-studied invertebrates and other species.

Fine filter targets are those species or natural communities which can not be assumed to be represented in a conservation plan simply by including the full range of coarse filter targets. Fine filter targets warrant a special effort to ensure they are conserved. These are typically rare or imperiled species or natural community types, but can include wide-ranging species, ecoregional endemic species, species that are ecoregionally disjunct, or keystone species.

2. Assemble information on the target locations and occurrence quality – Data are assembled on target occurrences from a variety of sources. Although existing agency databases make up the bulk of this data set, data gaps are often filled by gathering previously scattered information and consulting specialists for specific target groups.

3. Determine how to represent and rank target occurrences – Decisions are made regarding the best way to describe and map occurrences of each target. Targets may be represented as points for specific locations, such as rare plant population locations, or polygons to show the areal extent of coarse filter targets. In addition, the quality of each occurrence is ranked where possible using the NatureServe element occurrence ranking system (NatureServe and TNC 2000). The data are stored in a Geographical Information System (GIS).

4. Set representation levels for each target – The analytical tool used for ecoregional assessments requires representation levels or "goals" for how many populations or how much

habitat area must be conserved to sustain each target over time. These “goals” are used to drive the next step of the process: selection of a portfolio of conservation areas. In reality, very few targets are sufficiently understood to allow scientists to estimate with a high degree of confidence the number and distribution of occurrences that will be sufficient to ensure survival. It is essential that users of ECAs recognize this limitation. The goals do not correspond to sufficient conditions for long-term survival of species. They do, however, function as analytical tools for assembling an efficient portfolio of conservation areas that captures multiple examples of the ecoregion’s biodiversity. These goals also provide a metric for gauging the progress of biodiversity conservation in the ecoregion over time.

There is another more profound reason for not setting conservation goals in a scientific assessment. Conservation goals are a policy choice that should based on societal values. Policy choices are the responsibility of those entrusted to make them: agency directors, stakeholder commissions, county commissioners, the legislature, etc. This assessment was conducted by scientists not policy makers. Our use of goals is not a policy statement. The “goals” are simply an analytical device for mapping important places for conservation.

5. Rate the suitability of assessment units – An ecoregion is divided into thousands of “assessment units.” The assessment units can be based on watersheds, a cadastral system, or a regular rectangular or hexagonal grid. Each of these units is compared to the others using a set of factors related to suitability for conservation. Suitability is roughly equivalent to the likelihood of conservation success. Suitability encompasses surrogates for habitat quality, such as road density or the extent of developed areas, as well as factors likely to influence conservation feasibility, such as proximity to urban areas, the proportion of private lands, or the existence of established conservation areas (Davis *et al*. 1996).

It is important to note that the factors chosen for this “suitability index” strongly influence selection of conservation areas, i.e., a different set of factors can result in a different portfolio. Also, some factors in the suitability index cross into what is traditionally a policy arena. For example, setting the index to favor the selection of existing public over private land presumes a policy of using existing public lands to meet goals wherever possible; thereby minimizing the involvement of private or tribal lands.

6. Assemble a draft portfolio – An ECA entails hundreds of different targets existing at thousands of widely distributed locations. The relative biodiversity value and relative conservation suitability of thousands of potential conservation areas must be evaluated. This complexity of information precludes simple inspection by experts to arrive at the most efficient, yet comprehensive, set of conservation areas. Hence, ECAs use an optimal site selection algorithm known as SITES (Andelman *et al*. 1999). Developed for The Nature Conservancy by the National Center for Ecological Analysis and Synthesis, SITES is computer software that aids scientists in identifying an efficient set of conservation areas. It uses a computational algorithm developed at the University of Adelaide, Australia (Ball and Possingham 1999).

To use SITES, one must input data describing the biodiversity at and the conservation suitability of the thousands of assessment units in the ecoregion. The number of targets, condition of targets, and rarity of targets present at a particular place determines the biodiversity of the unit. Conservation suitability is input as a suitability index (described above) representing a set of weighted factors chosen to represent the relative likelihood of successful conservation at a unit. The relative weighting of each of these factors is determined by the scientists conducting the assessment.

SITES strives to minimize an objective function. It begins by selecting a random set of hexagons, i.e., a random conservation portfolio. Next, SITES iteratively explores improvements to this random portfolio by randomly adding or removing other units. At each iteration, the new portfolio is compared with the previous portfolio and the better one is accepted. The algorithm uses a method called simulated annealing (Kirkpatrick *et al*. 1983) to reject sub-optimal portfolios, thus greatly increasing the chances of converging on most efficient portfolio. Typically, the algorithm is run for 1 to 2 million iterations.

Keep in mind that SITES is a decision support tool. That is, it cannot generate the ultimate conservation portfolio. Expert review and revision are necessary to compensate for gaps in the input data or other limitations of this automated part of the portfolio development process.

7. Refine the Portfolio Through Expert Review – The assessment teams and additional outside experts review the draft portfolio to correct errors of omission or inclusion by the computer-driven site selection process. These experts also assist the teams with refining individual site boundaries.

Strengths and Limitations of ECAs

ECAs are a resource for planners and others interested in the status or conservation of the biological diversity of an ecoregion. ECAs improve on the informational resources previously available in several ways:

- ECAs are conducted at an ecoregional scale. It provides information for decisions and activities that occur at an ecoregional scale: establishing regional priorities for conservation action; coordinating programs for species or habitats that cross state, county, or other political boundaries; judging the regional importance of any particular site in the ecoregion; and measuring progress in protecting the full biodiversity of the ecoregion.

- In order to prepare an ECA, diverse data sources are drawn together into a single system. Terrestrial species and habitat information is brought together as an integrated planning resource. Expert input has been gathered, reviewed by other experts, and documented. This database is available for ongoing analyses, continued improvement of the data themselves, and application to other natural resource questions.

- An ECA tells us which areas contribute the most to the conservation of existing biodiversity. It provides a baseline to measure conservation progress over time as we continue to improve our understanding of the ecosystems and species we hope to conserve.

At the same time, it is important to recognize the limitations of ECAs and to understand how they should be utilized. Users should be mindful of the following:

- An ECA has no regulatory authority. It is simply a guide for conservation action across the ecoregion.

As a guide with no regulatory authority, a portfolio is intrinsicly flexible. A portfolio should not constrain decision makers in how they address local land use and conservation issues. Since many types of land use are compatible with biodiversity conservation, the large number and size of conservation areas creates numerous options for local conservation of biodiversity. Ultimately, the management or protection of the conservation priority areas will be based on the policies and values of local governments, organizations, and citizens. Decision makers should use this guide to inform their choices.

- Sites or “priority conservation areas” described in an ECA are not intended to be dominated by parks or nature reserves set aside from economic activity. While some areas may require such protection, most can and will accommodate multiple uses as determined by landowners, local communities and appropriate agencies.

- An ECA is one of many science-based tools that will assist conservation efforts by government agencies, non-governmental organizations, and individuals. It cannot replace, for example, recovery plans for endangered species, or the detailed planning required to design a local conservation project. It does not address the special considerations of salmon or game management, and so, for example, cannot be used to ensure adequate populations for harvest.

- ECAs are an ecoregion-scale assessment. Therefore, a conservation portfolio will not include many places that are significant for the conservation of local biodiversity, such as small wetlands, riparian areas, cliffs, and small, high-quality patches of common habitat types. Due the spatial scale of an assessment, some conservation priority areas may include places that are poorly suited for conservation. Also, the boundaries ascribed to sites in a portfolio may not coincide to boundaries drawn with higher resolution data. For this reason, local assessments will be necessary and are encouraged.

- A conservation portfolio should not be used as a guide for siting restoration projects. Priority conservation areas include high-quality habitat that must be maintained as well as lower-quality habitat that will require restoration. But they are not the only sites in the ecoregion that merit restoration, whether for rebuilding habitat for imperiled species, increasing salmon or game abundance, improving water quality, or other community objectives.

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Appendix B: NHI Wildlife Habitat Types

Westside Lowlands Conifer-Hardwood Forest
Christopher B. Chappell and Jimmy Kagan

Geographic Distribution. This forest habitat occurs throughout low-elevation western Washington, except on extremely dry or wet sites. In Oregon it occurs on the western slopes of the Cascades, around the margins of the Willamette Valley, in the Coast Range, and along the outer coast. The global distribution extends from southeastern Alaska south to southwestern Oregon.

Physical Setting. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 35-100 inches (90-254 cm), but can vary locally. Snowfall ranges from rare to regular, but is transitory. Summers are relatively dry. Summer fog is a major factor on the outer coast in the Sitka spruce zone. Elevation ranges from sea level to a maximum of about 2,000 ft (610 m) in much of northern Washington and 3,500 ft (1,067 m) in central Oregon. Soils and geology are very diverse. Topography ranges from relatively flat glacial till plains to steep mountainous terrain.

Landscape Setting. This is the most extensive habitat in the lowlands on the west side of the Cascades, except in southwestern Oregon, and forms the matrix within which other habitats occur as patches, especially Westside Riparian-Wetlands and less commonly Herbaceous Wetlands or Open Water. It also occurs adjacent to or in a mosaic with Urban and Mixed Environs (hereafter Urban) or Agriculture, Pasture and Mixed Environs (hereafter Agriculture) habitats. In the driest areas, it occurs adjacent to or in a mosaic with Westside Oak and Dry Douglas-fir Forest and Woodlands. Bordering this habitat at upper elevations is Montane Mixed Conifer Forest. Along the coastline, it often occurs adjacent to Coastal Dunes and Beaches. In southwestern Oregon, it may border Southwest Oregon Mixed Conifer-Hardwood Forest. The primary land use for this habitat is forestry.

Structure. This habitat is forest, or rarely woodland, dominated by evergreen conifers, deciduous broadleaf trees, or both. Late seral stands typically have an abundance of large (>164 ft [50 m] tall) coniferous trees, a multi-layered canopy structure, large snags, and many large logs on the ground. Early seral stands typically have smaller trees, single-storied canopies, and may be dominated by conifers, broadleaf trees, or both. Coarse woody debris is abundant in early seral stands after natural

disturbances but much less so after clearcutting. Forest understories are structurally diverse: evergreen shrubs tend to dominate on nutrient-poor or drier sites; deciduous shrubs, ferns, and/or forbs tend to dominate on relatively nutrient-rich or moist sites. Shrubs may be low (1.6 ft [0.5 m] tall), medium-tall (3.3-6.6 ft [1-2 m]), or tall (6.6-13.1 ft [2-4 m]). Almost all structural stages are represented in the successional sequence within this habitat. Mosses are often a major ground cover. Lichens are abundant in the canopy of old stands.

Composition. Western hemlock (Tsuga heterophylla) and Douglas-fir (Pseudotsuga menziesii) are the most characteristic species and 1 or both are typically present. Most stands are dominated by 1 or more of the following: Douglas-fir, western hemlock, western redcedar (Thuja plicata), Sitka spruce (Picea sitchensis), red alder (Alnus rubra), or bigleaf maple (Acer macrophyllum). Trees of local importance that may be dominant include Port-Orford cedar (Chamaecyparis lawsoniana) in the south, shore pine (Pinus contorta var. contorta) on stabilized dunes, and grand fir (Abies grandis) in drier climates. Western white pine (Pinus monticola) is frequent but subordinate in importance through much of this habitat. Pacific silver fir (Abies amabilis) is largely absent except on the wettest low-elevation portion of the western Olympic Peninsula, where it is common and sometimes co-dominant. Common small subcanopy trees are cascara buckthorn (Rhamnus purshiana) in more moist climates and Pacific yew (Taxus brevifolia) in somewhat drier climates or sites.

Sitka spruce is found as a major species only in the outer coastal area at low elevations where summer fog is a significant factor. Bigleaf maple is most abundant in the Puget Lowland, around the Willamette Valley, and in the central Oregon Cascades, but occurs elsewhere also. Douglas-fir is absent to uncommon as a native species in the very wet maritime outer coastal area of Washington, including the coastal plain on the west side of the Olympic Peninsula. However, it has been extensively planted in that area. Port-Orford cedar occurs only in southern Oregon. Paper birch (Betula papyrifera) occurs as a co-dominant only in Whatcom County, Washington. Grand fir occurs as an occasional co-dominant only in the Puget Lowland and Willamette Valley.

Dominant or co-dominant understory shrub species of more than local importance include salal (Gaultheria shallon), dwarf Oregongrape (Mahonia nervosa), vine maple (Acer circinatum), Pacific rhododendron (Rhododendron macrophyllum), salmonberry (Rubus spectabilis), trailing blackberry (R. ursinus), red elderberry (Sambucus racemosa), fools huckleberry (Menziesia ferruginea), beargrass (Xerophyllum tenax), oval-leaf huckleberry (Vaccinium ovalifolium), evergreen huckleberry (V. ovatum), and red huckleberry (V. parvifolium). Salal

and rhododendron are particularly associated with low nutrient or relatively dry sites.

Swordfern (Polystichum munitum) is the most common herbaceous species and is often dominant on nitrogen-rich or moist sites. Other forbs and ferns that frequently dominate the understory are Oregon oxalis (Oxalis oregana), deerfern (Blechnum spicant), bracken fern (Pteridium aquilinum), vanillaleaf (Achlys triphylla), twinflower (Linnaea borealis), false lily-of-the-valley (Maianthemum dilatatum), western springbeauty (Claytonia siberica), foamflower (Tiarella trifoliata), inside-out flower (Vancouveria hexandra), and common whipplea (Whipplea modesta).

Other Classifications and Key References. This habitat includes most of the forests and their successional seres within the Tsuga heterophylla and Picea sitchensis zones [88]. This habitat is also referred to as Douglas-fir-western hemlock and Sitka spruce-western hemlock forests [87], spruce-cedar-hemlock forest (Picea-Thuja-Tsuga, No. 1) and cedar-hemlock-Douglas-fir forest (Thuja-Tsuga-Pseudotsuga, No. 2) [136]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] would crosswalk with Sitka spruce-western hemlock maritime forest, Douglas-fir-western hemlock-red cedar forest, red alder forest, red alder-bigleaf maple forest, mixed conifer/mixed deciduous forest, south coast mixed-deciduous forest, and coastal lodgepole forest. The Washington GAP Vegetation map includes this vegetation as conifer forest, mixed hardwood/conifer forest, and hardwood forest in the Sitka spruce, western hemlock, Olympic Douglas-fir, Puget Sound Douglas-fir, Cowlitz River and Willamette Valley zones [37]. A number of other references describe elements of this habitat [13, 25, 26, 40, 42, 66, 90, 104, 110, 111, 114, 115, 210].

Natural Disturbance Regime. Fire is the major natural disturbance in all but the wettest climatic area (Sitka spruce zone), where wind becomes the major source of natural disturbance. Natural fire-return intervals generally range from about 100 years or less in the driest areas to several hundred years [1, 115, 160]. Mean fire-return interval for the western hemlock zone as a whole is 250 years, but may vary greatly. Major natural fires are associated with occasional extreme weather conditions [1]. Fires are typically high-severity, with few trees surviving. However, low- and moderate-severity fires that leave partial to complete live canopies are not uncommon, especially in drier climatic areas. Occasional major windstorms hit outer coastal forests most intensely, where fires are rare. Severity of wind disturbance varies greatly, with minor events being extremely frequent and major events occurring once every few decades. Bark beetles and fungi are significant causes of mortality that typically operate on a small scale. Landslides are another natural disturbance that occur in some areas.

Succession and Stand Dynamics. After a severe fire or blowdown, a typical stand will be briefly occupied by annual and perennial ruderal forbs and grasses as well as predisturbance understory shrubs and herbs that resprout [102]. Herbaceous species generally give way to dominance by shrubs or a mixture of shrubs and young trees within a few

years. If shrubs are dense and trees did not establish early, the site may remain as a shrubland for an indeterminate period. Early seral tree species can be any of the potential dominants for the habitat, depending on environment, type of disturbance, and seed source. All of these species except the short-lived red alder are capable of persisting for at least a few hundred years. Douglas-fir is the most common dominant after fire, but is uncommon in the wettest zones. It is also the most fire resistant of the trees in this habitat and survives moderate-severity fires well. After the tree canopy closes, the understory may become sparse, corresponding with the stem-exclusion stage [168]. Eventually tree density will decrease and the understory will begin to flourish again, typically at stand age 60-100 years. As trees grow larger and a new generation of shade-tolerant understory trees (usually western hemlock, less commonly western redcedar) grows up, a multi-layered canopy will gradually develop and be well expressed by stand age 200-400 years [89]. Another fire is likely to return before the loss of shade-intolerant Douglas-fir from the canopy at stand age 800-1,000 years, unless the stand is located in the wet maritime zone. Throughout this habitat, western hemlock tends to increase in importance as stand development proceeds. Coarse woody debris peaks in abundance in the first 50 years after a fire and is least abundant at about stand age 100-200 years [193].

Effects of Management and Anthropogenic Impacts. Red alder is more successful after typical logging disturbance than after fire alone on moist, nutrient-rich sites, perhaps because of the species' ability to establish abundantly on scarified soils [100]. Alder is much more common now because of large-scale logging activities [87]. Alder grows more quickly in height early in succession than the conifers, thereby prompting many forest managers to apply herbicides for alder control. If alder is allowed to grow and dominate early successional stands, it will decline in importance after about 70 years and die out completely by age 100. Often there are suppressed conifers in the subcanopy that potentially can respond to the death of the alder canopy. However, salmonberry sometimes forms a dense shrub layer under the alder, which can exclude conifer regeneration [88]. Salmonberry responds positively to soil disturbance, such as that associated with logging [19]. Bigleaf maple sprouts readily after logging and is therefore well adapted to increase after disturbance as well. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris over natural levels, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Douglas-fir has been almost universally planted, even in wet coastal areas of Washington, where it is rare in natural stands.

Status and Trends. Extremely large areas of this habitat remain. Some loss has occurred, primarily to development in the Puget Lowland. Condition of what remains has been degraded by industrial forest practices at both the stand and landscape scale. Most of the habitat is probably now in Douglas-fir plantations. Only a fraction of the original old-growth forest remains, mostly in national forests in the Cascade and Olympic mountains. Areal extent continues to be reduced gradually, especially in the Puget Lowland. An increase in alternative silviculture practices may be improving structural and species diversity in some areas. However, intensive logging of natural-origin mature and young stands and even small areas of old growth continues. Of the 62 plant associations representing this habitat listed in the National Vegetation Classification, 27 percent are globally imperiled or critically imperiled [10].

Montane Mixed Conifer Forest
Christopher B. Chappell

Geographic Distribution. These forests occur in mountains throughout Washington and Oregon, excepting the Basin and Range of southeastern Oregon. These include the Cascade Range, Olympic Mountains, Okanogan Highlands, Coast Range (rarely), Blue and Wallowa Mountains, and Siskiyou Mountains.

Physical Setting. This habitat is typified by a moderate to deep winter snow pack that persists for 3 to 9 months. The climate is moderately cool and wet to moderately dry and very cold. Mean annual precipitation ranges from about 40 inches (102 cm) to >200 inches (508 cm). Elevation is mid to upper montane, as low as 2,000 ft (610 m) in northern Washington, to as high as 7,500 ft (2,287 m) in southern Oregon. On the west side, it occupies an elevational zone of about 2,500 to 3,000 vertical feet (762 to 914 m), and on the eastside it occupies a narrower zone of about 1,500 vertical feet (457 m). Topography is generally mountainous. Soils are typically not well developed, but varied in their parent material: glacial till, volcanic ash, residuum, or colluvium. Spodosols are common.

Landscape Setting. This habitat is found adjacent to Westside Lowlands Conifer-Hardwood Forest, Eastside Mixed Conifer Forests, or Southwest Oregon Mixed Conifer-Hardwood Forest at its lower elevation limits and to Subalpine Parkland at its upper elevation limits. Inclusions of Montane Forested Wetlands, Westside Riparian Wetlands, and less commonly Open Water or Herbaceous Wetlands occur within the matrix of montane forest habitat. The typical land use is forestry or recreation. Most of this type is found on public lands managed for timber values and much of it has been harvested in a dispersed-patch pattern.

Structure. This is a forest, or rarely woodland, dominated by evergreen conifers. Canopy structure varies from single- to multi-storied. Tree size also varies from small to very large. Large snags and logs vary from abundant to uncommon. Understories vary in structure: shrubs, forbs, ferns, graminoids or some combination of these usually dominate, but they can be depauperate as well. Deciduous broadleaf shrubs are most typical as understory dominants. Early successional structure after logging or fire varies depending on understory species present. Mosses are a major ground cover and epiphytie lichens are typically abundant in the canopy.

Composition. This forest habitat is recognized by the dominance or prominence of 1 of the following species: Pacific silver fir (Abies amabilis), mountain

hemlock (Tsuga mertensiana), subalpine fir (A. lasiocarpa), Shasta red fir (A. magnific var. shastensi), Engelmann spruce (Picea engelmannii), noble fir (A. procera), or Alaska yellow-cedar (Chamaecyparis nootkatensis). Several other trees may co-dominate: Douglas-fir (Pseudotsuga menziesii), lodgepole pine (Pinus contorta), western hemlock (Tsuga heterophylla), western redcedar (Thuja plicata), or white fir (A. concolor). Tree regeneration is typically dominated by Pacific silver fir in moist westside middle-elevation zones; by mountain hemlock, sometimes with silver fir, in cool, very snowy zones on the west side and along the Cascade Crest; by subalpine fir in cold, drier eastside zones; and by Shasta red fir in the snowy mid- to upper-elevation zone of southwestern and south-central Oregon.

Subalpine fir and Engelmann spruce are major species only east of the Cascade Crest in Washington, in the Blue Mountains ecoregion, and in the northeastern Olympic Mountains (spruce is largely absent in the Olympic Mountains). Lodgepole pine is important east of the Cascade Crest throughout and in central and southern Oregon. Douglas-fir is important east of the Cascade Crest and at lower elevations on the west side. Pacific silver fir is a major species on the west side as far south as central Oregon. Noble fir, as a native species, is found primarily in the western Cascades from central Washington to central Oregon. Mountain hemlock is a common dominant at higher elevations along the Cascade Crest and to the west. Western hemlock, and to a lesser degree western redcedar, occur as dominants primarily with silver fir at lower elevations on the west side. Alaska yellow-cedar occurs as a co-dominant west of the Cascade Crest in Washington, rarely in northern Oregon. Shasta red fir and white fir occur only from central Oregon south, the latter mainly at lower elevations.

Deciduous shrubs that commonly dominate or co-dominate the understory are oval-leaf huckleberry (Vaccinium ovalifolium), big huckleberry (V. membranaceum), grouseberry (V. scoparium), dwarf huckleberry (V. cespitosum), fools huckleberry (Menziesia ferruginea), Cascade azalea (Rhododendron albiflorum), copperbush (Elliottia pyroliflorus), devil's-club (Oplopanax horridus), and, in the far south only, baldhip rose (Rosa gymnocarpa), currants (Ribes spp.), and creeping snowberry (Symphoricarpos mollis). Important evergreen shrubs include salal (Gaultheria shallon), dwarf Oregongrape (Mahonia nervosa), Pacific rhododendron (Rhododendron macrophyllum), deer oak (Quercus sadleriana), pinemat manzanita (Arctostaphylos nevadensis), beargrass (Xerophyllum tenax), and Oregon boxwood (Paxistima myrsinites).

Graminoid dominants are found primarily just along the Cascade Crest and to the east and include pinegrass (Calamagrostis rubescens), Geyer's sedge (Carex geyeri), smooth woodrush (Luzula glabrata var. hitchcockii), and long-stolon sedge (Carex inops). Deerfern (Blechnum spicant) and western oakfern (Gymnocarpium dryopteris) are commonly co-dominant. The most abundant forbs include Oregon oxalis (Oxalis oregana), single-leaf foamflower (Tiarella trifoliata var. unifoliata), rosy twisted-stalk (Streptopus roseus), queen's cup (Clintonia uniflora), western bunchberry (Cornus unalaschkensis), twinflower (Linnaea borealis), prince's pine (Chimaphila umbellata), five-leaved bramble (Rubus pedatus), and dwarf bramble (R. lasiococcus), sidebells (Orthilia secunda), avalanche lily (Erythronium montanum), Sitka valerian (Valeriana sitchensis), false lily-of-the-valley (Maianthemum dilatatum), and Idaho goldthread (Coptis occidentalis).

Other Classifications and Key References. This habitat includes most of the upland forests and their successional stages, except lodgepole pine dominated forests, in the Tsuga mertensiana, Abies amabilis, A. magnifica var. shastensis, A. lasiocarpa

zones of Franklin and Dyrness [88]. Portions of this habitat have also been referred to as A. amabilis-Tsuga heterophylla forests, A. magnifica var. shastensis forests, and Tsuga mertensiana forests [87]. It is equivalent to Silver fir-Douglas-fir forest No. 3, closed portion of Fir-hemlock forest No. 4, Red fir forest No. 7, and closed portion of Western spruce-fir forest No. 15 [136]; The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are mountain hemlock montane forest, true fir-hemlock montane forest, montane mixed conifer forest, Shasta red fir-mountain hemlock forest, and subalpine fir-lodgepole pine montane conifer; also most of the conifer forest in the Silver Fir, Mountain Hemlock, and Subalpine Fir Zones of Washington GAP [37]. A number of other references describe this habitat [13, 15, 17, 25, 26, 36, 38, 90, 108, 111, 114, 115, 118, 144, 148, 158, 212, 221].

Natural Disturbance Regime. Fire is the major natural disturbance in this habitat. Fire regimes are primarily of the high-severity type [1], but also include the moderate-severity regime (moderately frequent and highly variable) for Shasta red fir forests [39]. Mean fire-return intervals vary greatly, from ³800 years for some mountain hemlock-silver fir forests to about 40 years for red fir forests. Windstorms are a common small-scale disturbance and occasionally result in stand replacement. Insects and fungi are often important small-scale disturbances. However, they may affect larger areas also, for example, laminated root rot (Phellinus weirii) is a major natural disturbance, affecting large areas of mountain hemlock forests in the Oregon Cascades [72].

Succession and Stand Dynamics. After fire, a typical stand will briefly be occupied by annual and perennial ruderal forbs and grasses, as well as predisturbance understory shrubs and herbs that resprout. Stand initiation can take a long time, especially at higher elevations, resulting in shrub/herb dominance (with or without a scattered tree layer) for extended periods [3, 109]. Early seral tree species can be any of the potential dominants for the habitat, or lodgepole pine, depending on the environment, type of disturbance, and seed source. Fires tend to favor early seral dominance of lodgepole pine, Douglas-fir, noble fir, or Shasta red fir, if their seeds are present [1]. In some areas, large stand-replacement fires will result in conversion of this habitat to the Lodgepole Pine Forest and Woodland habitat, distinguished by dominance of lodgepole. After the tree canopy closes, the understory typically becomes sparse for a time. Eventually tree density will decrease and the understory will begin to flourish again, but this process takes longer than in lower elevation forests, generally at least 100 years after the disturbance, sometimes much longer [1]. As stand development proceeds, relatively shade-intolerant trees (lodgepole pine, Douglas-fir, western hemlock, noble fir, Engelmann spruce) typically decrease in importance and more shade-tolerant species (Pacific silver fir, subalpine fir, Shasta red fir, mountain hemlock) increase. Complex multi-layered canopies with large trees will typically take at least 300 years to develop, often much longer, and on some sites may never develop. Tree growth rates, and therefore the potential to develop these structural features, tend to decrease with increasing elevation.

Effects of Management and Anthropogenic Impacts. Forest management practices, such as clearcutting and plantations, have in many cases resulted in less diverse tree canopies with an emphasis on Douglas-fir. They also reduce coarse woody debris compared to natural levels, and truncate succession well before late-seral characteristics are expressed. Post-harvest regeneration of trees has been a perpetual problem for forest managers in much of this habitat [16, 97]. Planting of Douglas-fir has

often failed at higher elevations, even where old Douglas-fir were present in the unmanaged stand [115]. Slash burning often has negative impacts on productivity and regeneration [186]. Management has since shifted away from burning and toward planting noble fir or native species, natural regeneration, and advance regeneration [16, 103]. Noble fir plantations are now fairly common in managed landscapes, even outside the natural range of the species. Advance regeneration management tends to simulate wind disturbance but without the abundant downed wood component. Shelterwood cuts are a common management strategy in Engelmann spruce or subalpine fir stands [221].

Status and Trends. This habitat occupies large areas of the region. There has probably been little or no decline in the extent of this type over time. Large areas of this habitat are relatively undisturbed by human impacts and include significant old-growth stands. Other areas have been extensively affected by logging, especially dispersed patch clearcuts. The habitat is stable in area, but is probably still declining in condition because of continued logging. This habitat is one of the best protected, with large areas represented in national parks and wilderness areas. The only threat is continued road building and clearcutting in unprotected areas. None of the 81 plant associations representing this habitat listed in the National Vegetation Classification is considered imperiled [10].

Eastside (Interior) Mixed Conifer Forest
Rex C. Crawford

Geographic Distribution. The Eastside Mixed Conifer Forest habitat appears primarily the Blue Mountains, East Cascades, and Okanogan Highland Ecoregions of Oregon, Washington, adjacent Idaho, and western Montana. It also extends north into British Columbia.

Douglas-fir-ponderosa pine forests occur along the eastern slope of the Oregon and Washington Cascades, the Blue Mountains, and the Okanogan Highlands of Washington. Grand fir-Douglas-fir forests and western larch forests are widely distributed throughout the Blue Mountains and, lesser so, along the east slope of the Cascades south of Lake Chelan and in the eastern Okanogan Highlands. Western hemlock-western redcedar-Douglas-fir forests are found in the Selkirk Mountains of eastern Washington, and on the east slope of the Cascades south of Lake Chelan to the Columbia River Gorge.

Physical Setting. The Eastside Mixed Conifer Forest habitat is primarily mid-montane with an elevation range of between 1,000 and 7,000 ft (305-2,137 m), mostly between 3,000 and 5,500 ft (914-1,676 m). Parent materials for soil development vary. This habitat receives some of the greatest amounts of precipitation in the inland northwest, 30-80 inches (76-203 cm)/year. Elevation of this habitat varies geographically, with generally higher elevations to the east.

Landscape Setting. This habitat makes up most of the continuous montane forests of the inland Pacific Northwest. It is located between the subalpine portions of the Montane Mixed Conifer Forest habitat in eastern Oregon and Washington and lower tree line Ponderosa Pine and Forest and Woodlands.

Structure. Eastside Mixed Conifer habitats are montane forests and woodlands. Stand canopy structure is generally diverse, although single-layer forest canopies are currently more common than multi-layered forests with snags and large woody debris. The tree layer varies from closed forests to more open-canopy forests or woodlands. This habitat may include very open stands. The undergrowth is complex and diverse. Tall shrubs, low shrubs, forbs or any combination may dominate stands. Deciduous shrubs typify shrub layers. Prolonged canopy closure may lead to development of a sparsely vegetated undergrowth.

Composition. This habitat contains a wide array of tree species (9) and stand dominance patterns. Douglas-fir (Pseudotsuga menziesii) is the most common tree species in this habitat. It is almost always present and dominates or co-dominates most overstories. Lower elevations or drier sites may have ponderosa pine (Pinus ponderosa) as a co-dominant with Douglas-fir in the overstory and often have other shade-tolerant tree species growing in the undergrowth. On moist sites, grand fir (Abies

grandis), western redcedar (Thuja plicata) and/or western hemlock (Tsuga heterophylla) are dominant or co-dominant with Douglas-fir. Other conifers include western larch (Larix occidentalis) and western white pine (Pinus monticola) on mesic sites, Engelmann spruce (Picea engelmannii), lodgepole pine (Pinus contorta), and subalpine fir (Abies lasiocarpa) on colder sites. Rarely, Pacific yew (Taxus brevifolia) may be an abundant undergrowth tree or tall shrub.

Undergrowth vegetation varies from open to nearly closed shrub thickets with 1 to many layers. Throughout the eastside conifer habitat, tall deciduous shrubs include vine maple (Acer circinatum) in the Cascades, Rocky Mountain maple (A. glabrum), serviceberry (Amelanchier alnifolia), oceanspray (Holodiscus discolor), mallowleaf ninebark (Physocarpus malvaceus), and Scouler's willow (Salix scouleriana) at mid- to lower elevations. Medium-tall deciduous shrubs at higher elevations include fools huckleberry (Menziesia ferruginea), Cascade azalea (Rhododendron albiflorum), and big huckleberry (Vaccinium membranaceum). Widely distributed, generally drier site mid-height to short deciduous shrubs include baldhip rose (Rosa gymnocarpa), shiny-leaf spirea (Spiraea betulifolia), and snowberry (Symphoricarpos albus, S. mollis, and S. oreophilus). Low shrubs of higher elevations include low huckleberries (Vaccinium cespitosum, and V. scoparium) and five-leaved bramble (Rubus pedatus). Evergreen shrubs represented in this habitat are chinquapin (Castanopsis chrysophylla), a tall shrub in southeastern Cascades, low to mid-height dwarf Oregongrape (Mahonia nervosa in the east Cascades and M. repens elsewhere), tobacco brush (Ceanothus velutinus), an increaser with fire, Oregon boxwood (Paxistima myrsinites) generally at mid- to lower elevations, beargrass (Xerophyllum tenax), pinemat manzanita (Arctostaphylos nevadensis) and kinnikinnick (A. uva-ursi).Herbaceous broadleaf plants are important indicators of site productivity and disturbance. Species generally indicating productive sites include western oakfern (Gymnocarpium dryopteris), vanillaleaf (Achlys triphylla), wild sarsparilla (Aralia nudicaulis), wild ginger (Asarum caudatum), queen's cup (Clintonia uniflora), goldthread (Coptis occidentalis), false bugbane (Trautvetteria caroliniensis), windflower (Anemone oregana, A. piperi, A. lyallii), fairybells (Disporum hookeri), Sitka valerian (Valeriana sitchensis), and pioneer violet (Viola glabella). Other indicator forbs are dogbane (Apocynum androsaemifolium), false solomonseal (Maianthemum stellata), heartleaf arnica (Arnica cordifolia), several lupines (Lupinus caudatus, L. latifolius, L. argenteus ssp. argenteus var laxiflorus), western meadowrue (Thalictrum occidentale), rattlesnake plantain (Goodyera oblongifolia), skunkleaf polemonium (Polemonium pulcherrimum), trailplant (Adenocaulon bicolor), twinflower (Linnaea borealis), western starflower (Trientalis latifolia), and several wintergreens (Pyrola asarifolia, P. picta,

Orthilia secunda).

Graminoids are common in this forest habitat. Columbia brome (Bromus vulgaris), oniongrass (Melica bulbosa), northwestern sedge (Carex concinnoides) and western fescue (Festuca occidentalis) are found mostly in mesic forests with shrubs or mixed with forb species. Bluebunch wheatgrass (Pseudoroegneria spicata), Idaho fescue (Festuca idahoensis), and junegrass (Koeleria macrantha) are found in drier more open forests or woodlands. Pinegrass (Calamagrostis rubescens) and Geyer's sedge (C. geyeri) can form a dense layer under Douglas-fir or grand fir trees.

Other Classifications and Key References. This habitat includes the moist portions of the Pseudotsuga menziesii, the Abies grandis, and the Tsuga heterophylla zones of eastern Oregon and Washington [88]. This habitat is called Douglas-fir (No. 12), Cedar-Hemlock-Pine (No. 13), and Grand fir-Douglas-fir (No. 14) forests in Kuchler [136]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are the eastside Douglas-fir dominant-mixed conifer forest, ponderosa pine dominant mixed conifer forest, and the northeast Oregon mixed conifer forest. Quigley and Arbelbide [181] referred to this habitat as Grand fir/White fir, the Interior Douglas-fir, Western larch, Western redcedar/Western hemlock, and Western white pine cover types and the Moist Forest potential vegetation group. Other references detail forest associations for this habitat [45, 59, 117, 118, 123, 122, 144, 148, 208, 209, 212, 221, 228].

Natural Disturbance Regime. Fires were probably of moderate frequency (30-100 years) in presettlement times. Inland Pacific Northwest Douglas-fir and western larch forests have a mean fire interval of 52 years [22]. Typically, stand-replacement fire-return intervals are 150-500 years with moderate severity-fire intervals of 50-100 years. Specific fire influences vary with site characteristics. Generally, wetter sites burn less frequently and stands are older with more western hemlock and western redcedar than drier sites. Many sites dominated by Douglas-fir and ponderosa pine, which were formerly maintained by wildfire, may now be dominated by grand fir (a fire sensitive, shade-tolerant species).

Succession and Stand Dynamics. Successional relationships of this type reflect complex interrelationships between site potential, plant species characteristics, and disturbance regime [228]. Generally, early seral forests of shade-intolerant trees (western larch, western white pine, ponderosa pine, Douglas-fir) or tolerant trees (grand fir, western redcedar, western hemlock) develop some 50 years following disturbance. This stage is preceded by forb- or shrub- dominated communities. These early stage mosaics are maintained on ridges and drier topographic positions by frequent fires. Early seral forest develops into mid-seral habitat of large trees during the next 50-100 years. Stand replacing fires recycle this stage back to early seral stages over most of the landscape. Without high-severity fires, a late-seral condition develops either single-layer or multi-layer structure during the next 100-200 years. These structures are typical of cool bottomlands that usually only experience low-intensity fires.

Effects of Management and Anthropogenic Impacts. This habitat has been most affected by

timber harvesting and fire suppression. Timber harvesting has focused on large shade-intolerant species in mid- and late-seral forests, leaving shade-tolerant species. Fire suppression enforces those logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70 percent more abundant than in historical, native systems [181]. Late-seral forests of shade-intolerant species are now essentially absent. Early-seral forest abundance is similar to that found historically but lacks snags and other legacy features.

Status and Trends. Quigley and Arbelbide [181] concluded that the Interior Douglas-fir, Grand fir, and Western redcedar/Western hemlock cover types are more abundant now than before 1900, whereas the Western larch and Western white pine types are significantly less abundant. Twenty percent of Pacific Northwest Douglas-fir, grand fir, western redcedar, western hemlock, and western white pine associations listed in the National Vegetation Classification are considered imperiled or critically imperiled [10]. Roads, timber harvest, periodic grazing, and altered fire regimes have compromised these forests. Even though this habitat is more extensive than pre-1900, natural processes and functions have been modified enough to alter its natural status as functional habitat for many species.

Lodgepole Pine Forest and Woodlands
Rex C. Crawford

Geographic Distribution. This habitat is found along the eastside of the Cascade Range, in the Blue Mountains, the Okanogan Highlands and ranges north into British Columbia and south to Colorado and California.

With grassy undergrowth, this habitat appears primarily along the eastern slope of the Cascade Range and occasionally in the Blue Mountains and Okanogan Highlands. Subalpine lodgepole pine habitat occurs on the broad plateau areas along the crest of the Cascade Range and the Blue Mountains, and in the higher elevations in the Okanogan Highlands. On pumice soils this habitat is confined to the eastern slope of the Cascade Range from near Mt. Jefferson south to the vicinity of Crater Lake.

Physical Setting. This habitat is located mostly at mid- to higher elevations (3,000-9,000 ft [914-2,743 m]). These environments can be cold and relatively dry, usually with persistent winter snowpack. A few of these forests occur in low-lying frost pockets, wet areas, or under edaphic control (usually pumice) and are relatively long-lasting features of the landscape. Lodgepole pine is maintained as a dominant by the well-drained, deep Mazama pumice in eastern Oregon.

Landscape Setting. This habitat appears within Montane Mixed Conifer Forest east of the Cascade crest and the cooler Eastside Mixed Conifer Forest habitats. Most pumice soil lodgepole pine habitat is intermixed with Ponderosa Pine Forest and Woodland habitats and is located between Eastside Mixed Conifer Forest habitat and either Western Juniper Woodland or Shrubsteppe habitat.

Structure. The lodgepole pine habitat is composed of open to closed evergreen conifer tree canopies. Vertical structure is typically a single tree layer. Reproduction of other more shade-tolerant conifers can be abundant in the undergrowth. Several distinct undergrowth types develop under the tree layer: evergreen or deciduous medium-tall shrubs, evergreen low shrub, or graminoids with few shrubs. On pumice soils, a sparsely developed shrub and graminoid undergrowth appears with open to closed tree canopies.

Composition. The tree layer of this habitat is dominated by lodgepole pine (Pinus contorta var. latifolia and P. c. var. murrayana), but it is usually associated with other montane conifers (Abies concolor, A. grandis, A. magnifici var. shastensi, Larix occidentalis, Calocedrus decurrens, Pinus lambertiana, P. monticola, P. ponderosa, Pseudotsuga menziesii). Subalpine fir (Abies lasiocarpa), mountain hemlock (Tsuga mertensiana), Engelmann spruce (Picea engelmannii), and whitebark pine (Pinus albicaulis), indicators of

subalpine environments, are present in colder or higher sites. Quaking aspen (Populus tremuloides) sometimes occur in small numbers.

Shrubs can dominate the undergrowth. Tall deciduous shrubs include Rocky Mountain maple (Acer glabrum), serviceberry (Amelanchier alnifolia), oceanspray (Holodiscus discolor), or Scouler's willow (Salix scouleriana). These tall shrubs often occur over a layer of mid-height deciduous shrubs such as baldhip rose (Rosa gymnocarpa), russet buffaloberry (Shepherdia canadensis), shiny-leaf spirea (Spiraea betulifolia), and snowberry (Symphoricarpos albus and/or S. mollis). At higher elevations, big huckleberry (Vaccinium membranaceum) can be locally important, particularly following fire. Mid-tall evergreen shrubs can be abundant in some stands, for example, creeping Oregongrape (Mahonia repens), tobacco brush (Ceanothus velutinus), and Oregon boxwood (Paxistima myrsinites). Colder and drier sites support low-growing evergreen shrubs, such as kinnikinnick (Arctostaphylos uva-ursi) or pinemat manzanita (A. nevadensis). Grouseberry (V. scoparium) and beargrass (Xerophyllum tenax) are consistent evergreen low shrub dominants in the subalpine part of this habitat. Manzanita (Arctostaphylos patula), kinnikinnick, tobacco brush, antelope bitterbrush (Purshia tridentata), and wax current (Ribes cereum) are part of this habitat on pumice soil.

Some undergrowth is dominated by graminoids with few shrubs. Pinegrass (Calamagrostis rubescens) and/or Geyer's sedge (Carex geyeri) can appear with grouseberry in the subalpine zone. Pumice soils support grassy undergrowth of long-stolon sedge (C. inops), Idaho fescue (Festuca idahoensis) or western needlegrass (Stipa occidentalis). The latter 2 species may occur with bitterbrush or big sagebrush and other bunchgrass steppe species. Other nondominant indicator graminoids frequently encountered in this habitat are California oatgrass (Danthonia californica), blue wildrye (Elymus glaucus), Columbia brome (Bromus vulgaris) and oniongrass (Melica bulbosa). Kentucky bluegrass (Poa pratensis), and bottlebrush squirreltail (Elymus elymoides) can be locally abundant where livestock grazing has persisted.

The forb component of this habitat is diverse and varies with environmental conditions. A partial forb list includes goldthread (Coptis occidentalis), false solomonseal (Maianthemum stellata), heartleaf arnica (Arnica cordifolia), several lupines (Lupinus caudatus, L. latifolius, L. argenteus ssp. argenteus var. laxiflorus), meadowrue (Thalictrum occidentale),

queen's cup (Clintonia uniflora), rattlesnake plantain (Goodyera oblongifolia), skunkleaf polemonium (Polemonium pulcherrimum), trailplant (Adenocaulon bicolor), twinflower (Linnaea borealis), Sitka valerian (Valeriana sitchensis), western starflower (Trientalis latifolia), and several wintergreens (Pyrola asarifolia, P. picta, Orthilia secunda).

Other Classifications and Key References. The Lodgepole Pine Forest and Woodland habitat includes the Pinus contorta zone of eastern Oregon and Washington [88]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Type [127] that would represent this type is lodgepole pine forest and woodlands. Quigley and Arbelbide [181] referred to this habitat as Lodgepole pine cover type and as a part of the Dry Forest potential vegetation group. Other references detail forest associations with this habitat [117, 118, 122, 123, 144, 212, 221].

Natural Disturbance Regime. This habitat typically reflects early successional forest vegetation that originated with fires. Inland Pacific Northwest lodgepole pine has a mean fire interval of 112 years [22]. Summer drought areas generally have low to medium-intensity ground fires occurring at intervals of 25-50 years, whereas areas with more moisture have a sparse undergrowth and slow fuel build-up that results in less frequent, more intense fire. With time, lodgepole pine stands increase in fuel loads. Woody fuels accumulate on the forest floor from insect (mountain pine beetle) and disease outbreaks and residual wood from past fires. Mountain pine beetle outbreaks thin stands that add fuel and create a drier environment for fire or open canopies and create GAPs for other conifer regeneration. High-severity crown fires are likely in young stands, when the tree crowns are near deadwood on the ground. After the stand opens up, shade-tolerant trees increase in number.

Succession and Stand Dynamics. Most Lodgepole Pine Forest and Woodlands are early- to mid seral stages initiated by fire. Typically, lodgepole pine establishes within 10-20 years after fire. This can be a GAP phase process where seed sources are scarce. Lodgepole stands break up after 100-200 years. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth. Because lodgepole pine cannot reproduce under its own canopy, old unburned stands are replaced by shade-tolerant conifers. Lodgepole pine on pumice soils is not seral to other tree species; these extensive stands, if not burned, thin naturally, with lodgepole pine regenerating in patches. On poorly drained pumice soils, quaking aspen sometimes plays a mid-seral role and is displaced by lodgepole when aspen clones die. Serotinous cones (cones releasing seeds after fire) are uncommon in eastern Oregon lodgepole pine (P. c. var. murrayana). On the Colville National Forest in Washington, only 10 percent of lodgepole pine (P. c. var. latifolia) trees in low-elevation Douglas-fir habitats had serotinous cones, whereas 82 percent of cones in high-elevation subalpine fir habitats were serotinous [4].

Effects of Management and Anthropogenic Impacts. Fire suppression has left many single-canopy lodgepole pine habitats unburned to develop into more multilayered stands. Thinning of serotinous lodgepole pine forests with fire intervals <20 years can reduce their importance over time. In pumice-soil lodgepole stands, lack of natural regeneration in harvest units has lead to creation of "pumice deserts" within otherwise forested habitats [47].

Status and Trends. Quigley and Arbelbide [181] concluded that the extent of the lodgepole pine cover type in Oregon and Washington is the same as before 1900 and in regions may exceed its historical extent. Five percent of Pacific Northwest lodgepole pine associations listed in the National Vegetation Classification are considered imperiled [10]. At a finer scale, these forests have been fragmented by roads, timber harvest, and influenced by periodic livestock grazing and altered fire regimes.

Ponderosa Pine Forest and Woodlands (includes Eastside Oak)
Rex C. Crawford and Jimmy Kagan

Geographic Distribution. This habitat occurs in much of eastern Washington and eastern Oregon, including the eastern slopes of the Cascades, the Blue Mountains and foothills, and the Okanogan Highlands. Variants of it also occur in the Rocky Mountains, the eastern Sierra Nevada, and mountains within the Great Basin. It extends into south-central British Columbia as well.

In the Pacific Northwest, ponderosa pine-Douglas-fir woodland habitats occur along the eastern slope of the Cascades, the Okanogan Highlands, and in the Blue Mountains. Ponderosa pine woodland and savanna habitats occur in the foothills of the Blue Mountains, along the eastern base of the Cascade Range, the Okanogan Highlands, and in the Columbia Basin in northeastern Washington. Ponderosa pine is widespread in the pumice zone of south-central Oregon between Bend and Crater Lake east of the Cascade Crest. Ponderosa pine-Oregon white oak habitat appears east of the Cascades in the vicinity of Mt. Hood near the Columbia River Gorge north to the Yakama Nation and south to the Warm Springs Nation. Oak dominated woodlands follow a similar distribution as Ponderosa Pine-White Oak habitat but are more restricted and less common.

Physical Setting. This habitat generally occurs on the driest sites supporting conifers in the Pacific Northwest. It is widespread and variable, appearing on moderate to steep slopes in canyons, foothills, and on plateaus or plains near mountains. In Oregon, this habitat can be maintained by the dry pumice soils, and in Washington it can be associated with serpentine soils. Average annual precipitation ranges from about 14 to 30 inches (36 to 76 cm) on ponderosa pine sites in Oregon and Washington and often as snow. This habitat can be found at elevations of 100 ft (30m) in the Columbia River Gorge to dry, warm areas over 6,000 ft (1,829 m). Timber harvest, livestock grazing, and pockets of urban development are major land uses.

Landscape Setting. This woodland habitat typifies the lower treeline zone forming transitions with Eastside Mixed Conifer Forest and Western Juniper and Mountain Mahogany Woodland, Shrubsteppe, Eastside Grassland, or Agriculture habitats. Douglas-fir-ponderosa pine woodlands are found near or within the Eastside Mixed Conifer Forest habitat. Oregon oak woodlands appear in the driest most restricted landscapes in transition to Eastside Grassland or Shrubsteppe.

Structure. This habitat is typically a woodland or savanna with tree canopy coverage of 10- 60 percent, although closed-canopy stands are

possible. The tree layer is usually composed of widely spaced large conifer trees. Many stands tend towards a multi-layered condition with encroaching conifer regeneration. Isolated taller conifers above broadleaf deciduous trees characterize part of this habitat. Deciduous woodlands or forests are an important part of the structural variety of this habitat. Clonal deciduous trees can create dense patches across a grassy landscape rather than scattered individual trees. The undergrowth may include dense stands of shrubs or, more often, be dominated by grasses, sedges, or forbs. Shrubsteppe shrubs may be prominent in some stands and create a distinct tree-shrub-sparse-grassland habitat.

Composition. Ponderosa pine (Pinus ponderosa) and Douglas-fir (Pseudotsuga menziesii) are the most common evergreen trees in this habitat. The deciduous conifer, western larch (Larix occidentalis), can be a co-dominant with the evergreen conifers in the Blue Mountains of Oregon, but seldom as a canopy dominant. Grand fir (Abies grandis) may be frequent in the undergrowth on more productive sites giving stands a multi-layer structure. In rare instances, grand fir can be co-dominant in the upper canopy. Tall ponderosa pine over Oregon white oak (Quercus garryana) trees form stands along part of the east Cascades. These stands usually have younger cohorts of pines. Oregon white oak dominates open woodlands or savannas in limited areas.

The undergrowth can include dense stands of shrubs or, more often, be dominated by grasses, sedges, and/or forbs. Some Douglas-fir and ponderosa pine stands have a tall to medium-tall deciduous shrub layer of mallowleaf ninebark (Physocarpus malvaceus) or common snowberry (Symphoricarpos albus). Grand fir seedlings or saplings may be present in the undergrowth. Pumice soils support a shrub layer represented by green-leaf or white-leaf manzanita (Arctostaphylos patula or A. viscida). Short shrubs, pinemat manzanita (Arctostaphylos nevadensis) and kinnikinnick (A. uva-ursi) are found across the range of this habitat. Antelope bitterbrush (Purshia tridentata), big sagebrush (Artemisia tridentata), black sagebrush (A. nova), green rabbitbrush (Chrysothamnus viscidiflorus), and in southern Oregon, curl-leaf mountain mahogany (Cercocarpus ledifolius) often grow with Douglas-fir, ponderosa pine and/or Oregon white oak, which typically have a bunchgrass and shrubsteppe ground cover.

Undergrowth is generally dominated by herbaceous species, especially graminoids. Within a forest matrix, these woodland habitats have an open to closed sodgrass undergrowth dominated by pinegrass (Calamagrostis rubescens), Geyer's sedge (Carex geyeri), Ross' sedge (C. rossii), long-stolon sedge (C. inops), or blue wildrye (Elymus glaucus). Drier savanna and woodland undergrowth typically contains bunchgrass steppe species, such as Idaho fescue (Festuca idahoensis), rough fescue (F. campestris), bluebunch wheatgrass (Pseudoroegneria spicata), Indian ricegrass (Oryzopsis hymenoides), or needlegrasses (Stipa comata, S. occidentalis). Common

exotic grasses that may appear in abundance are cheatgrass (Bromus tectorum), and bulbous bluegrass (Poa bulbosa). Forbs are common associates in this habitat and are too numerous to be listed.

Other Classifications and Key References. This habitat is referred to as Merriam's Arid Transition Zone, Western ponderosa forest (Pinus), and Oregon Oak wood (Quercus) in Kuchler [136], and as Pacific ponderosa pine-Douglas-fir and Pacific ponderosa pine, and Oregon white oak by the Society of American Foresters. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are ponderosa pine forest and woodland, ponderosa pine-white oak forest and woodland, and ponderosa pine-lodgepole pine on pumice. Other references describe elements of this habitat [45, 62, 88, 117, 118, 121, 122, 123, 144, 148, 209, 212, 221, 222].

Natural Disturbance Regime. Fire plays an important role in creating vegetation structure and composition in this habitat. Most of the habitat has experienced frequent low-severity fires that maintained woodland or savanna conditions. A mean fire interval of 20 years for ponderosa pine is the shortest of the vegetation types listed by Barrett *et al.*[22]. Soil drought plays a role in maintaining an open tree canopy in part of this dry woodland habitat.

Succession and Stand Dynamics. This habitat is climax on sites near the dry limits of each of the dominant conifer species and is more seral as the environment becomes more favorable for tree growth. Open seral stands are gradually replaced by more closed shade-tolerant climax stands. Oregon white oak can reproduce under its own shade but is intolerant of overtopping by conifers. Oregon white oak woodlands are considered fire climax and are seral to conifers. In drier conditions, unfavorable to conifers, oak is climax. Oregon white oak sprouts from the trunk and root crown following cutting or burning and form clonal patches of trees.

Effects of Management and Anthropogenic Impacts. Pre-1900, this habitat was mostly open and park like with relatively few undergrowth trees. Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the

habitat a more closed, multi-layered canopy. For example, this habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Fire suppression has lead to a buildup of fuels that in turn increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by conifers. Large late-seral ponderosa pine, Douglas-fir, and Oregon white oak are harvested in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. Ponderosa pine-Oregon white oak habitat is now denser than in the past and may contain more shrubs than in pre-settlement habitats. In some areas, new woodlands have been created by patchy tree establishment at the forest-steppe boundary.

Status and Trends. Quigley and Arbelbide [181] concluded that the Interior Ponderosa Pine cover type is significantly less in extent than pre-1900 and that the Oregon White Oak cover type is greater in extent than pre-1900. They included much of this habitat in their Dry Forest potential vegetation group [181], which they concluded has departed from natural succession and disturbance conditions. The greatest structural change in this habitat is the reduced extent of the late-seral, single-layer condition. This habitat is generally degraded because of increased exotic plants and decreased native bunchgrasses. One third of Pacific Northwest Oregon white oak, ponderosa pine, and dry Douglas-fir or grand fir community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

Upland Aspen Forest
Rex C. Crawford and Jimmy Kagan

Geographic Distribution. Quaking aspen groves are the most widespread habitat in North America, but are a minor type throughout eastern Washington and Oregon. Upland Aspen habitat is found in isolated mountain ranges of Southeastern Oregon, e.g. Steens Mountains, and in the northeastern Cascades of Washington. Aspen stands are much more common in the Rocky Mountain states.

Physical Setting. This habitat generally occurs on well-drained mountain slopes or canyon walls that have some moisture. Rockfalls, talus, or stony north slopes are often typical sites. It may occur in steppe on moist microsites. This habitat is not associated with streams, ponds, or wetlands. This habitat is found from 2,000 to 9,500 ft (610 to 2,896 m) elevation.

Landscape Setting. Aspen forms a "subalpine belt" above the Western Juniper and Mountain Mahogany Woodland habitat and below Montane Shrubsteppe Habitat on Steens Mountain in southern Oregon. It can occur in seral stands in the lower Eastside Mixed Conifer Forest and Ponderosa Pine Forest and Woodlands habitats. Primary land use is livestock grazing.

Structure. Deciduous trees usually <48 ft (15 m) tall dominate this woodland or forest habitat. The tree layer grows over a forb-, grass-, or low-shrub-dominated undergrowth. Relatively simple 2-tiered stands characterize the typical vertical structure of woody plants in this habitat. This habitat is composed of 1 to many clones of trees with larger trees toward the center of each clone. Conifers invade and create mixed evergreen-deciduous woodland or forest habitats.

Composition. Quaking aspen (Populus tremuloides) is the characteristic and dominant tree in this habitat. It is the sole dominant in many stands although scattered ponderosa pine (Pinus ponderosa) or Douglas-fir (Pseudotsuga menziesii) may be present. Snowberry (Symphoricarpos oreophilus and less frequently, S. albus) is the most common dominant shrub. Tall shrubs, Scouler's willow (Salix scouleriana) and serviceberry (Amelanchier alnifolia) may be abundant. On mountain or canyon slopes, antelope bitterbrush (Purshia tridentata), mountain big sagebrush (Artemisia tridentata ssp. vaseyana), low sagebrush (A. arbuscula), and curl-leaf mountain mahogany (Cercocarpus ledifolius) often occur in and adjacent to this woodland habitat.
In some stands, pinegrass (Calamagrostis rubescens) may dominate the ground cover without shrubs. Other common grasses are Idaho fescue (Festuca idahoensis), California brome (Bromus carinatus), or blue wildrye (Elymus glaucus). Characteristic tall forbs include horsemint (Agastache spp.), aster (Aster spp.), senecio (Senecio spp.), coneflower (Rudbeckia spp.). Low forbs include meadowrue (Thalictrum spp.), bedstraw (Galium spp.), sweetcicely (Osmorhiza spp.), and valerian (Valeriana spp.).

Other Classifications and Key References. This habitat is called "Aspen" by the Society of American Foresters and "Aspen woodland" by the Society of Range Management. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Type [127] that would represent this type is aspen groves. Other references describe this habitat [2, 88, 119, 161, 222,].

Natural Disturbance Regime. Fire plays an important role in maintenance of this habitat. Quaking aspen will colonize sites after fire or other stand disturbances through root sprouting. Research on fire scars in aspen stands in central Utah [119] indicated that most fires occurred before 1885, and concluded that the natural fire return interval was 7-10 years. Ungulate browsing plays a variable role in aspen habitat; ungulates may slow tree regeneration by consuming aspen sprouts on some sites, and may have little influence in other stands.

Succession and Stand Dynamics. There is no generalized successional pattern across the range of this habitat. Aspen sprouts after fire and spreads vegetatively into large clonal or multi-clonal stands. Because aspen is shade intolerant and cannot reproduce under its own canopy, conifers can invade most aspen habitat. In central Utah, quaking aspen was invaded by conifers in 75-140 years. Apparently, some aspen habitat is not invaded by conifers, but eventually clones deteriorate and succeed to shrubs, grasses, and/or forbs. This transition to grasses and forbs occurs more likely on dry sites.

Effects of Management and Anthropogenic Impacts. Domestic sheep reportedly consume 4 times more aspen sprouts than do cattle. Heavy livestock browsing can adversely impact aspen growth and regeneration. With fire suppression and alteration of fine fuels, fire rejuvenation of aspen habitat has been greatly reduced since about 1900. Conifers now dominate many seral aspen stands and extensive stands of young aspen are uncommon.

Status and Trends. With fire suppression and change in fire regimes, the Aspen Forest habitat is less common than before 1900. None of the 5 Pacific Northwest upland quaking aspen community types in the National Vegetation Classification is considered imperiled [10].

Subalpine Parkland
Rex C. Crawford and Christopher B. Chappell

Geographic Distribution. The Subalpine Parkland habitat occurs throughout the high mountain ranges of Washington and Oregon (e.g., Cascade crest, Olympic Mountains, Wallowa and Owyhee Mountains, and Okanogan Highlands), extends into mountains of Canada and Alaska, and to the Sierra Nevada and Rocky Mountains.

Physical Setting. Climate is characterized by cool summers and cold winters with deep snowpack, although much variation exists among specific vegetation types. Mountain hemlock sites receive an average precipitation of >50 inches (127 cm) in 6 months and several feet of snow typically accumulate. Whitebark pine sites receive 24-70 inches (61-178 cm) per year and some sites only rarely accumulate a significant snowpack. Summer soil drought is possible in eastside parklands but rare in west side areas. Elevation varies from 4,500 to 6,000 ft (1,371 to 1,829 m) in the western Cascades and Olympic Mountains and from 5,000 to 8,000 ft (1,524 to 2,438 m) in the eastern Cascades and Wallowa Mountains.

Landscape Setting. The Subalpine Parkland habitat lies above the Mixed Montane Conifer Forest or Lodgepole Pine Forest habitat and below the Alpine Grassland and Shrubland habitat. Associated wetlands in subalpine parklands extend up a short distance into the alpine zone. Primary land use is recreation, watershed protection, and grazing.

Structure. Subalpine Parkland habitat has a tree layer typically between 10 and 30 percent canopy cover. Openings among trees are highly variable. The habitat appears either as parkland, that is, a mosaic of treeless openings and small patches of trees often with closed canopies, or as woodlands or savanna-like stands of scattered trees. The ground layer can be composed of (1) low to matted dwarf-shrubs (<1 ft [0.3 m] tall) that are evergreen or deciduous and often small-leaved; (2) sod grasses, bunchgrasses, or sedges; (3) forbs; or (4) moss- or lichen-covered soils. Herb or shrub-dominated wetlands appear within the parkland areas and are considered part of this habitat; wetlands can occur as deciduous shrub thickets up to 6.6 ft (2 m) tall, as scattered tall shrubs, as dwarf shrub thickets, or as short herbaceous plants <1.6 ft (0.5 m) tall. In general, western Cascades and Olympic areas are mostly parklands composed of a mosaic of patches of trees interspersed with heather shrublands or wetlands, whereas, eastern Cascades and Rocky mountain areas are parklands and woodlands typically dominated by grasses or sedges, with fewer heathers.

Composition. Species composition in this habitat varies with geography or local site conditions. The tree layer can be composed of 1 or several tree species. Subalpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmannii) and lodgepole pine (Pinus contorta) are found throughout the Pacific Northwest, whereas limber pine (P. flexilis) is restricted to southeastern Oregon. Alaska yellowcedar (Chamaecyparis nootkatensis), Pacific silver fir (A. amabilis), and mountain hemlock (Tsuga mertensiana) are most common in the Olympics and Cascades. Whitebark pine (P. albicaulis) is found primarily in the eastern

Cascade Mountains Okanogan Highlands, and Blue Mountains. Subalpine larch (Larix lyallii) occurs only in the northern Cascade Mountains, primarily east of the crest.

West Cascades and Olympic areas generally are parklands. Tree islands often have big huckleberry (Vaccinium membranaceum) in the undergrowth interspersed with heather shrublands between. Openings are composed of pink mountain-heather (Phyllodoce empetriformis), and white mountain-heather (Cassiope mertensiana) and Cascade blueberry (Vaccinium deliciosum). Drier areas are more woodland or savanna like, often with low shrubs, such as common juniper (Juniperus communis), kinnikinnick (Arctostaphylos uva-ursi), low whortleberries or grouseberries (Vaccinium myrtillus or V. scoparium) or beargrass (Xerophyllum tenax) dominating the undergrowth. Wetland shrubs in the Subalpine Parkland habitat include bog-laurel (Kalmia microphylla), Booth's willow (Salix boothii), undergreen willow (S. commutata), Sierran willow (S. eastwoodiae), and blueberries (Vaccinium uliginosum or V. deliciosum)

Undergrowth in drier areas may be dominated by pinegrass (Calamagrostis rubescens), Geyer's sedge (Carex geyeri), Ross' sedge (C. rossii), smooth woodrush (Luzula glabrata var. hitchcockii), Drummond's rush (Juncus drummondii), or short fescues (Festuca viridula, F. brachyphylla, F. saximontana). Various sedges are characteristic of wetland graminoid-dominated habitats: black (Carex nigricans), Holm's Rocky Mountain (C. scopulorum), Sitka (C. aquatilis var. dives) and Northwest Territory (C. utriculatia) sedges. Tufted hairgrass (Deschampsia caespitosa) is characteristic of subalpine wetlands.

The remaining flora of this habitat is diverse and complex. The following herbaceous broadleaf plants are important indicators of differences in the habitat: American bistort (Polygonum bistortoides), American false hellebore (Veratrum viride), fringe leaf cinquefoil (Potentilla flabellifolia), marsh marigolds (Caltha leptosepala), avalanche lily (Erythronium montanum), partridgefoot (Luetkea pectinata), Sitka valerian (Valeriana sitchensis), subalpine lupine (Lupinus arcticus ssp. subalpinus), and alpine aster (Aster alpigenus). Showy sedge (Carex spectabilis) is also locally abundant.

Other Classifications and Key References. This habitat is called the Hudsonian Zone [155], Parkland subzone [134], meadow-forest mosaic [74], upper subalpine zone [88], Meadows and Park, and Subalpine Parkland [20]. Quigley and Arbelbide [181] called this habitat Whitebark pine and Whitebark pine-Subalpine larch cover types. Kuchler [136] included this within the subalpine fir-mountain hemlock forest. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are whitebark-lodgepole pine montane forest and subalpine parkland. Additional references describe this habitat [11, 49, 75, 105, 112, 114, 115, 139, 144, 221].

Natural Disturbance Regime. Although fire is rare to infrequent in this habitat, it plays an important role, particularly in drier environments. Whitebark pine woodland fire intervals varied from 50 to 300 years before 1900. Mountain hemlock parkland fire reoccurrence is 400-800 years. Wind blasting by ice and snow crystals is a critical factor in these woodlands and establishes the higher limits of the habitat. Periodic shifts in climatic factors, such as drought, snowpack depth, or snow duration either allow tree

invasions into meadows and shrublands or eliminate or retard tree growth. Volcanic activity plays a long-term role in establishing this habitat. Wetlands are usually seasonally or perennially flooded by snowmelt and springs, or by subirrigation.

Succession and Stand Dynamics. Succession in this habitat occurs through a complex set of relationships between vegetation response to climatic shifts and catastrophic disturbance, and plant species interactions and site modification that create microsites. A typical succession of subalpine trees into meadows or shrublands begins with the invasion of a single tree, subalpine fir and mountain hemlock in the wetter climates and whitebark pine and subalpine larch in drier climates. If the environment allows, tree density slowly increases (over decades to centuries) through seedlings or branch layering by subalpine fir. The tree patches or individual trees change the local environment and create microsites for shade-tolerant trees, Pacific silver fir in wetter areas, and subalpine fir and Engelmann spruce in drier areas. Whitebark pine, an early invading tree, is dispersed long distances by Clark's nutcrackers and shorter distances by mammals. Most other tree species are wind dispersed.

Effects of Management and Anthropogenic Impacts. Fire suppression has contributed to change in habitat structure and functions. For example, the current "average" whitebark pine stand will burn every 3,000 years or longer because of fire suppression. Blister rust, an introduced pathogen, is increasing whitebark pine mortality in these woodlands [4]. Even limited logging can have prolonged effects because of slow invasion rates of trees. This is particularly important on drier sites and in subalpine larch stands. During wet cycles, fire suppression can lead to tree islands coalescing and the conversion of parklands into a more closed forest habitat. Parkland conditions can displace alpine conditions through tree invasions. Livestock use and heavy horse or foot traffic can lead to trampling and soil compaction. Slow growth in this habitat prevents rapid recovery.

Status and Trends. This habitat is generally stable with local changes to particular tree variants. Whitebark pine maybe declining because of the effects of blister rust or fire suppression that leads to conversion of parklands to more closed forest. Global climate warming will likely have an amplified effect throughout this habitat. Less than 10 percent of Pacific Northwest subalpine parkland community types listed in the National Vegetation Classification are considered imperiled [10].

Alpine Grassland and Shrublands
Christopher B. Chappell and Jimmy Kagan

Geographic Distribution. This habitat occurs in high mountains throughout the region, including the Cascades, Olympic Mountains, Okanogan Highlands, Wallowa Mountains, Blue Mountains, Steens Mountain in southeastern Oregon, and, rarely, the Siskiyous. It is most extensive in the Cascades from Mount Rainier north and in the Wallowa Mountains. Similar habitats occur throughout mountains of northwestern North America.

Physical Setting. The climate is the coldest of any habitat in the region. Winters are characterized by moderate to deep snow accumulations, very cold temperatures, and high winds. Summers are relatively cool. Growing seasons are short because of persistent snow pack or frost. Blowing snow and ice crystals on top of the snow pack at and above treeline prevent vegetation such as trees from growing above the depth of the snow pack. Snow pack protects vegetation from the effects of this winter wind-related disturbance and from excessive frost heaving. Community composition is much influenced by relative duration of snow burial and exposure to wind and frost heaving [75]. Elevation ranges from a minimum of 5,000 ft (1,524 m) in parts of the Olympics to [3]10,000 ft (3,048 m). The topography varies from gently sloping broad ridgetops, to glacial cirque basins, to steep slopes of all aspects. Soils are generally poorly developed and shallow, though in subalpine grasslands they may be somewhat deeper or better developed. Geologic parent material varies with local geologic history.

Landscape Setting. This habitat always occurs above upper treeline in the mountains or a short distance below it (grasslands in the subalpine parkland zone). Typically, it occurs adjacent to, or in a mosaic with, Subalpine Parkland. Occasionally, it may grade quickly from this habitat down into Montane Mixed Conifer Forest without intervening Subalpine Parkland. In southeastern Oregon, this habitat occurs adjacent to and above Upland Aspen Forest and Shrubsteppe habitats. Small areas of Open Water, Herbaceous Wetlands, and Subalpine Parkland habitats sometimes occur within a matrix of this habitat. Cliffs, talus, and other barren areas are common features within or adjacent to this habitat. Land use is primarily recreation, but in some areas east of the Cascade Crest, it is grazing, especially by sheep.

Structure. This habitat is dominated by grassland, dwarf-shrubland (mostly evergreen microphyllous), or forbs. Cover of the various life forms is extremely variable, and total cover of vascular plants can range from sparse to complete. Patches of krummholz (coniferous tree species maintained in shrub form by extreme environmental conditions) are a common component of this habitat, especially just above upper treeline. In subalpine grasslands, which are considered part of this habitat, widely scattered coniferous trees sometimes occur. Five major structural types can be distinguished: (1) subalpine and

alpine bunchgrass grasslands, (2) alpine sedge turf, (3) alpine heath or dwarf-shrubland, (4) fellfield and boulderfield, and (5) snowbed forb community. Fellfields have a large amount of bare ground or rocks with a diverse and variable open layer of forbs, graminoids, and less commonly dwarf-shrubs. Snowbed forb communities have relatively sparse cover of few species of mainly forbs. In the alpine zone, these types often occur in a complex fine-scale mosaic with each other.

Composition. Most subalpine or alpine bunchgrass grasslands are dominated by Idaho fescue (Festuca idahoensis), alpine fescue (F. brachyphylla), green fescue (F. viridula), Rocky Mountain fescue (F. saximontana), or timber oatgrass (Danthonia intermedia), and to a lesser degree, purple reedgrass (Calamagrostis purpurascens), downy oat-grass (Trisetum spicatum) or muttongrass (Poa fendleriana). Forbs are diverse and sometimes abundant in the grasslands. Alpine sedge turfs may be moist or dry and are dominated by showy sedge (Carex spectabilis), black alpine sedge (C. nigricans), Brewer's sedge (C. breweri), capitate sedge (C. capitata), nard sedge (C. nardina), dunhead sedge (C. phaeocephala), or western single-spike sedge (C. pseudoscirpoidea).

One or more of the following species dominates alpine heaths: pink mountain-heather (Phyllodoce empetriformis), green mountain-heather (P. glanduliflora), white mountain-heather (Cassiope mertensiana), or black crowberry (Empetrum nigrum). Other less extensive dwarf-shrublands may be dominated by the evergreen coniferous common juniper (Juniperus communis), the evergreen broadleaf kinnikinnick (Arctostaphylos uva-ursi), the deciduous shrubby cinquefoil (Pentaphylloides floribunda) or willows (Salix cascadensis and S. reticulata ssp. nivalis). Tree species occurring as shrubby krummholz in the alpine are subalpine fir (Abies lasiocarpa), whitebark pine (Pinus albicaulis), mountain hemlock (Tsuga mertensiana), Engelmann spruce (Picea engelmannii), and subalpine larch (Larix lyallii).

Fellfields and similar communities are typified by variable species assemblages and co-dominance of multiple species, including any of the previously mentioned species, especially the sedges, as well as golden fleabane (Erigeron aureus), Lobb's lupine (Lupinus sellulus var. lobbii), spreading phlox (Phlox diffusa), eight-petal mountain-avens (Dryas octopetala), louseworts (Pedicularis contorta, P. ornithorhyncha) and many others. Snowbed forb communities are dominated by Tolmie's saxifrage (Saxifraga tolmiei), Shasta buckwheat (Eriogonum pyrolifolium), or Piper's woodrush (Luzula piperi).

Other Classifications and Key References. This habitat is equivalent to the alpine communities and the subalpine Festuca communities of Franklin and Dyrness [88]. It is also referred to as Alpine meadows and barren No. 52 [136]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are subalpine grassland and alpine fell-snowfields; represented by non-forest in the alpine/parkland zone of Washington GAP [37]. Other references describe this habitat [61, 65, 75, 80, 94, 105, 112, 123, 139, 195, 207].

Natural Disturbance Regime. Most natural disturbances seem to be small scale in their effects or very infrequent. Herbivory and associated trampling disturbance by elk, mountain goats, and occasionally bighorn sheep seems to be an important disturbance in some areas, creating patches of open ground, though the current distribution and abundance of these ungulates is in part a result of introductions. Small mammals can also have significant effects on vegetation: e.g., the heather vole occasionally overgrazes

heather communities [80]. Frost heaving is a climatically related small-scale disturbance that is extremely important in structuring the vegetation [80]. Extreme variation from the norm in snow pack depth and duration can act as a disturbance, exposing plants to winter dessication [80], shortening the growing season, or facilitating summer drought. Subalpine grasslands probably burn on occasion and can be formed or expanded in area by fires in subalpine parkland [139].

Succession and Stand Dynamics. Little is known about vegetation changes in these communities, in part because changes are relatively slow. Tree invasion rates into subalpine grasslands are relatively slow compared to other subalpine communities [139]. Seedling establishment for many plant species in the alpine zone is poor. Heath communities take about 200 years to mature after initial establishment and may occupy the same site for thousands of years [139].

Effects of Management and Anthropogenic Impacts. The major human impacts on this habitat are trampling and associated recreational impacts, e.g., tent sites. Resistance and resilience of vegetation to impacts varies by life form [48]. Sedge turfs are perhaps most resilient to trampling and heaths are least resilient. Trampling to the point of significantly opening an alpine heath canopy will initiate a degradation and erosion phase that results in continuous bare ground, largely unsuitable for vascular plant growth [80]. Bare ground in the alpine zone left alone after recreational disturbance will typically not revegetate in a time frame that humans can appreciate. Introduction of exotic ungulates can have noticeable impacts (e.g., mountain goats in the Olympic Mountains). Domestic sheep grazing has also had dramatic impacts [196], especially in the bunchgrass habitats east of the Cascades.

Status and Trends. This habitat is naturally very limited in extent in the region. There has been little to no change in abundance over the last 150 years. Most of this habitat is still in good condition and dominated by native species. Some areas east of the Cascade Crest have been degraded by livestock use. Recreational impacts are noticeable in some national parks and wilderness areas. Current trends seem to be largely stable, though there may be some slow loss of subalpine grassland to recent tree invasion. Threats include increasing recreational pressures, continued grazing at some sites, and, possibly, global climate change resulting in expansion of trees into this habitat. Only 1 out of 40 plant associations listed in the National Vegetation Classification is considered imperiled[10].

Western Juniper and Mountain Mahogany Woodlands
Rex. C. Crawford and Jimmy Kagan

Geographic Distribution. This habitat is distributed from the Pacific Northwest south into southern California and east to western Montana and Utah, where it often occurs with pinyon-juniper habitat. In Oregon and Washington, this dry woodland habitat appears primarily in the Owyhee Uplands, High Lava Plains, and northern Basin and Range ecoregions. Secondarily, it develops in the foothills of the Blue Mountains and East Cascades ecoregions, and seems to be expanding into the southern Columbia Basin ecoregion, where it was naturally found in outlier stands.

Western juniper woodlands with shrubsteppe species appear throughout the range of the habitat primarily in central and southern Oregon. Many isolated mahogany communities occur throughout canyons and mountains of eastern Oregon. Juniper-mountain mahogany communities are found in the Ochoco and Blue Mountains.

Physical Setting. This habitat is widespread and variable, occurring in basins and canyons, and on slopes and valley margins in the southern Columbia Plateau, and on fire-protected sites in the northern Basin and Range province. It may be found on benches and foothills. Western juniper and/or mountain mahogany woodlands are often found on shallow soils, on flats at mid- to high elevations, usually on basalts. Other sites range from deep, loess soils and sandy slopes to very stony canyon slopes. At lower elevations, or in areas outside of shrubsteppe, this habitat occurs on slopes and in areas with shallow soils. Mountain mahogany can occur on steep rimrock slopes, usually in areas of shallow soils or protected slopes. This habitat can be found at elevations of 1,500- 8,000 ft (457-2,438 m), mostly from 4,000 to 6,000 ft (1,220-1,830 m). Average annual precipitation ranges from approximately 10 to 13 inches (25 to 33 cm), with most occurring as winter snow.

Landscape Setting. This habitat reflects a transition between Ponderosa Pine Forest and Woodlands and Shrubsteppe, Eastside Grasslands, and rarely Desert Playa and Salt Desert Scrub habitats. Western juniper generally occurs on higher topography, whereas the shrub communities are more common in depressions or steep slopes with bunchgrass undergrowth. In the Great Basin, mountain mahogany may form a distinct belt on mountain slopes and ridgetops above pinyon-juniper woodland. Mountain-mahogany can occur in isolated, pure patches that are often very dense. The primary land use is livestock grazing.

Structure. This habitat is made up of savannas, woodlands, or open forests with 10-60 percent canopy cover. The tallest layer is composed of short (6.6-40 ft [2-12 m] tall) evergreen trees. Dominant plants may assume a tall-shrub growth form on some sites. The short trees appear in a mosaic pattern with areas of low or medium-tall (usually evergreen) shrubs alternating with areas of tree layers and widely spaced low or medium-tall shrubs. The herbaceous layer is usually composed of short or medium tall bunchgrass or, rarely, a rhizomatous grass-forb undergrowth. These vegetated areas can be interspersed with rimrock or scree. A well-developed cryptogam layer often covers the ground, although bare rock can make up much of the ground cover.

Composition. Western juniper and/or mountain mahogany dominate these woodlands either with bunchgrass or shrubsteppe undergrowth. Western juniper (Juniperus occidentalis) is the most common dominant tree in these woodlands. Part of this habitat will have curl-leaf mountain mahogany

(Cercocarpus ledifolius) as the only dominant tall shrub or small tree. Mahogany may be co-dominant with western juniper. Ponderosa pine (Pinus ponderosa) can grow in this habitat and in some rare instances may be an important part of the canopy.

The most common shrubs in this habitat are basin, Wyoming, or mountain big sagebrush (Artemisia tridentata ssp. tridentata, ssp. wyomingensis, and ssp. vaseyana) and/or bitterbrush (Purshia tridentata). They usually provide significant cover in juniper stands. Low or stiff sagebrush (Artemisia arbuscula or A. rigida) are dominant dwarf shrubs in some juniper stands. Mountain big sagebrush appears most commonly with mountain mahogany and mountain mahogany mixed with juniper. Snowbank shrubland patches in mountain mahogany woodlands are composed of mountain big sagebrush with bitter cherry (Prunus emarginata), quaking aspen (Populus tremuloides), and serviceberry (Amelanchier alnifolia). Shorter shrubs such as mountain snowberry (Symphoricarpos oreophilus) or creeping Oregongrape (Mahonia repens) can be dominant in the undergrowth. Rabbitbrush (Chrysothamnus nauseosus and C. viscidiflorus) will increase with grazing.

Part of this woodland habitat lacks a shrub layer. Various native bunchgrasses dominate different aspects of this habitat. Sandberg bluegrass (Poa sandbergii), a short bunchgrass, is the dominant and most common grass throughout many juniper sites. Medium-tall bunchgrasses such as Idaho fescue (Festuca idahoensis), bluebunch wheatgrass (Pseudoroegneria spicata), needlegrasses (Stipa occidentalis, S. thurberiana, S. lemmonii), bottlebrush squirreltail (Elymus elymoides) can dominate undergrowth. Threadleaf sedge (Carex filifolia) and basin wildrye (Leymus cinereus) are found in lowlands and Geyer's and Ross' sedge (Carex geyeri, C. rossii), pinegrass (Calamagrostis rubescens), and blue wildrye (E. glaucus) appear on mountain foothills. Sandy sites typically have needle-and-thread (Stipa comata) and Indian ricegrass (Oryzopsis hymenoides). Cheatgrass (Bromus tectorum) or bulbous bluegrass (Poa bulbosa) often dominates overgrazed or disturbed sites. In good condition this habitat may have mosses growing under the trees.

Other Classifications and Key References. This habitat is also called Juniper Steppe Woodland [136]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are ponderosa pine-western juniper woodland, western juniper woodland, and mountain mahogany shrubland. Other references describe this habitat [64, 79, 122, 207].

Natural Disturbance Regime. Both mountain mahogany and western juniper are fire intolerant. Under natural high-frequency fire regimes both species formed savannas or occurred as isolated patches on fire-resistant sites in shrubsteppe or steppe habitat. Western juniper is considered a topoedaphic climax tree in a number of sagebrush-grassland, shrubsteppe, and drier conifer sites. It is an increaser in many earlier seral communities in these zones and invades without fires. Most trees >13 ft (4 m) tall can survive low-intensity fires. The historic fire regime of mountain mahogany communities varies with community type and structure. The fire-return interval for mountain mahogany (along the Salmon River in Idaho) was 13-22 years until the early 1900's and has increased ever since. Mountain mahogany can live to 1,350 years in western and central Nevada. Some old-growth mountain mahogany stands avoid fire by growing on extremely rocky sites.

Succession and Stand Dynamics. Juniper invades shrubsteppe and steppe and reduces undergrowth productivity. Although slow seed dispersal delays recovery time, western juniper can regain dominance in 30-50 years following fire. A fire-return interval of 30-50 years typically arrests juniper invasion. The successional role of curl-leaf mountain mahogany

varies with community type. Mountain brush communities where curl-leaf mountain mahogany is either dominant or co-dominant are generally stable and successional rates are slow.

Effects of Management and Anthropogenic Impacts. Over the past 150 years, with fire suppression, overgrazing, and changing climatic factors, western juniper has increased its range into adjacent shrubsteppe, grasslands, and savannas. Increased density of juniper and reduced fine fuels from an interaction of grazing and shading result in high severity fires that eliminate woody plants and promote herbaceous cover, primarily annual grasses. Diverse mosses and lichens occur on the ground in this type if it has not been too disturbed by grazing. Excessive grazing will decrease bunchgrasses and increase exotic annual grasses plus various native and exotic forbs. Animals seeking shade under trees decrease or eliminate bunchgrasses and contribute to increasing cheatgrass cover.

Status and Trends. This habitat is dominated by fire-sensitive species, and therefore, the range of western juniper and mountain mahogany has expanded because of an interaction of livestock grazing and fire suppression. Quigley and Arbelbide [181] concluded that in the Inland Pacific Northwest, Juniper/Sagebrush, Juniper Woodlands, and Mountain Mahogany cover types now are significantly greater in extent than before 1900. Although it covers more area, this habitat is generally in degraded condition because of increased exotic plants and decreased native bunchgrasses. One third of Pacific Northwest juniper and mountain mahogany community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

Eastside (Interior) Grasslands
Rex. C. Crawford and Jimmy Kagan

Geographic Distribution. This habitat is found primarily in the Columbia Basin of Idaho, Oregon, and Washington, at mid- to low elevations and on plateaus in the Blue Mountains, usually within the ponderosa pine zone in Oregon.

Idaho fescue grassland habitats were formerly widespread in the Palouse region of southeastern Washington and adjacent Idaho; most of this habitat has been converted to agriculture. Idaho fescue grasslands still occur in isolated, moist sites near lower treeline in the foothills of the Blue Mountains, the Northern Rockies, and east Cascades near the Columbia River Gorge. Bluebunch wheatgrass grassland habitats are common throughout the Columbia Basin, both as modified native grasslands in deep canyons and the dry Palouse and as fire-induced representatives in the shrubsteppe. Similar grasslands appear on the High Lava Plains ecoregion, where they occur in a matrix with big sagebrush or juniper woodlands. In Oregon they are also found in burned shrubsteppe and canyons in the Basin and Range and Owyhee Uplands. Sand dropseed and three-awn needlegrass grassland habitats are restricted to river terraces in the Columbia Basin, Blue Mountains, and Owyhee Uplands of Oregon and Washington. Primary location of this habitat extends along the Snake River from Lewiston south to the Owyhee River.

Physical Setting. This habitat develops in hot, dry climates in the Pacific Northwest. Annual precipitation totals 8-20 inches (20-51 cm); only 10 percent falls in the hottest months, July through September. Snow accumulation is low (1-6 inches [3-15 cm]) and occurs only in January and February in eastern portions of its range and November through March in the west. More snow accumulates in grasslands within the forest matrix. Soils are

variable: (1) highly productive loess soils up to 51 inches (130 cm) deep, (2) rocky flats, (3) steep slopes, and (4) sandy, gravel or cobble soils. An important variant of this habitat occurs on sandy, gravelly, or silty river terraces or seasonally exposed river gravel or Spokane flood deposits. The grassland habitat is typically upland vegetation but it may also include riparian bottomlands dominated by non-native grasses. This habitat is found from 500 to 6,000 ft (152-1,830 m) in elevation.

Landscape Setting. Eastside grassland habitats appear well below and in a matrix with lower treeline Ponderosa Pine Forests and Woodlands or Western Juniper and Mountain Mahogany Woodlands. It can also be part of the lower elevation forest matrix. Most grassland habitat occurs in 2 distinct large landscapes: plateau and canyon grasslands. Several rivers flow through narrow basalt canyons below plateaus supporting prairies or shrubsteppe. The canyons can be some 2,132 ft (650 m) deep below the plateau. The plateau above is composed of gentle slopes with deep silty loess soils in an expansive rolling dune-like landscape. Grasslands may occur in a patchwork with shallow soil scablands or within biscuit scablands or mounded topography. Naturally occurring grasslands are beyond the range of bitterbrush and sagebrush species. This habitat exists today in the shrubsteppe landscape where grasslands are created by brush removal, chaining or spraying, or by fire. Agricultural uses and introduced perennial plants on abandoned or planted fields are common throughout the current distribution of eastside grassland habitats.

Structure. This habitat is dominated by short to medium-tall grasses (<3.3 ft [1 m]). Total herbaceous cover can be closed to only sparsely vegetated. In general, this habitat is an open and irregular arrangement of grass clumps rather than a continuous sod cover. These medium-tall grasslands often have scattered and diverse patches of low shrubs, but few or no medium-tall shrubs (<10 percent cover of shrubs are taller than the grass layer). Native forbs may contribute significant cover or they may be absent. Grasslands in canyons are

dominated by bunchgrasses growing in lower densities than on deep-soil prairie sites. The soil surface between perennial plants can be covered with a diverse cryptogamic or microbiotic layer of mosses, lichens, and various soil bacteria and algae. Moister environments can support a dense sod of rhizomatous perennial grasses. Annual plants are a common spring and early summer feature of this habitat.

Composition. Bluebunch wheatgrass (Pseudoroegneria spicata) and Idaho fescue (Festuca idahoensis) are the characteristic native bunchgrasses of this habitat and either or both can be dominant. Idaho fescue is common in more moist areas and bluebunch wheatgrass more abundant in drier areas. Rough fescue (F. campestris) is a characteristic dominant on moist sites in northeastern Washington. Sand dropseed (Sporobolus cryptandrus) or three-awn (Aristida longiseta) are native dominant grasses on hot dry sites in deep canyons. Sandberg bluegrass (Poa sandbergii) is usually present, and occasionally codominant in drier areas. Bottlebrush squirreltail (Elymus elymoides) and Thurber needlegrass (Stipa thurberiana) can be locally dominant. Annual grasses are usually present; cheatgrass (Bromus tectorum) is the most widespread. In addition, medusahead (Taeniatherum caput-medusae), and other annual bromes (Bromus commutatus, B. mollis, B. japonicus) may be present to co-dominant. Moist environments, including riparian bottomlands, are often co-dominated by Kentucky bluegrass (Poa pratensis).

A dense and diverse forb layer can be present or entirely absent; >40 species of native forbs can grow in this habitat including balsamroots (Balsamorhiza spp.), biscuitroots (Lomatium spp.), buckwheat (Eriogonum spp.), fleabane (Erigeron spp.), lupines (Lupinus spp.), and milkvetches (Astragalus spp.). Common exotic forbs that can grow in this habitat are knapweeds (Centaurea solstitialis, C. diffusa, C. maculosa), tall tumblemustard (Sisymbrium altissimum), and Russian thistle (Salsola kali).

Smooth sumac (Rhus glabra) is a deciduous shrub

locally found in combination with these grassland species. Rabbitbrushes (Chrysothamnus nauseosus, C. viscidiflorus) can occur in this habitat in small amounts, especially where grazed by livestock. In moist Palouse regions, common snowberry (Symphoricarpos albus) or Nootka rose (Rosa nutkana) may be present, but is shorter than the bunchgrasses. Dry sites contain low succulent pricklypear (Opuntia polyacantha). Big sagebrush (Artemisia tridentata) is occasional and may be increasing in grasslands on former shrubsteppe sites. Black hawthorn (Crataegus douglasii) and other tall shrubs can form dense thickets near Idaho fescue grasslands. Rarely, ponderosa pine (Pinus ponderosa) or western juniper (Juniperus occidentalis) can occur as isolated trees.

Other Classifications and Key References. This habitat is called Palouse Prairie, Pacific Northwest grassland, steppe vegetation, or bunchgrass prairie in general ecological literature. Quigley and Arbelbide [181] called this habitat Fescue-Bunchgrass and Wheatgrass Bunchgrass and the dry Grass cover type. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are northeast Oregon canyon grassland, forest-grassland mosaic, and modified grassland; Washington GAP [37] types 13, 21, 22, 24, 29-31, 82, and 99 map this habitat. Kuchler [136] includes this within Fescue-wheatgrass and wheatgrass-bluegrass. Franklin and Dyrness [88] include this habitat in steppe zones of Washington and Oregon. Other references describe this habitat [28, 60, 159, 166, 206, 207].

Natural Disturbance Regime. The fire-return interval for sagebrush and bunchgrass is estimated at 25 years [22]. The native bunchgrass habitat apparently lacked extensive herds of large grazing and browsing animals until the late 1800's. Burrowing animals and their predators likely played important roles in creating small-scale patch patterns.

Succession and Stand Dynamics. Currently fires burn less frequently in the Palouse grasslands than historically because of fire suppression, roads, and conversions to cropland [159]. Without fire, black hawthorn shrubland patches expand on slopes along with common snowberry and rose. Fires covering large areas of shrubsteppe habitat can eliminate shrubs and their seed sources and create eastside grassland habitat. Fires that follow heavy grazing or repeated early season fires can result in annual grasslands of cheatgrass, medusahead, knapweed, or yellow star-thistle. Annual exotic grasslands are common in dry grasslands and are included in modified grasslands as part of the Agriculture habitat.

Effects of Management and Anthropogenic Impacts. Large expanses of grasslands are currently used for livestock ranching. Deep soil Palouse sites are mostly converted to agriculture. Drier grasslands and canyon grasslands, those with shallower soils, steeper topography, or hotter, drier environments, were more intensively grazed and for longer periods than were deep-soil grasslands [207]. Evidently, these drier native bunchgrass grasslands changed

irreversibly to persistent annual grass and forblands. Some annual grassland, native bunchgrass, and shrubsteppe habitats were converted to intermediate wheatgrass, or more commonly, crested wheatgrass (Agropyron cristatum)-dominated areas. Apparently, these form persistent grasslands and are included as modified grasslands in the Agriculture habitat. With intense livestock use, some riparian bottomlands become dominated by non-native grasses. Many native dropseed grasslands have been submerged by dam reservoirs.

Status and Trends. Most of the Palouse prairie of southeastern Washington and adjacent Idaho and Oregon has been converted to agriculture. Remnants still occur in the foothills of the Blue Mountains and in isolated, moist Columbia Basin sites. The Palouse is one of the most endangered ecosystems in the U.S. [166] with only 1 percent of the original habitat remaining; it is highly fragmented with most sites <10 acres. All these areas are subject to weed invasions and drift of aerial biocides. Since 1900, 94 percent of the Palouse grasslands have been converted to crop, hay, or pasture lands. Quigley and Arbelbide [181] concluded that Fescue-Bunchgrass and Wheatgrass bunchgrass cover types have significantly decreased in area since pre-1900, while exotic forbs and annual grasses have significantly increased since pre-1900. Fifty percent of the plant associations recognized as components of eastside grassland habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

Shrubsteppe
Rex. C. Crawford and Jimmy Kagan

Geographic Distribution. Shrubsteppe habitats are common across the Columbia Plateau of Washington, Oregon, Idaho, and adjacent Wyoming, Utah, and Nevada. It extends up into the cold, dry environments of surrounding mountains.

Basin big sagebrush shrubsteppe occurs along stream channels, in valley bottoms and flats throughout eastern Oregon and Washington. Wyoming sagebrush shrubsteppe is the most widespread habitat in eastern Oregon and Washington, occurring throughout the Columbia Plateau and the northern Great Basin. Mountain big sagebrush shrubsteppe habitat occurs throughout the mountains of the eastern Oregon and Washington. Bitterbrush shrubsteppe habitat appears primarily along the eastern slope of the Cascades, from north-central Washington to California and occasionally in the Blue Mountains. Three-tip sagebrush shrubsteppe occurs mostly along the northern and western Columbia Basin in Washington and occasionally appears in the lower valleys of the Blue Mountains and in the Owyhee Upland ecoregions of Oregon. Interior shrub dunes and sandy steppe and shrubsteppe habitat is concentrated at low elevations near the Columbia River and in isolated pockets in the Northern Basin and Range and Owyhee Uplands. Bolander silver sagebrush shrubsteppe is common in southeastern Oregon. Mountain silver sagebrush is more prevalent in the Oregon East Cascades and in montane meadows in the southern Ochoco and Blue Mountains.

Physical Setting. Generally, this habitat is associated with dry, hot environments in the Pacific Northwest although variants are in cool, moist areas with some snow accumulation in climatically dry mountains. Elevation range is wide (300-9,000 ft [91-2,743 m]) with most habitat occurring between 2,000 and 6,000 ft (610-1,830 m). Habitat occurs on deep alluvial, loess, silty or sandy-silty soils, stony flats, ridges, mountain slopes, and slopes of lake beds with ash or pumice soils.

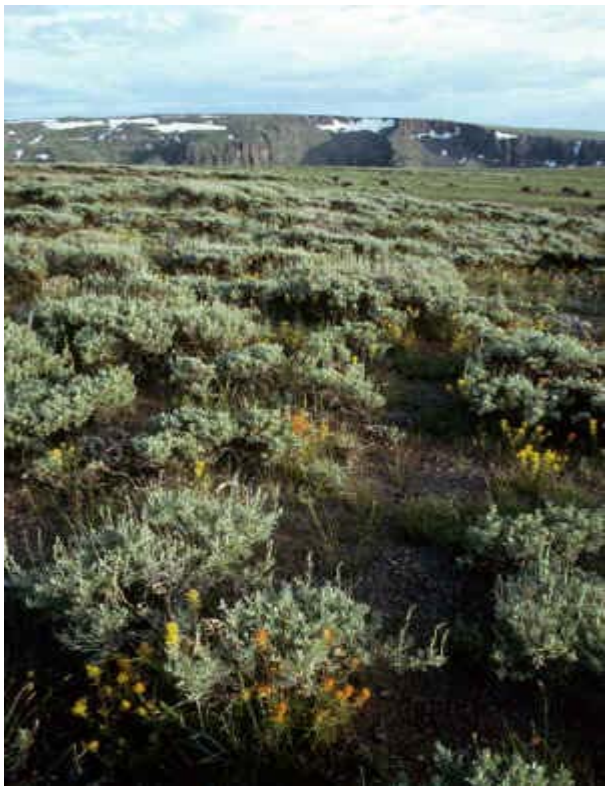
Landscape Setting. Shrubsteppe habitat defines a biogeographic region and is the major vegetation on average sites in the Columbia Plateau, usually below Ponderosa Pine Forest and Woodlands, and Western Juniper and Mountain Mahogany Woodlands habitats. It forms mosaic landscapes with these woodland habitats and Eastside Grasslands, Dwarf Shrubsteppe, and Desert Playa and Salt Scrub habitats. Mountain sagebrush shrubsteppe occurs at high elevations occasionally within the dry Eastside Mixed Conifer Forest and Montane Mixed Conifer Forest habitats. Shrubsteppe habitat can appear in large landscape patches. Livestock grazing is the primary land use in the shrubsteppe although much has been converted to irrigation or dry land agriculture. Large areas occur in military training areas and wildlife refuges.

Structure. This habitat is a shrub savanna or shrubland with shrub coverage of 10-60 percent. In an undisturbed condition, shrub cover varies between 10 and 30 percent. Shrubs are generally evergreen although deciduous shrubs are prominent in many habitats. Shrub height typically is medium-

tall (1.6-3.3 ft [0.5-1.0 m]) although some sites support shrubs approaching 9 ft (2.7 m) tall. Vegetation structure in this habitat is characteristically an open shrub layer over a moderately open to closed bunchgrass layer. The more northern or productive sites generally have a denser grass layer and sparser shrub layer than southern or more xeric sites. In fact, the rare good-condition site is better characterized as grassland with shrubs than a shrubland. The bunchgrass layer may contain a variety of forbs. Good-condition habitat has very little exposed bare ground, and has mosses and lichens carpeting the area between taller plants. However, heavily grazed sites have dense shrubs making up >40 percent cover, with introduced annual grasses and little or no moss or lichen cover. Moist sites may support tall bunchgrasses (>3.3 ft [1 m]) or rhizomatous grasses. More southern shrubsteppe may have native low shrubs dominating with bunchgrasses.

Composition. Characteristic and dominant mid-tall shrubs in the shrubsteppe habitat include all 3 subspecies of big sagebrush, basin (Artemisia tridentata ssp. tridentata), Wyoming (A. t. ssp. wyomingensis) or mountain (A. t. ssp. vaseyana), antelope bitterbrush (Purshia tridentata), and 2 shorter sagebrushes, silver (A. cana) and three-tip (A. tripartita). Each of these species can be the only shrub or appear in complex seral conditions with other shrubs. Common shrub complexes are bitterbrush and Wyoming big sagebrush, bitterbrush and three-tip sagebrush, Wyoming big sagebrush and three-tip sagebrush, and mountain big sagebrush and silver sagebrush. Wyoming and mountain big sagebrush can codominate areas with tobacco brush (Ceanothus velutinus). Rabbitbrush (Chrysothamnus viscidiflorus) and short-spine horsebrush (Tetradymia spinosa) are common associates and often dominate sites after disturbance. Big sagebrush occurs with the shorter stiff sagebrush (A. rigida) or low sagebrush (A. arbuscula) on shallow soils or high elevation sites. Many sandy areas are shrub-free or are open to patchy shrublands of bitterbrush and/or rabbitbrush. Silver sagebrush is the dominant and characteristic shrub along the edges of stream courses, moist meadows, and ponds. Silver sagebrush and rabbitbrush are associates in disturbed areas.

When this habitat is in good or better ecological condition a bunchgrass steppe layer is characteristic. Diagnostic native bunchgrasses that often dominate different shrubsteppe habitats are (1) mid-grasses: bluebunch wheatgrass (Pseudoroegneria spicata), Idaho fescue (Festuca idahoensis), bottlebrush squirreltail (Elymus elymoides), and Thurber needlegrass (Stipa thurberiana); (2) short grasses: threadleaf sedge (Carex filifolia) and Sandberg bluegrass (Poa sandbergii); and (3) the tall grass, basin wildrye (Leymus cinereus). Idaho fescue is characteristic of the most productive shrubsteppe vegetation. Bluebunch wheatgrass is co-dominant at xeric locations, whereas western needlegrass (Stipa occidentalis), long-stolon (Carex inops) or Geyer's sedge (C. geyeri) increase in abundance in higher elevation shrubsteppe habitats. Needle-and-thread (Stipa comata) is the characteristic native bunchgrass on stabilized sandy soils. Indian ricegrass (Oryzopsis hymenoides) characterizes dunes. Grass layers on montane sites contain



slender wheatgrass (Elymus trachycaulus), mountain fescue (F. brachyphylla), green fescue (F. viridula), Geyer's sedge, or tall bluegrasses (Poa spp.). Bottlebrush squirreltail can be locally important in the Columbia Basin, sand dropseed (Sporobolus cryptandrus) is important in the Basin and Range and basin wildrye is common in the more alkaline areas. Nevada bluegrass (Poa secunda), Richardson muhly (Muhlenbergia richardsonis), or alkali grass (Puccinella spp.) can dominate silver sagebrush flats. Many sites support non-native plants, primarily cheatgrass (Bromus tectorum) or crested wheatgrass (Agropyron cristatum) with or without native grasses. Shrubsteppe habitat, depending on site potential and disturbance history, can be rich in forbs or have little forb cover. Trees may be present in some shrubsteppe habitats, usually as isolated individuals from adjacent forest or woodland habitats.

Other Classifications and Key References. This habitat is called Sagebrush steppe and Great Basin sagebrush by Kuchler [136]. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are big sagebrush shrubland, sagebrush steppe, and bitterbrush-big sagebrush shrubland. Franklin and Dyrness [88] discussed this habitat in shrubsteppe zones of Washington and Oregon. Other references describe this habitat [60, 116, 122, 123, 212, 224, 225].

Natural Disturbance Regime. Barrett *et al.* [22] concluded that the fire-return interval for this habitat is 25 years. The native shrubsteppe habitat apparently lacked extensive herds of large grazing and browsing animals until the late 1800's. Burrowing animals and their predators likely played important roles in creating small-scale patch patterns.

Succession and Stand Dynamics. With disturbance, mature stands of big sagebrush are reinvaded through soil-stored or windborne seeds. Invasion can be slow because sagebrush is not disseminated over long distances. Site dominance by big sagebrush usually takes a decade or more depending on fire severity and season, seed rain, post-fire moisture, and plant competition. Three-tip sagebrush is a climax species that reestablishes (from seeds or commonly from sprouts) within 5-10 years following a disturbance. Certain disturbance regimes promote three-tip sagebrush and it can out-compete herbaceous species. Bitterbrush is a climax species that plays a seral role colonizing by seed onto rocky and/or pumice soils. Bitterbrush may be declining and may be replaced by woodlands in the absence of fire. Silver sagebrush is a climax species that establishes during early seral stages and coexists with later arriving species. Big sagebrush, rabbitbrush, and short-spine horsebrush invade and can form dense stands after fire or livestock grazing. Frequent or high-intensity fire can create a patchy shrub cover or can eliminate shrub cover and create Eastside Grasslands habitat.

Effects of Management and Anthropogenic Impacts. Shrub density and annual cover increase, whereas bunchgrass density decreases with livestock use. Repeated or intense disturbance, particularly on drier sites, leads to cheatgrass dominance and replacement of native bunchgrasses. Dry and sandy soils are sensitive to grazing, with needle-and-thread replaced by cheatgrass at most sites. These disturbed sites can be converted to modified grasslands in the Agriculture habitat.

Status and Trends. Shrubsteppe habitat still dominates most of southeastern Oregon although half of its original distribution in the Columbia Basin has been converted to agriculture. Alteration of fire regimes, fragmentation, livestock grazing, and the addition of >800 exotic plant species have changed the character of shrubsteppe habitat. Quigley and Arbelbide [181] concluded that Big Sagebrush and Mountain Sagebrush cover types are significantly smaller in area than before 1900, and that Bitterbrush/Bluebunch Wheatgrass cover type is similar to the pre-1900 extent. They concluded that Basin Big Sagebrush and Big sagebrush-Warm potential vegetation type's successional pathways are altered, that some pathways of Antelope Bitterbrush are altered and that most pathways for Big Sagebrush-Cool are unaltered. Overall this habitat has seen an increase in exotic plant importance and a decrease in native bunchgrasses. More than half of the Pacific Northwest shrubsteppe habitat community types listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

Agriculture, Pasture and Mixed Environs
W. Daniel Edge, Rex C. Crawford, and David H. Johnson

Geographic Distribution. Agricultural habitat is widely distributed at low to mid-elevations (<6,000 ft [1,830 m]) throughout both states. This habitat is most abundant in broad river valleys throughout both states and on gentle rolling terrain east of the Cascades.

Physical Setting. This habitat is maintained across a range of climatic conditions typical of both states. Climate constrains agricultural production at upper elevations where there are <90 frost-free days. Agricultural habitat in arid regions east of the Cascades with <10 inches (25 cm) of rainfall require supplemental irrigation or fallow fields for 1-2 years to accumulate sufficient soil moisture. Soils types are variable, but usually have a well developed A horizon. This habitat is found from 0 to 6,000 ft (0 to 1,830 m) elevation.

Landscape Setting. Agricultural habitat occurs within a matrix of other habitat types at low to mid-elevations, including Eastside grasslands, Shrubsteppe, Westside Lowlands Conifer-Deciduous Forest and other low to mid-elevation forest and woodland habitats. This habitat often dominates the landscape in flat or gently rolling terrain, on well-developed soils, broad river valleys, and areas with access to abundant irrigation water. Unlike other habitat types, agricultural habitat is often characterized by regular landscape patterns (squares, rectangles, and circles) and straight borders because of ownership boundaries and multiple crops within a region. Edges can be abrupt along the habitat borders within agricultural habitat and with other adjacent habitats.

Structure. This habitat is structurally diverse because it includes several cover types ranging from low-stature annual grasses and row crops (<3.3 ft [1 m]) to mature orchards (>66 ft [20 m]). However, within any cover type, structural diversity is typically low because usually only 1 to a few species of similar height are cultivated. Depending on management intensity or cultivation method, agricultural habitat may vary substantially in structure annually; cultivated cropland and modified grasslands are typified by periods of bare soil and harvest whereas pastures are mowed, hayed, or grazed 1 or more times during the growing season. Structural diversity of agricultural habitat is increased at local scales by the presences of non-cultivated or less intensively managed vegetation such as fencerows, roadsides, field borders, and shelterbelts.

Composition. Agricultural habitat varies substantially in composition among the cover types it includes. Cultivated cropland includes >50 species of annual and perennial plants in Oregon and Washington, and hundreds of varieties ranging from vegetables such as carrots, onions, and peas to annual grains such as wheat, oats, barley, and rye. Row crops of vegetables and herbs are characterized by bare soil, plants, and plant debris along bottomland areas of streams and rivers and areas having sufficient water for

irrigation. Annual grains, such as barley, oats, and wheat are typically produced in almost continuous stands of vegetation on upland and rolling hill terrain without irrigation.

The orchard/vineyard/nursery cover type is composed of fruit and nut (apples, peaches, pears, and hazelnuts) trees, vineyards (grapes, Kiwi), berries (strawberries, blueberries, blackberries, and raspberries), Christmas trees, and nursery operations (ornamental container and greenhouses). This cover type is generally located on upland sites with access to abundant irrigation. Cultivation for most orchards, vineyards and Christmas tree farms includes an undergrowth of short-stature perennial grasses between the rows of trees, vines, or bushes. Christmas trees are typically produced without irrigation on upland sites with poorer soils.

Improved pastures are used to produce perennial herbaceous plants for grass seed and hay. Alfalfa and several species of fescue (Festuca spp.) and bluegrass (Poa spp.), orchardgrass (Dactylis glomerata), and timothy (Phleum pratensis) are commonly seeded in improved pastures. Grass seed fields are single-species stands, whereas pastures maintained for haying are typically composed of 2 to several species. The improved pasture cover type is one of the most common agricultural uses in both states and produced with and without irrigation.

Unimproved pastures are predominately grassland sites, often abandoned fields that have little or no active management such as irrigation, fertilization, or herbicide applications. These sites may or may not be grazed by livestock. Unimproved pastures include rangelands planted to exotic grasses that are found on private land, state wildlife areas, federal wildlife refuges and U.S. Department of Agriculture Conservation Reserve Program (CRP) sites. Grasses commonly planted on CRP sites are crested wheatgrass (Agropyron cristatum), tall fescue (F.

arundinacea), perennial bromes (Bromus spp.) and wheatgrasses (Elytrigia spp.). Intensively grazed rangelands, which have been seeded to intermediate wheatgrass (Elytrigia intermedia), crested wheatgrass, or are dominated by increaser exotics such as Kentucky wheatgrass (Poa pratensis) or tall oatgrass (Arrhenatherum elatius) are unimproved pastures. Other unimproved pastures have been cleared and intensively farmed in the past, but are allowed to convert to other vegetation. These sites may be composed of uncut hay, litter from previous seasons, standing dead grass and herbaceous material, invasive exotic plants (tansy ragwort [Senecio jacobea], thistle [Cirsium spp.], Himalaya blackberry [Rubus discolor], and Scot's broom [Cytisus scoparius]) with patches of native black hawthorn (Crataegus douglasii), snowberry (Symphoricarpos spp.), spirea (Spirea spp.), poison oak (Toxicodendron diversilobum), and encroachment of various tree species, depending on seed source and environment.

Modified grasslands are generally overgrazed habitats that formerly were native grasslands or shrubsteppe but are now dominated by annual plants with only remnant individual plants of the native vegetation. Cheatgrass (Bromus tectorum), other annual bromes, medusahead (Taeniatherum caput-medusae), bulbous bluegrass (Poa bulbosa), and knapweeds (Centaurea spp.) are common increasers that form modified grasslands. Fire, following heavy grazing or repeated early season fires can create modified grassland monocultures of cheatgrass.

Agricultural habitat also contains scattered dwellings and outbuildings such as barns and silos, rural cemeteries, ditchbanks, windbreaks, and small inclusions of remnant native vegetation. These sites typically have a discontinuous tree layer or 1 to a few trees over a ground cover similar to improved or unimproved pastures.

Other Classifications and Key References. Quigley and Arbelbide [181] referred to this as agricultural and exotic forbs-annual grasses cover types. Csuti *et al.* [58] referred to this habitat as agricultural. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Type [127] that would represent this type is agriculture. U.S. Department of Agriculture Conservation Reserve Program lands are included in this habitat.

Natural Disturbance Regime. Natural fires are almost totally suppressed in this habitat, except for unimproved pastures and modified grasslands, where fire-return intervals can resemble those of native grassland habitats. Fires are generally less frequent today than in the past, primarily because of fire suppression, construction of roads, and conversion of grass and forests to cropland [159]. Bottomland areas along streams and rivers are subject to periodic floods, which may remove or deposit large amounts of soil.

Succession and Stand Dynamics. Management practices disrupt natural succession and stand dynamics in most of the agricultural habitats. Abandoned eastside agricultural habitats may convert to other habitats, mostly grassland and shrub habitats from the surrounding native habitats. Some agricultural habitats that occur on highly

erodible soils, especially east of the Cascades, have been enrolled in the U.S. Department of Agriculture Conservation Reserve Program. In the absence of fire or mowing, west side unimproved pastures have increasing amounts of hawthorn, snowberry, rose (Rosa spp.), Himalaya blackberry, spirea, Scot's broom, and poison oak. Douglas-fir or other trees can be primary invaders in some environments.

E**ffects of Management and Anthropogenic Impacts.** The dominant characteristic of agricultural habitat is a regular pattern of management and vegetation disturbance. With the exception of the unimproved pasture cover type, most areas classified as agricultural habitat receive regular inputs of fertilizer and pesticides and have some form of vegetation harvest and manipulation. Management practices in cultivated cropland include different tillage systems, resulting in vegetation residues during the non-growing season that range from bare soil to 100 percent litter. Cultivation of some crops, especially in the arid eastern portions of both states, may require the land to remain fallow for 1-2 growing seasons in order to store sufficient soil moisture to grow another crop. Harvest in cultivated cropland, Christmas tree plantations, and nurseries, and mowing or haying in improved pasture cover types substantially change the structure of vegetation. Harvest in orchards and vineyards are typically less intrusive, but these crops as well as Christmas trees and some ornamental nurseries are regularly pruned. Improved pastures are often grazed after haying or during the non-growing season. Livestock grazing is the dominant use of unimproved pastures. All of these practices prevent agricultural areas from reverting to native vegetation. Excessive grazing in unimproved pastures may increase the prevalence of weedy or exotic species.

Status and Trends. Agricultural habitat has steadily increased in amount and size in both states since Eurasian settlement of the region. Conversion to agricultural habitat threatens several native habitat types [166]. The greatest conversion of native habitats to agricultural production occurred between 1950 and 1985, primarily as a function of U.S. agricultural policy [96]. Since the 1985 Farm Bill and the economic downturn of the early to mid 1980's, the amount of land in agricultural habitat has stabilized and begun to decline [164]. The 1985 and subsequent Farm Bills contained conservation provisions encouraging farmers to convert agricultural land to native habitats [96, 153]. Clean farming practices and single-product farms have become prevalent since the 1960's, resulting in larger farms and widespread removal of fencerows, field borders, roadsides, and shelterbelts [96, 153, 164]. In Oregon, land-use planning laws prevent or slow urban encroachment and subdivisions into areas zoned as agriculture. Washington's growth management is currently controlled by counties and agricultural land conversion to urban development is much less regulated.

Urban and Mixed Environs
Howard L. Ferguson

Geographic Distribution. Urban habitat occurs throughout Oregon and Washington. Most urban development is located west of the Cascades of both Oregon and Washington, with the exception of Spokane, Washington, which developed because of early railroad systems and connections to the East. However, urban growth is being felt in almost every small town throughout the Pacific Northwest.

Physical Setting. Urban development occurs in a variety of sites in the Pacific Northwest. It creates a physical setting unique to itself: temperatures are elevated and background lighting is increased; wind velocities are altered by the urban landscape, often reduced except around the tallest structures downtown, where high-velocity winds are funneled around the skyscrapers. Urban development often occurs in areas with little or no slope and frequently includes wetland habitats. Many of these wetlands have been filled in and eliminated. Today, ironically, many artificial "wetland" impoundments are being created for stormwater management, whose function is the same as the original wetland that was destroyed.

Landscape Setting. Urban development occurs within or adjacent to nearly every habitat type in Oregon and Washington, and often replaces habitats that are valuable for wildlife. The highest urban densities normally occur in lower elevations along natural or human-made transportation corridors, such as rivers, railroad lines, coastlines, or interstate highways. These areas often contain good soils with little or no slope and lush vegetation. Once level areas become crowded, growth continues along rivers or shores of lakes or oceans, and eventually up elevated sites with steep slopes or rocky outcrops. Because early settlers often modified the original landscape for agricultural purposes, many of our urban areas are surrounded by agricultural and grazing lands.

Structure. The original habitat is drastically altered in urban environments and is replaced by buildings, impermeable surfaces, bridges, dams, and planting of non-native species. Some human-made structures provide habitats similar to those of cavities, caves, fissures, cliffs, and ledges. With the onset of urban development, total crown cover and tree density are reduced to make way for the construction of buildings and associated infrastructure. Many structural features typical of the historical vegetation, such as snags, dead and downed wood, and brush piles, are often completely removed from the landscape. Understory vegetation may be completely absent, or if present, is diminutive and single-layered. Typically, 3 zones are characteristic of urban habitat.

High-density Zone. The high-density zone is the downtown area of the inner city. It also encompasses the heavy industrial and large commercial interests of the city in addition to high-density housing areas such as apartment buildings or high-rise condominiums. This zone has =60 percent of its total surface area covered by impervious surfaces. This zone has the smallest lot size, the tallest buildings, the least amount of total tree canopy cover, the lowest tree density, the highest percentage of exotics, the poorest understory and subcanopy, and the poorest vegetative structure [4a, 116a, 185a]. Human structures have replaced almost all vegetation [23b, 148a]. Road density is the highest of all zones. An example of road density can be seen from Washington's Growth Management Plan requiring Master Comprehensive Plans to set aside 20 percent of the identified urban growth area for roads and road rights-of-way. For example, Spokane's urban growth area is approximately 57,000 acres (23,077 ha); therefore >11,000 acres (4,453 ha) were set aside for road surfaces.

In the high-density zone, land-use practices have removed most of the native vegetation. Patch sizes of remaining natural areas often are so small that native interior species cannot be supported. Not only are

remaining patches of native vegetation typically disconnected, but also they are frequently missing the full complement of vertical strata [149]. Stream corridors become heavily impacted and discontinuous. Most, if not all, wetlands have been filled or removed. Large buildings dominate the landscape and determine the placement of vegetation in this zone [30a]. This zone has the most street tree strips or sidewalk trees, most of which are exotics. There is virtually no natural tree replacement, and new trees are planted only when old ones die or are removed. Replacement trees are chosen for their small root systems and are generally short in stature with small diameters. Ground cover in this zone, if not synthetic or impervious, is typically exotic grasses or exotic annuals, most of which are rarely allowed to go to seed. Snags, woody debris, rock piles, and any other natural structures are essentially nonexistent. There are few tree cavities because of cosmetic pruning, cavity filling, snag removal, and tree thinning [149].

Medium-density Zone. This zone, continuing out from the center of the continuum is the medium-density zone, composed of light industry mixed with high-density residential areas. Housing density of 3-6 single-family homes per acre (7-15 per ha) is typical. Compared with the high-density zone, this zone has more potential wildlife habitat. With 30-59 percent impervious soil cover, this zone has 41-70 percent of the ground available for plants. Road density is less than the high-density zone.

Vegetation in this mid-zone is typically composed of non-native plant species. Native plants, when present, represent only a limited range of the natural diversity for the area.
The shrub layer is typically clipped or minimal, even in heavily vegetated areas. Characteristic of this zone are manicured lawns, trimmed hedges, and topped trees. Lawns can be highly productive [82a, 97a]. Tree canopy is still discontinuous and consists of 1-2 levels, if present at all. Consequently, vertical vegetative diversity and total amount of understory are still low. Coarse and fine woody debris is minimal or absent; most snags and diseased live trees are still removed as hazards in this zone [119a, 119b].
Isolated wetlands, stream corridors, open spaces, and greenbelts are more frequently retained in this zone than in the high-density zone. However, remnant wetland and upland areas are often widely separated by urban development.

Low-density Zone. The low-density zone is the outer zone of the urban-rural continuum. This zone contains only 10-29 percent impervious ground cover and normally contains only single-family homes. It has more natural ground cover than artificial surfaces. Vegetation is denser and more abundant than in the previous two zones. Typical housing densities are 0.4-1.6 single-family homes per acre (1-4 per ha). Road density is lowest of all 3 zones and consists of many secondary and tertiary roads. Roads, fences, livestock paddocks, and pets are more abundant than in neighboring rural areas. With many animals and limited acreage, pasture conditions may be more overgrazed in this zone than in the rural zone; overgrazing can significantly affect shrub layers as well. Areas around home sites are often cleared for fire protection. Dogs are more likely to be loose and allowed to run free, increasing disturbance levels and wildlife harassment in this zone. Vegetable and flower gardens are widespread; fencing is prevalent.

Many wetlands remain and are less impacted. Water levels are more stable and peak flows are more typical of historical flows. Water tables are less impacted and vernal wetlands are more frequent; stream corridors are less impacted and more continuous.
Although this zone may have large areas of native vegetation and is generally the least impacted of all 3 zones; it still has been significantly altered by human activities and associated disturbances.

This zone has the most vertical and horizontal structure and diversity of any of the 3 urban zones [30a, 80a, 140a, 187a]. In forested areas, tree conditions are semi-natural, although stand characteristics vary from parcel to parcel. The tree canopy is more continuous and may include multiple levels. Patch sizes are large enough to support native interior species. Large blocks of native vegetation may still be found, and some of these may be connected to large areas of native undeveloped land. In this zone, snags, diseased trees, coarse and fine woody debris, brush piles, and rock piles are widespread. Structural diversity approaches historical levels. Non-native hedges are nearly nonexistent and the native shrub layer, except for small areas around houses, is relatively intact. Lawns are fewer, and native ground covers are more common than in the previous two zones.

Composition. Remnant isolated blocks of native vegetation may be found scattered throughout a town or city mixed with a multitude of introduced exotic vegetation. As urban development increases, these remnant native stands become fragmented and isolated. The dominant species in an urban setting may be exotic or native; for example, in Seattle, the dominant species in 1 area may be Douglas-fir (Pseudotsuga menziesii), whereas a few blocks away it may be the exotic silver maple (Acer saccharinum). Dominant species will not only vary from city to city but also within each city and within each of the 3 urban zones. Nowack [167] found that in the high-density urban zone, species richness is low, and in 1 case, 4 species made up almost 50 percent of the cover. In the same study, exotics made up 69 percent of the total species.

In urban and suburban areas, species richness is often increased because of the introduction of exotics. The juxtaposition of exotics interspersed with native vegetation produces a diverse mosaic with areas of extensive edge. Also, because of irrigation and the addition of fertilizers, the biomass in the urban communities is often increased [149]. Interest in the use of native plants for landscaping is rapidly expanding [135, 172], particularly in the more arid sites where drought-resistant natives are the only plants able to survive without water.

Across the U.S., urban tree cover ranges from 1 to 55 percent [167]. As expected, tree cover tends to be highest in cities developed in naturally forested areas with an average of 32 percent cover in forested areas, 28 percent in grasslands, and 10 percent in arid areas. Yakima, Washington, has an overall city tree cover of 18 percent, ranging from 10 percent to 12 percent in the industrial/commercial area to 23 percent in the low-density residential zone [167]. Remnant blocks of native vegetation or native trees left standing in yards and parks will compositionally be related to whatever native habitat was present on site prior to development. In the Puget Sound and Willamette Valley areas, Douglas-fir is a major constituent, whereas the Spokane area has a lot of ponderosa pine (Pinus ponderosa).

Other Classifications and Key References. Many attempts have been made to classify or describe the complex urban environment. The Washington GAP Analysis [37] classified urban environments as "developed" land cover using the same 3 zones as described above: (1) high density (>60 percent impervious surface); (2) medium density (30-60 percent impervious surface); and (3) low density (10-30 percent impervious surface). The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] represented this type as an urban class. Several other relevant studies characterizing the urban environment have been reported [182, 129, 34, 70, 151].

Natural Disturbance Regime. In many instances, natural disturbances are modified or prevented from occurring by humans over the landscape and this is particularly true of urban areas. However,

disturbances such as ice, wind, or firestorms still occur. The severity of these intermittent disturbances varies greatly in magnitude and their impact on the landscape varies accordingly. One of the differences between urban and non-urban landscapes is the lengthening of the disturbance cycles. Another is found in the aftermath of these disturbances. In urban areas, damaged trees are often entirely removed and if they are replaced, a shorter, smaller tree, often non-native, is selected. The natural fire disturbance interval is highly modified in the urban environment. Fire (mostly accidental or arson) still occurs, and is quickly suppressed. Another natural disturbance in many of our Pacific Northwest towns is flooding, which historically altered and rerouted many of our rivers and streams, and still scarifies fields and deposits soil on flood plains and potentially recharges local aquifers. Floods now are more frequent and more violent than in the past because of the many modifications made to our watersheds. Attempts to lessen flooding in urban areas often lead to channelization, paving, or diking of our waterways, most of which fail in their attempt to stem the flooding and usually result in increased flooding for the communities farther downstream.

Succession and Stand Dynamics. Due to anthropogenic influences found in the urban environment, succession differs in the urban area from that expected for a native stand. Rowntree [185] emphasized that urbanization is not in the same category as natural disturbance in affecting succession. He points out that urbanization is anthropogenic and acts to remove complete vegetation associations and creates new ones made of mixes of native residual vegetation and introduced vegetation. Much human effort in the city goes toward either completely removing native vegetation or sustaining or maintaining a specific vegetative type, e.g., lawns or hedges. Much of the vegetative community remains static. Understory and ground covers are constantly pruned or removed, seedlings are pulled and lawns are planted, fertilized, mowed, and meticulously maintained. Trees may be protected to maturity or even senescence, yet communities are so fragmented or modified that a genuine old-growth community never exists. However, a type of "urban succession" occurs across the urban landscape. The older neighborhoods with their mature stands are at a later seral stage than new developments; species diversity is characteristically higher in older neighborhoods as well. An oddity of the urban environment is the absence of typical structure generally found within the various seral stages. For example, the understory is often removed in a typical mid-seral stand to give it a "park-like" look. Or if the understory is allowed to remain, it is kept pruned to a consistent height. Lawns are the ever-present substitute for native ground covers. Multi-layered habitat is often reduced to 1 or 2 heights. Vertical and horizontal structural diversity is drastically reduced.

Effects of Management and Anthropogenic Impacts. These additional, often irreversible, impacts include more impervious surfaces, more and larger human-made structures, large-scale storm and wastewater management, large-scale sewage treatment, water and air pollution, toxic chemicals, toxic chemical use on urban lawns and gardens, removal of species considered to be pests, predation and disturbance by pets and feral cats and dogs, and the extensive and continual removal of habitat due to expanding urbanization, and in some cases, uncontrolled development. Another significant impact is the introduction and cultivation of exotics in urban areas. Native vegetation is often completely replaced by exotics, leaving little trace of the native vegetative cover.

Status and Trends. From 1970 to 1990, >30,000 mile^2 (77,700 km^2) of rural lands in the U.S. became urban, as classified by the U.S. Census Bureau. That amount of land equals about one third of Oregon's total land area [12]. From 1940 to 1970, the population of the Portland urban region doubled and the amount of land occupied by that population quadrupled [201]. More than 300 new residents arrive in Washington each day, and each day, Washington loses 100 acres (41 ha) of forest to development [215]. Using satellite photos and GIS software, American Forests [9] discovered that nearly one third of Puget Sound's most heavily timbered land has disappeared since the early 1970's. The amount of land with few or no trees more than doubled, from 25 percent to 57 percent, an increase of >1 million acres (404,858 ha). Development and associated urban growth was blamed as the single biggest factor affecting the area's environment. This urban growth is predicted to continue to increase at an accelerated pace, at the expense of native habitat.

Open Water - Lakes, Rivers, and Streams
Eva L. Greda, David H. Johnson, and Tom O'Neil

Lakes, Ponds, and Reservoirs

Geographical Distribution. Lakes in Oregon and Washington occur statewide and are found from near sea level to about 10,200 ft (3,110 m) above sea level. There are 3,887 lakes and reservoirs in western Washington and they total 176,920 acres (71,628 ha) [226]. In contrast, there are 4,073 lakes and reservoirs in eastern Washington that total 436,843 acres (176,860 ha) [227]. There are 6,000 lakes, ponds, and reservoirs in Oregon including almost 1,800 named lakes and over 3,800 named reservoirs, all amounting to 270,641 acres (109,571 ha). Oregon has the deepest lake in the nation, Crater Lake, at 1,932 ft (589 m) [23].

Physical Setting. Continental glaciers melted and left depressions, where water accumulated and formed many lakes in the region. These kinds of lakes are predominantly found in Lower Puget Sound. Landslides that blocked natural valleys also allowed water to fill in behind them to form lakes, like Crescent Lake, Washington. The lakes in the Cascades and Olympic ranges were formed through glaciation and range in elevation from 2,500 to 5,000 ft (762 to 1,524 m). Beavers create many ponds and marshes in Oregon and Washington. Craters created by extinct volcanoes, like Battleground Lake, Washington, also formed lakes. Human-made reservoirs created by dams impound water that creates lakes behind them, like Bonneville Dam on the main stem of the Columbia River. In the lower Columbia Basin, many lakes formed in depressions and rocky coulees through the process of seepage from irrigation waters [226].

Structure. There are 4 distinct zones within this aquatic system: (1) the littoral zone at the edge of lakes is the most productive with diverse aquatic beds and emergent wetlands (part of Herbaceous Wetland's habitat); (2) the limnetic zone is deep open water, dominated by phytoplankton and freshwater fish, and extends down to the limits of light penetration; (3) the profundal zone below the limnetic zone, devoid of plant life and dominated with detritivores; (4) and the benthic zone reflecting bottom soil and sediments. Nutrients from the profundal zone are recycled back to upper layers by the spring and fall turnover of the water. Water in temperate climates stratifies because of the changes in water density. The uppermost layer, the epilimnion, is where water is warmer (less dense). Next, the metalimnion or thermocline, is a narrow layer that prevents the mixing of the upper and lowermost layers. The lowest layer is the hypolimnion, with colder and most dense waters. During the fall turnover, the cooled upper layers are mixed with other layers through wind action.

Natural Disturbance Regime. There are seasonal and decadal variations in the patterns of precipitation. In the Coast Range, there is usually 1 month of drought per year (usually July or August) and 2 months of drought once in a decade. The Willamette Valley and the Cascades experience 1 month with no rain every year and a 2-month dry period every third year. In eastern Oregon, dry periods last 2 or 3 months every year, with dry spells as long as 4-6 months occurring once every 4 years. Dry years, with

<33 percent of normal precipitation occur once every 30 years along the coast, every 20 years in the Willamette Valley, every 30 years in the Cascades, and every 15 years in most of eastern Oregon [23].

Floods occur in Oregon and Washington every year. Flooding season west of the Cascades occurs from October through April, with more than half of the floods occurring during December and January. Floods are the result of precipitation and snow melts. Floods west of the Cascades are influenced by precipitation mostly and thus are short-lived, while east of the Cascades floods are caused by melting snow, and the amount of flooding depends on how fast the snow melts. High water levels frequently last up to 60 days. In 1984, heavy precipitation flooded Malheur and Harney lakes to the point where the 2 lakes were joined together for several years. The worst floods have resulted from cloudbursts caused by thunderstorms, like Heppner, Oregon's 1903 flood. Other "flash floods" in the region were among the largest floods in the U.S. and occurred in the John Day Basin's Meyers Canyon in 1956 and the Umatilla Basin's Lane Canyon in 1965 [23].

Effects of Management and Anthropogenic Impacts. Sewage effluents caused eutrophication of Lake Washington in Seattle, where plants increased in biomass and caused decreased light transmission. The situation was corrected, however, before it became serious as a result of a campaign of public education, and timely cleanup of the lake [146]. Irrigation projects aimed at watering drier portions of the landscape may pose flooding dangers, as was the case with Soap Lake and Lake Leonore in eastern Washington. Finally, natural salinity of lakes can decrease as a result of irrigation withdrawal and can change the biota associated with them [92].

Rivers and Streams

Geographic Distribution. Streams and rivers are distributed statewide in Oregon and Washington, forming a continuous network connecting high mountain areas to lowlands and the Pacific coast. There are >12,000 named rivers and streams in Oregon, totaling 112,640 miles (181,238 km) [23] in length. Oregon's longest stretch of river is the Columbia (309 miles [497 km]) that borders Oregon and Washington. The longest river in Oregon is the John Day (284 miles [457 km]) and the shortest river is the D River (440 ft [134 m]) that is the world's second shortest river. Washington has more streams than any other state except Alaska. In Washington, the coastal region has 3,783 rivers and streams totaling 8,176 miles (13,155 km) [174]. The Puget Sound Region has 10,217 rivers and streams, which add to 16,600 miles (26,709 km) in length [223]. The rivers and streams range from cold, fast-moving high-elevation streams to warmer lowland valley rivers [223]. In all, there are 13,955 rivers and streams that add up to 24,774 miles (39,861 km) [174]. There are many more streams in Washington yet to be catalogued [174].

Physical Setting. Climate of the area's coastal region is very wet. The northern region in Washington is volcanic and bordered to the east by the Olympic Mountain Range, on the north by the Strait of Juan de Fuca, and on the west by the Pacific Ocean. In contrast, the southern portion in Washington is characterized by low-lying, rolling hills [174]. The Puget Sound Region has a wet climate. Most of the streams entering Puget Sound have originated in glacier fields high in the mountains.

Water from melting snowpacks and glaciers provide flow during the spring and winter. Annual rainfall in the lowlands ranges from 35 to 50 inches (89-127 cm), from 75 to 100 inches (191 to 254 cm) in the foothills, and from 100 to >200 inches (254 to 508 cm) in the mountains (mostly in the form of snow) [174].

Rivers and streams in southwestern Oregon are fed by rain and are located in an area composed of sheared bedrock and is thus an unstable terrain. Streams in that area have high suspended-sediment loads. Beds composed of gravel and sand are easily transported during floods. The western Cascades in Washington and Oregon are composed of volcanically derived rocks and are more stable. They have low sediment-transport rates and stable beds composed largely of cobbles and boulders, which move only during extreme events [81]. Velocities of river flow ranges from as little as 0.2 to 12 mph (0.3 to19.3 km/hr) while large streams have an average annual flow of 10 cubic feet (0.3 m^3) per second or greater [23, 169]. Rivers and streams in the Willamette Valley are warm, productive, turbid, and have high ionic strength. They are characterized by deep pools, and highly embedded stream bottoms with claypan and muddy substrates, and the greatest fish species diversity. High desert streams of the interior are similar to those of the Willamette Valley but are shallower, with fewer pools, and more runs, glides, cobbles, boulders, and sand. The Cascades and Blue mountains are similar in that they have more runs and glides and fewer pools, similar fish assemblages, and similar water quality [218].

Landscape setting. This habitat occurs throughout Washington and Oregon. Ponds, lakes, and reservoirs are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin the Westside Riparian Wetlands, Eastside Riparian Wetlands, Herbaceous Wetlands, or Bays and Estuaries habitats.

Other Classifications and Key References. This habitat is called riverine and lacustrine in Anderson *et al.* [10], Cowardin *et al.* [53], Washington GAP Analysis Project [37], Mayer and Laudenslayer [150], and Wetzel [217]. However, this habitat is referred to as Open Water in the Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127].

Effects of Management and Anthropogenic Impacts. Removal of gravel results in reduction of spawning areas for anadromous fish. Overgrazing, and loss of vegetation caused by logging produces increased water temperatures and excessive siltation, harming the invertebrate communities such as that reported in the John Day River Basin, Oregon [146]. Incorrectly installed culverts may act as barriers to migrating fish and may contribute to erosion and siltation downstream [174]. Construction of dams is associated with changes in water quality, fish passage, competition between species, loss of spawning areas because of flooding, and declines in native fish populations [146]. Historically, the region's rivers contained more braided multi-channels. Flood control measures such as channel straightening, diking, or removal of streambed material along with urban and agriculture development have all contributed to a

loss of oxbows, river meanders, and flood plains. Unauthorized or over-appropriated withdrawals of water from the natural drainages also have caused a loss of open water habitat that has been detrimental to fish and wildlife production, particularly in the summer [174].

Agricultural, industrial, and sewage runoff such as salts, sediments, fertilizers, pesticides, and bacteria harm aquatic species [146]. Sludge and heavy waste buildup in estuaries is harmful to fish and shellfish. Unregulated aerial spraying of pesticides over agricultural areas also poses a threat to aquatic and terrestrial life [174]. Direct loss of habitat and water quality occurs through irrigation [130]. The Oregon Department of Environmental Quality, after a study of water quality of the Willamette River, determined that up to 80 percent of water pollution enters the river from nonpoint sources and especially agricultural activity [23]. Very large floods (e.g., Oregon Flood of 1964) may change the channels permanently through the settling of large amounts of sediments from hillslopes, through debris flow, and through movement of large boulders, particularly in the montane areas. The width of the channel along the main middle fork of the Willamette increased over a period of 8 years. Clearcutting creates excessive intermittent runoff conditions and increases erosion and siltation of streams as well as diminishes shade, and therefore causes higher water temperatures, fewer terrestrial and aquatic food organisms, and increased predation. Landslides, which contributed to the widening of the channel, were a direct result of clearcutting. Clearcut logging can alter snow accumulation and increase the size of peak flows during times of snowmelt [197]. Clearcutting and vegetation removal affects the temperatures of streams, increasing them in the summer and decreasing in winter, especially in eastern parts of the Oregon and Washington [24]. Building of roads, especially those of poor quality, can be a major contributor to sedimentation in the streams [82].

Status and Trends. The principal trend has been in relationship to dam building or channelization for hydroelectric power, flood control, or irrigation purposes. As an example, in 1994, there were >900 dams in Washington alone. The dams vary according to size, primary purpose, and ownership (state, federal, private, local) [214]. The first dam and reservoir in Washington was the Monroe Street Dam and Reservoir, built in 1890 at Spokane Falls. Since then the engineering and equipment necessary for dam building developed substantially, culminating in such projects as the Grand Coulee Dam on the Columbia River [214]. In response to the damaging effects of dams on the indigenous biota and alteration and destruction of freshwater aquatic habitats, Oregon and Washington state governments questioned the benefits of dams, especially in light of the federal listing of several salmon species. There are now talks of possibly removing small dams, like the Savage Rapids Dam in Oregon, to removing large federal dams like those on the lower Snake River [23].

Herbaceous Wetlands
Rex C. Crawford, Jimmy Kagan, and Christopher B. Chappell

Geographic Distribution. Herbaceous wetlands are found throughout the world and are represented in Oregon and Washington wherever local hydrologic conditions promote their development. This habitat includes all those except bogs and those within Subalpine Parkland and Alpine.

Freshwater aquatic bed habitats are found throughout the Pacific Northwest, usually in isolated sites. They are more widespread in valley bottoms and high rainfall areas (e.g., Willamette Valley, Puget Trough, coastal terraces, coastal dunes), but are present in montane and arid climates as well. Hardstem bulrush-cattail-burred marshes occur in wet areas throughout Oregon and Washington. Large marshes are common in the lake basins of Klamath, Lake, and Harney counties, Oregon. Sedge meadows and montane meadows are common in the Blue and Ochoco mountains of central and northeastern Oregon, and in the valleys of the Olympic and Cascade Mountains and Okanogan Highlands. Extensive wet meadow habitats occur in Klamath, Deschutes, and western Lake Counties in Oregon.

Physical Setting. This habitat is found on permanently flooded sites that are usually associated with oxbow lakes, dune lakes, or potholes. Seasonally to semi-permanently flooded wetlands are found where standing freshwater is present through part of the growing season and the soils stay saturated throughout the season. Some sites are temporarily to seasonally flooded meadows and generally occur on clay, pluvial, or alluvial deposits within montane meadows, or along stream channels in shrubland or woodland riparian vegetation. In general, this habitat is flat, usually with stream or river channels or open water present. Elevation varies from sea level to 10,000 feet (3,048 m), although infrequently above 6,000 ft (1,830 m).

Landscape Setting. Herbaceous wetlands are found in all terrestrial habitats except Subalpine Parkland, Alpine Grasslands, and Shrublands habitats. Herbaceous wetlands commonly form a pattern with Westside and Eastside Riparian-Wetlands and Montane Coniferous Wetlands habitats along stream corridors. These marshes and wetlands also occur in closed basins in a mosaic with open water by lakeshores or ponds. Extensive deflation plain wetlands have developed between Coastal Dunes and Beaches habitat and the Pacific Ocean. Herbaceous wetlands are found in a mosaic with alkali grasslands in the Desert Playa and Salt Scrub habitat.

Structure. The herbaceous wetland habitat is generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). These meadows often occur with deep or shallow water habitats with floating or rooting aquatic forbs. Various wetland communities are found in mosaics or in nearly pure stands of single species. Herbaceous cover is open to dense. The habitat can be comprised of tule marshes >6.6 ft (2 m) tall or sedge meadows and

wetlands <3.3 ft (1 m) tall. It can be a dense, rhizomatous sward or a tufted graminoid wetland. Graminoid wetland vegetation generally lacks many forbs, although the open extreme of this type contains a diverse forb component between widely spaced tall tufted grasses.

Composition. Various grasses or grass-like plants dominate or co-dominate these habitats. Cattails (Typha latifolia) occur widely, sometimes adjacent to open water with aquatic bed plants. Several bulrush species (Scirpus acutus, S. tabernaemontani, S. maritimus, S. americanus, S. nevadensis) occur in nearly pure stands or in mosaics with cattails or sedges (Carex spp.). Burreed (Sparganium angustifolium , S. eurycarpum) are the most important graminoids in areas with up to 3.3 ft (1m) of deep standing water. A variety of sedges characterize this habitat. Some sedges (Carex aquatilis, C. lasiocarpa, C. scopulorum, C. simulata, C. utriculata, C. vesicaria) tend to occur in cold to cool environments. Other sedges (C. aquatilis var. dives, C. angustata, C. interior, C. microptera, C. nebrascensis) tend to be at lower elevations in milder or warmer environments. Slough sedge (C. obnupta), and several rush species (Juncus falcatus, J. effusus, J. balticus) are characteristic of coastal dune wetlands that are included in this habitat. Several spike rush species (Eleocharis spp.) and rush species can be important. Common grasses that can be local dominants and indicators of this habitat are American sloughgrass (Beckmannia syzigachne), bluejoint reedgrass (Calamagrostis canadensis), mannagrass (Glyceria spp.) and tufted hairgrass (Deschampsia caespitosa). Important introduced grasses that increase and can dominate with disturbance in this wetland habitat include reed canary grass (Phalaris arundinacea), tall fescue (Festuca arundinacea) and Kentucky bluegrass (Poa pratensis).

Aquatic beds are part of this habitat and support a number of rooted aquatic plants, such as, yellow pond lily (Nuphar lutea) and unrooted, floating plants such as pondweeds (Potamogeton spp.), duckweed (Lemna minor), or water-meals (Wolffia spp.). Emergent herbaceous broadleaf plants, such as Pacific water parsley (Oenanthe sarmentosa), buckbean (Menyanthes trifoliata), water star-warts (Callitriche spp.), or bladderworts (Utricularia spp.) grow in permanent and semi-permanent standing water. Pacific silverweed (Argentina egedii) is common in coastal dune wetlands. Montane meadows occasionally are forb dominated with plants such as arrowleaf groundsel (Senecio triangularis) or ladyfern (Athyrium filix-femina). Climbing nightshade (Solanum dulcamara), purple loosestrife (Lythrum salicaria), and poison hemlock (Conium maculatum) are common non-native forbs in wetland habitats.

Shrubs or trees are not a common part of this herbaceous habitat although willow (Salix spp.) or other woody plants occasionally occur along margins, in patches or along streams running through these meadows.

Other Classifications and Key References. This habitat is called palustrine emergent wetlands in Cowardin *et al.* [53]. Other references describe this habitat [43, 44, 57, 71, 131, 132, 138, 147, 219]. This habitat occurs in both lotic and lentic systems. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are wet meadow, palustrine emergent, and National Wetland Inventory (NWI) palustrine shrubland.

Natural Disturbance Regime. This habitat is maintained through a variety of hydrologic regimes that limit or exclude invasion by large woody plants. Habitats are permanently flooded, semi-permanently flooded, or flooded seasonally and may remain saturated through most of the growing season. Most wetlands are resistant to fire and those that are dry enough to burn usually burn in the fall. Most plants are sprouting species and recover quickly. Beavers play an important role in creating ponds and other impoundments in this habitat. Trampling and grazing by large native mammals is a natural process that creates habitat patches and influences tree invasion and success.

Succession and Stand Dynamics. Herbaceous wetlands are often in a mosaic with shrub- or tree-dominated wetland habitat. Woody species can successfully invade emergent wetlands when this herbaceous habitat dries. Emergent wetland plants invade open-water habitat as soil substrate is exposed; e.g., aquatic sedge and Northwest Territory sedge (Carex utriculata) are pioneers following beaver dam breaks. As habitats flood, woody species decrease to patches on higher substrate (soil, organic matter, large woody debris) and emergent plants increase unless the flooding is permanent. Fire suppression can lead to woody species invasion in drier herbaceous wetland habitats; e.g., Willamette Valley wet prairies are invaded by Oregon ash (Fraxinus latifolia) with fire suppression.

Effects of Management and Anthropogenic Impacts. Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roading or removing vegetation on adjacent slopes) results in changes in amount and pattern of herbaceous wetland habitat. If the alteration is long term, wetland systems may reestablish to reflect new hydrology, e.g., cattail is an aggressive invader in roadside ditches. Severe livestock grazing and trampling decreases aquatic sedge, Northwest Territory sedge (Carex utriculata), bluejoint reedgrass, and tufted hairgrass. Native species, however, such as Nebraska sedge, Baltic and jointed rush (Juncus nodosus), marsh cinquefoil (Comarum palustris), and introduced species dandelion (Taraxacum officinale), Kentucky bluegrass, spreading bentgrass (Agrostis stolonifera), and fowl bluegrass (Poa palustris) generally increase with grazing.

Status and Trends. Nationally, herbaceous wetlands have declined and the Pacific Northwest is no exception. These wetlands receive regulatory protection at the national, state, and county level; still, herbaceous wetlands have been filled, drained, grazed, and farmed extensively in the lowlands of Oregon and Washington. Montane wetland habitats are less altered than lowland habitats even though they have undergone modification as well. A keystone species, the beaver, has been trapped to near extirpation in parts of the Pacific Northwest and its population has been regulated in others. Herbaceous wetlands have decreased along with the diminished influence of beavers on the landscape. Quigley and Arbelbide [181] concluded that herbaceous wetlands are susceptible to exotic, noxious plant invasions.

Montane Coniferous Wetlands
Christopher B. Chappell

Geographic Distribution. This habitat occurs in mountains throughout much of Washington and Oregon, except the Basin and Range of southeastern Oregon, the Klamath Mountains of southwestern Oregon, and the Coast Range of Oregon. This includes the Cascade Range, Olympic Mountains, Okanogan Highlands, Blue and Wallowa mountains.

Physical Setting. This habitat is typified as forested wetlands or floodplains with a persistent winter snow pack, ranging from moderately to very deep. The climate varies from moderately cool and wet to moderately dry and very cold. Mean annual precipitation ranges from about 35 to >200 inches (89 to >508 cm). Elevation is mid- to upper montane, as low as 2,000 ft (610 m) in northern Washington, to as high as 9,500 ft (2,896 m) in eastern Oregon. Topography is generally mountainous and includes everything from steep mountain slopes to nearly flat valley bottoms. Gleyed or mottled mineral soils, organic soils, or alluvial soils are typical. Subsurface water flow within the rooting zone is common on slopes with impermeable soil layers. Flooding regimes include saturated, seasonally flooded, and temporarily flooded. Seeps and springs are common in this habitat.

Landscape Setting. This habitat occurs along stream courses or as patches, typically small, within a matrix of Montane Mixed Conifer Forest, or less commonly, Eastside Mixed Conifer Forest or Lodgepole Pine Forest and Woodlands. It also can occur adjacent to other wetland habitats: Eastside Riparian-Wetlands, Westside Riparian-Wetlands, or Herbaceous Wetlands. The primary land uses are forestry and watershed protection.

Structure. This is a forest or woodland (>30 percent tree canopy cover) dominated by evergreen conifer trees. Deciduous broadleaf trees are occasionally co-dominant. The understory is dominated by shrubs (most often deciduous and relatively tall), forbs, or graminoids. The forb layer is usually well developed even where a shrub layer is dominant. Canopy structure includes single-storied canopies and complex multi-layered ones. Typical tree sizes range from small to very large. Large woody debris is often a prominent feature, although it can be lacking on less productive sites.

Composition. Indicator tree species for this habitat, any of which can be dominant or co-dominant, are Pacific silver fir (Abies amabilis), mountain hemlock (Tsuga mertensiana), and Alaska yellow-cedar (Chamaecyparis nootkatensis) on the westside, and Engelmann spruce (Picea engelmannii), subalpine fir (Abies lasiocarpa), lodgepole pine (Pinus contorta), western hemlock (T. heterophylla), or western redcedar (Thuja plicata) on the eastside. Lodgepole pine is prevalent only in wetlands of eastern Oregon. Western hemlock and redcedar are common associates with silver fir on the westside. They are diagnostic of this habitat on the east slope of the central Washington Cascades, and in the Okanogan Highlands, but are not diagnostic there. Douglas-fir (Pseudotsuga menziesii) and grand fir (Abies grandis) are sometimes prominent on the eastside. Quaking aspen (Populus tremuloides) and black cottonwood (P. balsamifera ssp. trichocarpa) are in certain instances important to co-dominant, mainly on the eastside.

Dominant or co-dominant shrubs include devil's-club (Oplopanax horridus), stink currant (Ribes bracteosum), black currant (R. hudsonianum), swamp gooseberry (R. lacustre), salmonberry (Rubus spectabilis), red-osier dogwood (Cornus sericea), Douglas' spirea (Spirea douglasii), common snowberry (Symphoricarpos albus), mountain alder (Alnus incana), Sitka alder (Alnus viridis ssp. sinuata), Cascade azalea (Rhododendron albiflorum), and glandular Labrador-tea (Ledum glandulosum). The dwarf shrub bog blueberry (Vaccinium uliginosum) is an occasional understory dominant. Shrubs more typical of adjacent uplands are sometimes co-dominant, especially big huckleberry (V. membranaceum), oval-leaf huckleberry (V. ovalifolium), grouseberry (V. scoparium), and fools huckleberry (Menziesia ferruginea).

Graminoids that may dominate the understory include bluejoint reedgrass (Calamagrostis canadensis), Holm's Rocky Mountain sedge (Carex scopulorum), widefruit sedge (C. angustata), and fewflower spikerush (Eleocharis quinquiflora). Some of the most abundant forbs and ferns are ladyfern (Athyrium filix-femina), western oakfern (Gymnocarpium dryopteris), field horsetail (Equisetum arvense), arrowleaf groundsel (Senecio triangularis), two-flowered marshmarigold (Caltha leptosepala ssp. howellii), false bugbane (Trautvetteria carolinensis), skunk-cabbage (Lysichiton americanus), twinflower (Linnaea borealis), western bunchberry (Cornus unalaschkensis), clasping-leaved twisted-stalk (Streptopus amplexifolius), singleleaf foamflower (Tiarella trifoliata var. unifoliata), and five-leaved bramble (Rubus pedatus).

Other Classifications and Key References. This habitat includes nearly all of the wettest forests within the Abies amabilis and Tsuga mertensiana zones of western Washington and northwestern Oregon and most of the wet forests in the Tsuga heterophylla and Abies lasiocarpa zones of eastern Oregon and Washington [88]. On the eastside, they may extend down into the Abies grandis zone also. This habitat is not well represented by the GAP projects because of its relatively limited acreage and the difficulty of identification from satellite images. But in the Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] the vegetation types that include this type would be higher elevation palustrine forest, palustrine shrubland, and NWI palustrine emergent. These are primarily palustrine forested wetlands with a seasonally flooded, temporarily flooded, or saturated flooding regime [54]. They occur in both lotic and lentic systems. Other references describe this habitat [36, 57, 90, 101, 108, 111, 114, 115, 118, 123, 132, 221].

Natural Disturbance Regime. Flooding, debris flow, fire, and wind are the major natural disturbances. Many of these sites are seasonally or temporarily flooded. Floods vary greatly in frequency depending on fluvial position. Floods can deposit new sediments or create new surfaces for primary succession. Debris flows/torrents are major scouring events that reshape stream channels and riparian surfaces, and create opportunities for primary succession and redistribution of woody debris. Fire is more prevalent east of the Cascade Crest. Fires are typically high in severity and can replace entire stands, as these tree species have low fire resistance. Although fires have not been studied specifically in these wetlands, fire frequency is probably low. These wetland areas are less likely to burn than surrounding uplands, and so may sometimes escape extensive burns as old forest refugia [1]. Shallow rooting and wet soils are conducive to windthrow, which is a common small-scale disturbance that influences forest patterns. Snow avalanches probably disturb portions of this habitat in the northwestern Cascades and Olympic Mountains. Fungal pathogens and insects also act as important small-scale natural disturbances.

Succession and Stand Dynamics. Succession has not been well studied in this habitat. Following disturbance, tall shrubs may dominate for some time,

especially mountain alder, stink currant, salmonberry, willows (Salix spp.), or Sitka alder. Quaking aspen and black cottonwood in these habitats probably regenerate primarily after floods or fires, and decrease in importance as succession progresses. Lodgepole pine is often associated with post-fire conditions in eastern Oregon [131], although in some wetlands it can be an edaphic climax species. Pacific silver fir, subalpine fir, or Engelmann spruce would be expected to increase in importance with time since the last major disturbance. Western hemlock, western redcedar, and Alaska yellow-cedar typically maintain co-dominance as stand development progresses because of the frequency of small-scale disturbances and the longevity of these species. Tree size, large woody debris, and canopy layer complexity all increase for at least a few hundred years after fire or other major disturbance.

Effects of Management and Anthropogenic Impacts. Roads and clearcut logging practices can increase the frequency of landslides and resultant debris flows/torrents, as well as sediment loads in streams [198, 199, 229]. This in turn alters hydrologic patterns and the composition and structure of montane riparian habitats. Logging typically reduces large woody debris and canopy structural complexity. Timber harvest on some sites can cause the water table to rise and subsequently prevent trees from establishing [221]. Wind disturbance can be greatly increased by timber harvest in or adjacent to this habitat.

Status and Trends. This habitat is naturally limited in its extent and has probably declined little in area over time. Portions of this habitat have been degraded by the effects of logging, either directly on site or through geohydrologic modifications. This type is probably relatively stable in extent and condition, although it may be locally declining in condition because of logging and road building. Five of 32 plant associations representing this habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled [10].

Eastside (Interior) Riparian-Wetlands
Rex C. Crawford and Jimmy Kagan

Geographic Distribution. Riparian and wetland habitats dominated by woody plants are found throughout eastern Oregon and eastern Washington.

Mountain alder-willow riparian shrublands are major habitats in the forested zones of eastern Oregon and eastern Washington. Eastside lowland willow and other riparian shrublands are the major riparian types throughout eastern Oregon and Washington at lower elevations. Black cottonwood riparian habitats occur throughout eastern Oregon and Washington, at low to middle elevations. White alder riparian habitats are restricted to perennial streams at low elevations, in drier climatic zones in Hells Canyon at the border of Oregon, Washington, and Idaho, in the Malheur River drainage and in western Klickitat and south central Yakima counties, Washington. Quaking aspen wetlands and riparian habitats are widespread but rarely a major component throughout eastern Washington and Oregon. Ponderosa pine-Douglas-fir riparian habitat occurs only around the periphery of the Columbia Basin in Washington and up into lower montane forests.

Physical Setting. Riparian habitats appear along perennial and intermittent rivers and streams. This habitat also appears in impounded wetlands and along lakes and ponds. Their associated streams flow along low to high gradients. The riparian and wetland forests are usually in fairly narrow bands along the moving water that follows a corridor along montane or valley streams. The most typical stand is limited to 100-200 ft (31-61 m) from streams. Riparian forests also appear on sites subject to temporary flooding during spring runoff. Irrigation of streamsides and toeslopes provides more water than precipitation and is important in the development of this habitat, particularly in drier climatic regions. Hydrogeomorphic surfaces along streams supporting this habitat have seasonally to temporarily flooded hydrologic regimes. Eastside riparian and wetland habitats are found from 100- 9,500 ft (31-2,896 m) in elevation.

Landscape Setting. Eastside riparian habitats occur along streams, seeps, and lakes within the Eastside Mixed Conifer Forest, Ponderosa Pine Forest and Woodlands, Western Juniper and Mountain Mahogany Woodlands, and part of the Shrubsteppe habitat. This habitat may be described as occupying warm montane and adjacent valley and plain riparian environments.

Structure. The Eastside riparian and wetland habitat contains shrublands, woodlands, and forest communities. Stands are closed to open canopies and often multi-layered. A typical riparian habitat would be a mosaic of forest, woodland, and shrubland patches along a stream course. The tree layer can be dominated by broadleaf, conifer, or mixed canopies. Tall shrub layers, with and without trees, are deciduous and often nearly completely closed thickets. These woody riparian habitats have

an undergrowth of low shrubs or dense patches of grasses, sedges, or forbs. Tall shrub communities (20-98 ft [6-30 m], occasionally tall enough to be considered woodlands or forests) can be interspersed with sedge meadows or moist, forb-rich grasslands. Intermittently flooded riparian habitat has ground cover composed of steppe grasses and forbs. Rocks and boulders may be a prominent feature in this habitat.

Composition. Black cottonwood (Populus balsamifera ssp. trichocarpa), quaking aspen (P. tremuloides), white alder (Alnus rhombifolia), peachleaf willow (Salix amygdaloides) and, in northeast Washington, paper birch (Betula papyrifera) are dominant and characteristic tall deciduous trees. Water birch (B. occidentalis), shining willow (Salix lucida ssp. caudata) and, rarely, mountain alder (Alnus incana) are co-dominant to dominant mid-size deciduous trees. Each can be the sole dominant in stands. Conifers can occur in this habitat, rarely in abundance, more often as individual trees. The exception is ponderosa pine (Pinus ponderosa) and Douglas-fir (Pseudotsuga menziesii) that characterize a conifer-riparian habitat in portions of the shrubsteppe zones.

A wide variety of shrubs are found in association with forest/woodland versions of this habitat. Red-osier dogwood (Cornus sericea), mountain alder, gooseberry (Ribes spp.), rose (Rosa spp.), common snowberry (Symphoricarpos albus) and Drummonds willow (Salix drummondii) are important shrubs in this habitat. Bog birch (B. nana) and Douglas spiraea (Spiraea douglasii) can occur in wetter stands. Red-osier dogwood and common snowberry are shade-tolerant and dominate stand interiors, while these and other shrubs occur along forest or woodland edges and openings. Mountain alder is frequently a prominent shrub, especially at middle elevations. Tall shrubs (or small trees) often growing under or with white alder include chokecherry (Prunus virginiana), water birch, shining willow, and netleaf hackberry (Celtis reticulata).

Shrub-dominated communities contain most of the species associated with tree communities. Willow species (Salix bebbiana, S. boothii, S. exigua, S geyeriana, or S. lemmonii) dominate many sites. Mountain alder can be dominant and is at least codominant at many sites. Chokecherry, water birch, serviceberry (Amelanchier alnifolia), black hawthorn (Crataegus douglasii), and red-osier dogwood can also be codominant to dominant. Shorter shrubs, Woods rose, spiraea, snowberry and gooseberry are usually present in the undergrowth.

The herb layer is highly variable and is composed of an assortment of graminoids and broadleaf herbs. Native grasses (Calamagrostis canadensis, Elymus glaucus, Glyceria spp., and Agrostis spp.) and sedges (Carex aquatilis, C. angustata, C. lanuginosa, C. lasiocarpa, C. nebrascensis, C. microptera, and C. utriculata) are significant in many habitats. Kentucky bluegrass (Poa pratensis) can be abundant where heavily grazed in the past. Other weedy grasses, such as orchard grass (Dactylis glomerata), reed canarygrass (Phalaris arundinacea), timothy (Phleum pratense), bluegrass (Poa bulbosa, P. compressa),

and tall fescue (Festuca arundinacea) often dominate disturbed areas. A short list of the great variety of forbs that grow in this habitat includes Columbian monkshood (Aconitum columbianum), alpine leafybract aster (Aster foliaceus), ladyfern (Athyrium filix-femina), field horsetail (Equisetum arvense), cow parsnip (Heracleum maximum), skunkcabbage (Lysichiton americanus), arrowleaf groundsel (Senecio triangularis), stinging nettle (Urtica dioica), California false hellebore (Veratrum californicum), American speedwell (Veronica americana), and pioneer violet (Viola glabella).

Other Classifications and Key References. This habitat is called Palustrine scrub-shrub and forest in Cowardin *et al.* [53]. Other references describe this habitat [44, 57, 60, 131, 132, 147, 156]. This habitat occurs in both lotic and lentic systems. The Oregon GAP II Project [126] and Oregon Vegetation Landscape-Level Cover Types [127] that would represent this type are eastside cottonwood riparian gallery, palustrine forest, palustrine shrubland, and National Wetland Inventory (NWI) palustrine emergent.

Natural Disturbance Regime. This habitat is tightly associated with stream dynamics and hydrology. Flood cycles occur within 20-30 years in most riparian shrublands although flood regimes vary among stream types. Fires recur typically every 25-50 years but fire can be nearly absent in colder regions or on topographically protected streams. Rafted ice and logs in freshets may cause considerable damage to tree boles in mountain habitats. Beavers crop younger cottonwood and willows and frequently dam side channels in these stands. These forests and woodlands require various flooding regimes and specific substrate conditions for reestablishment. Grazing and trampling is a major influence in altering structure, composition, and function of this habitat; some portions are very sensitive to heavy grazing.

Succession and Stand Dynamics. Riparian vegetation undergoes "typical" stand development that is strongly controlled by the site's initial conditions following flooding and shifts in hydrology. The initial condition of any hydrogeomorphic surface is a sum of the plants that survived the disturbance, plants that can get to the site, and the amount of unoccupied habitat available for invasions. Subsequent or repeated floods or other influences on the initial vegetation select species that can survive or grow in particular life forms. A typical woody riparian habitat dynamic is the invasion of woody and herbaceous plants onto a new alluvial bar away from the main channel. If the bar is not scoured in 20 years, a tall shrub and small deciduous tree stand will develop. Approximately 30 years without disturbance or change in hydrology will allow trees to overtop shrubs and form woodland. Another 50 years without disturbance will allow conifers to invade and in another 50 years a mixed hardwood-conifer stand will develop. Many deciduous tall shrubs and trees cannot be invaded by conifers. Each stage can be reinitiated, held in place, or shunted into different vegetation by changes in stream or wetland hydrology, fire, grazing, or an interaction of those factors.

Effects of Management and Anthropogenic Impacts. Management effects on woody riparian vegetation can be obvious, e.g., removal of vegetation by dam construction, roads, logging, or they can be subtle, e.g., removing beavers from a watershed, removing large woody debris, or

construction of a weir dam for fish habitat. In general, excessive livestock or native ungulate use leads to less woody cover and an increase in sod-forming grasses particularly on fine-textured soils. Undesirable forb species, such as stinging nettle and horsetail, increase with livestock use.

Status and Trends. Quigley and Arbelbide [181] concluded that the Cottonwood-Willow cover type covers significantly less in area now than before 1900 in the Inland Pacific Northwest. The authors concluded that although riparian shrubland was a minor part of the landscape, occupying 2 percent, they estimated it to have declined to 0.5 percent of the landscape. Approximately 40 percent of riparian shrublands occurred above 3,280 ft (1,000 m) in elevation pre-1900; now nearly 80 percent is found above that elevation. This change reflects losses to agricultural development, roading, dams and other flood-control activities. The current riparian shrublands contain many exotic plant species and generally are less productive than historically. Quigley and Arbelbide [181] found that riparian woodland was always rare and the change in extent from the past is substantial.

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Appendix C: Percent Change in Wildlife Habitat Types

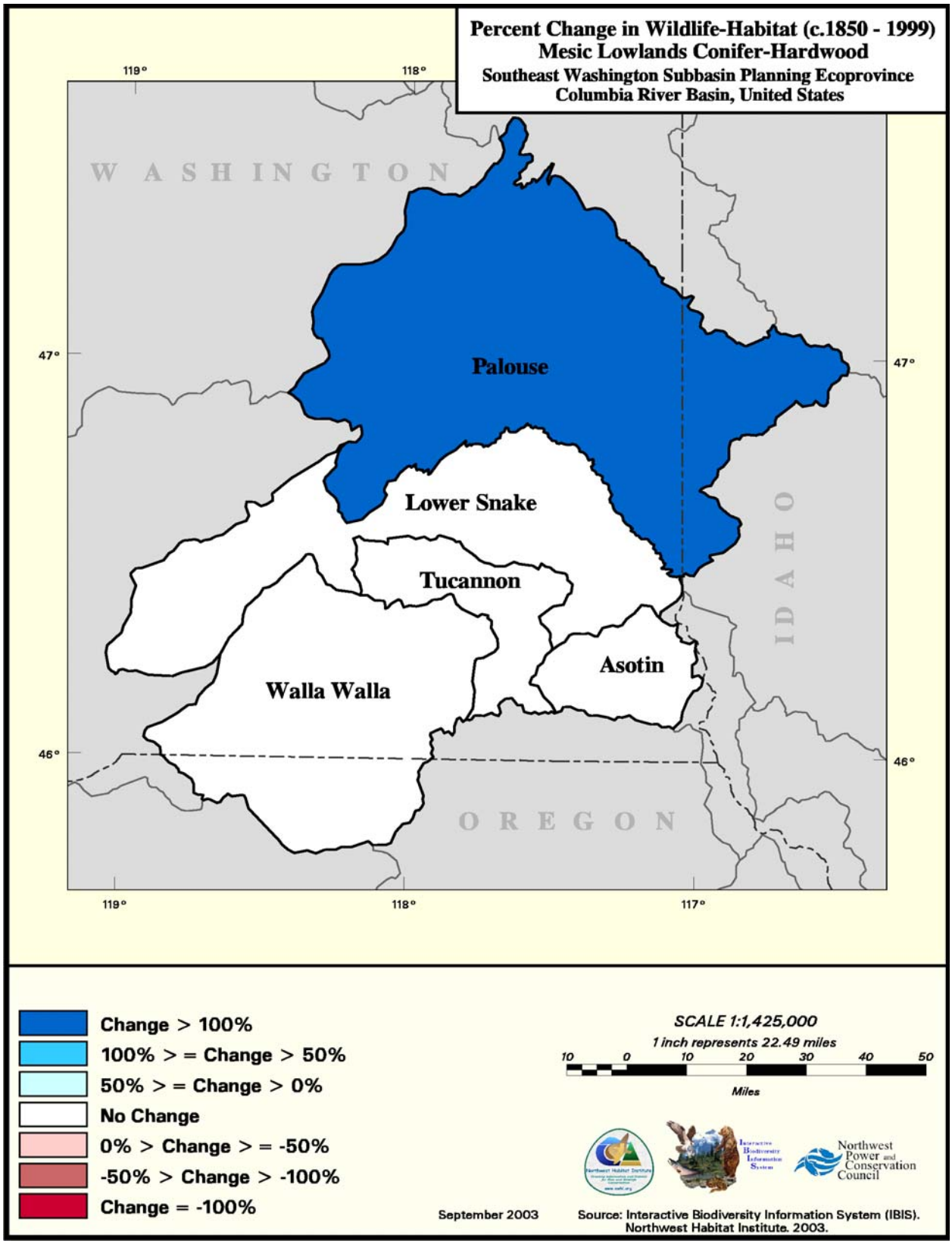

Figure C-1. Percent change in Mesic Lowlands Conifer-Hardwood Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

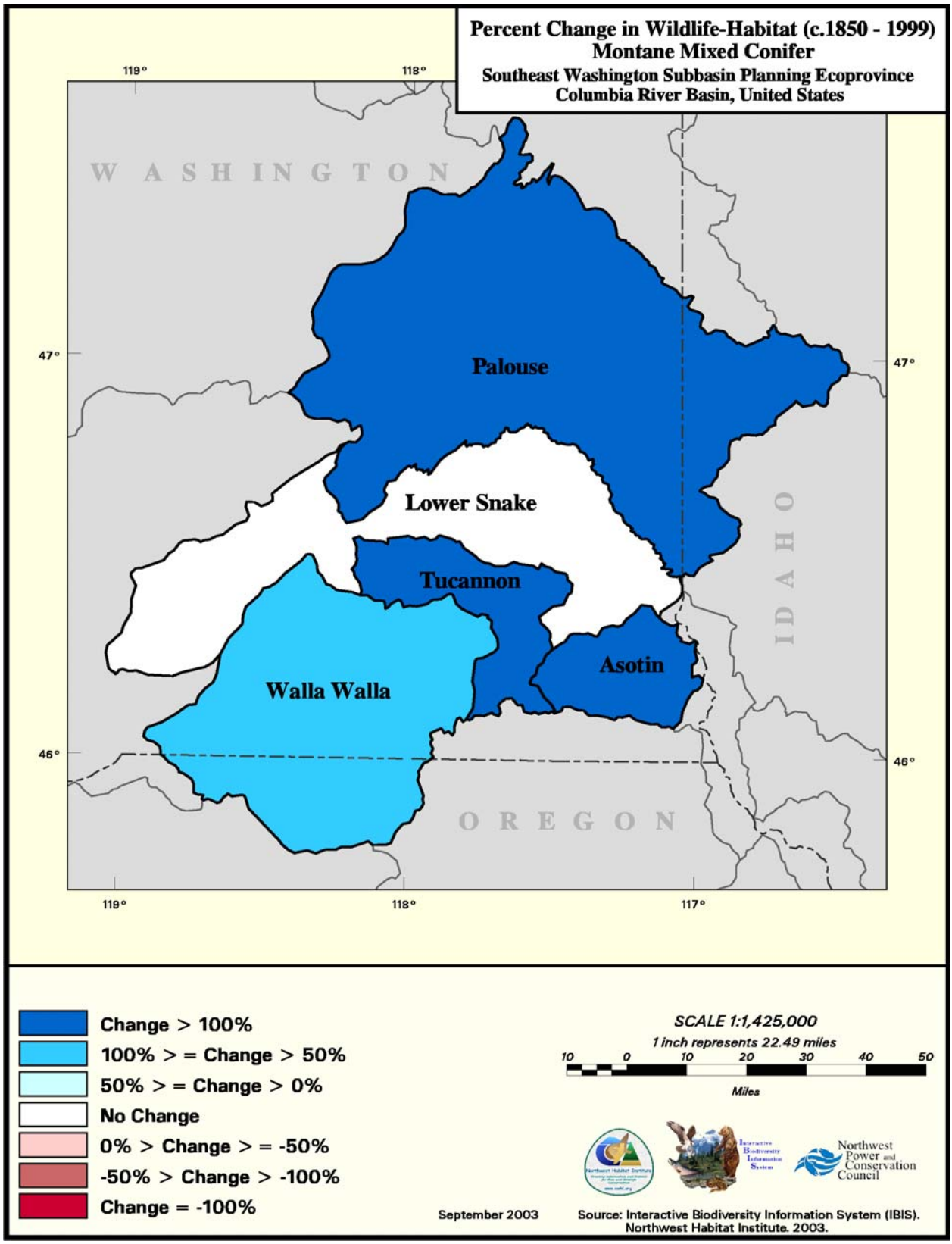

Figure C-2. Percent change in Montane Mixed Conifer Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

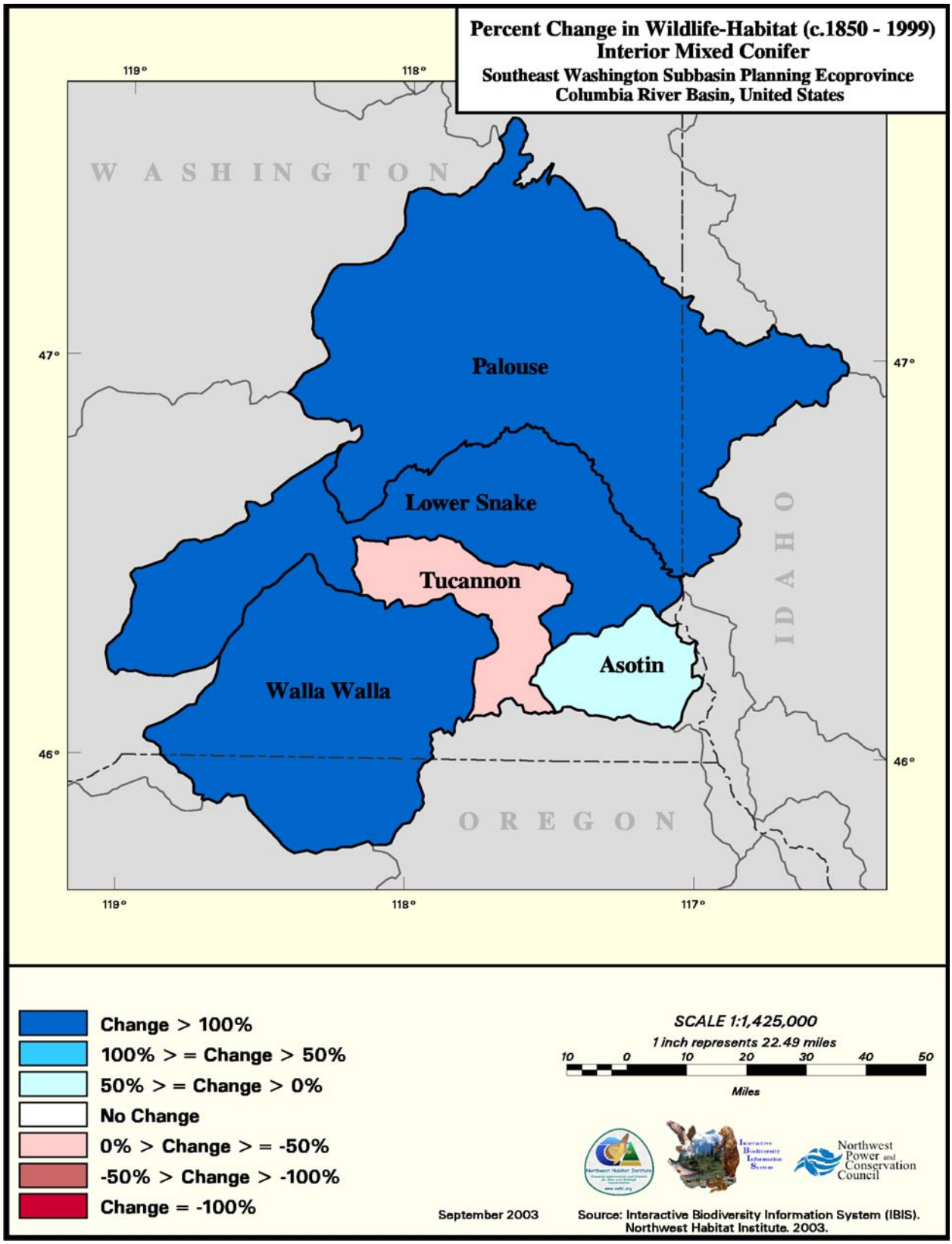

Figure C-3. Percent change in Interior Mixed Conifer Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

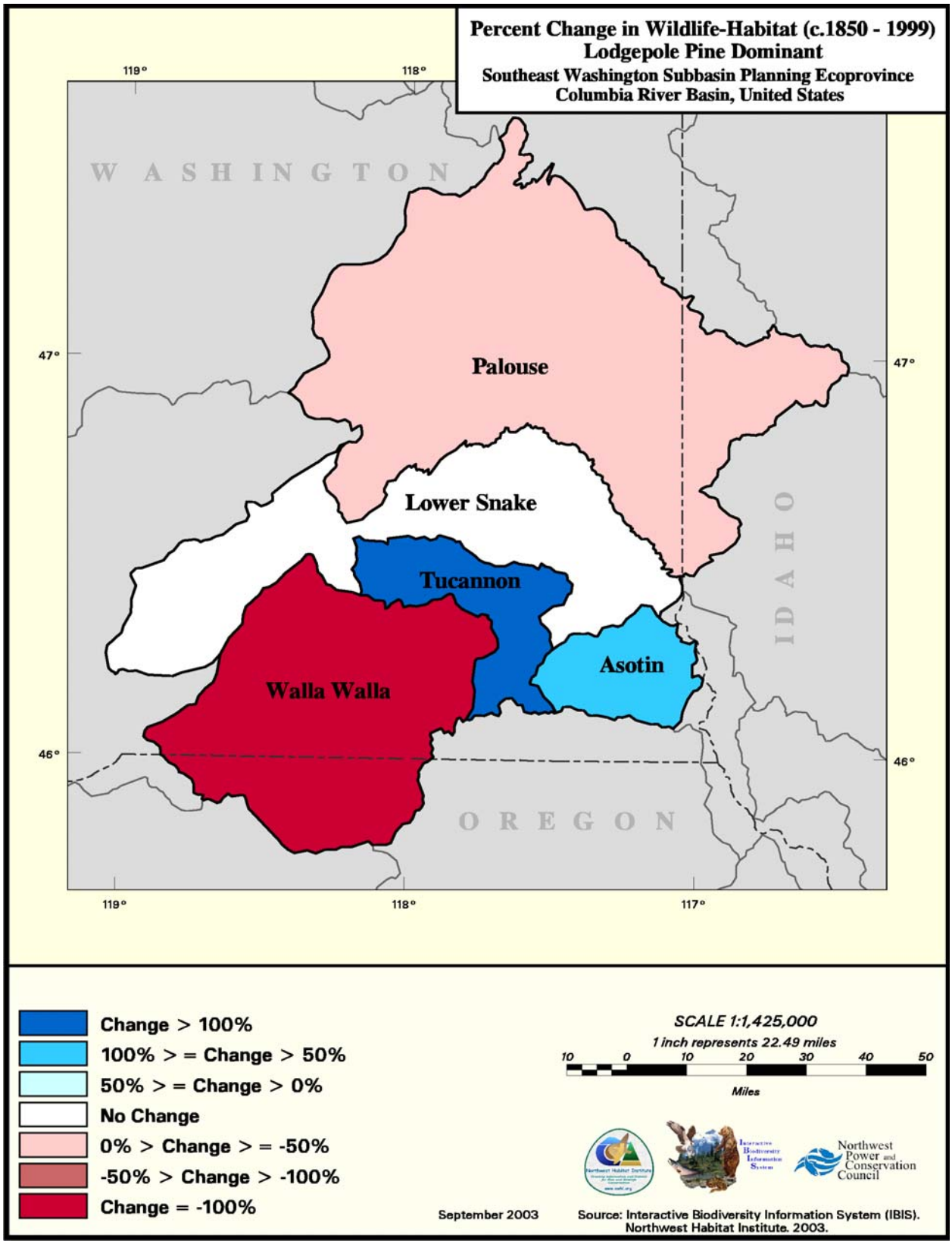

Figure C-4. Percent change in Lodgepole Pine Dominant Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

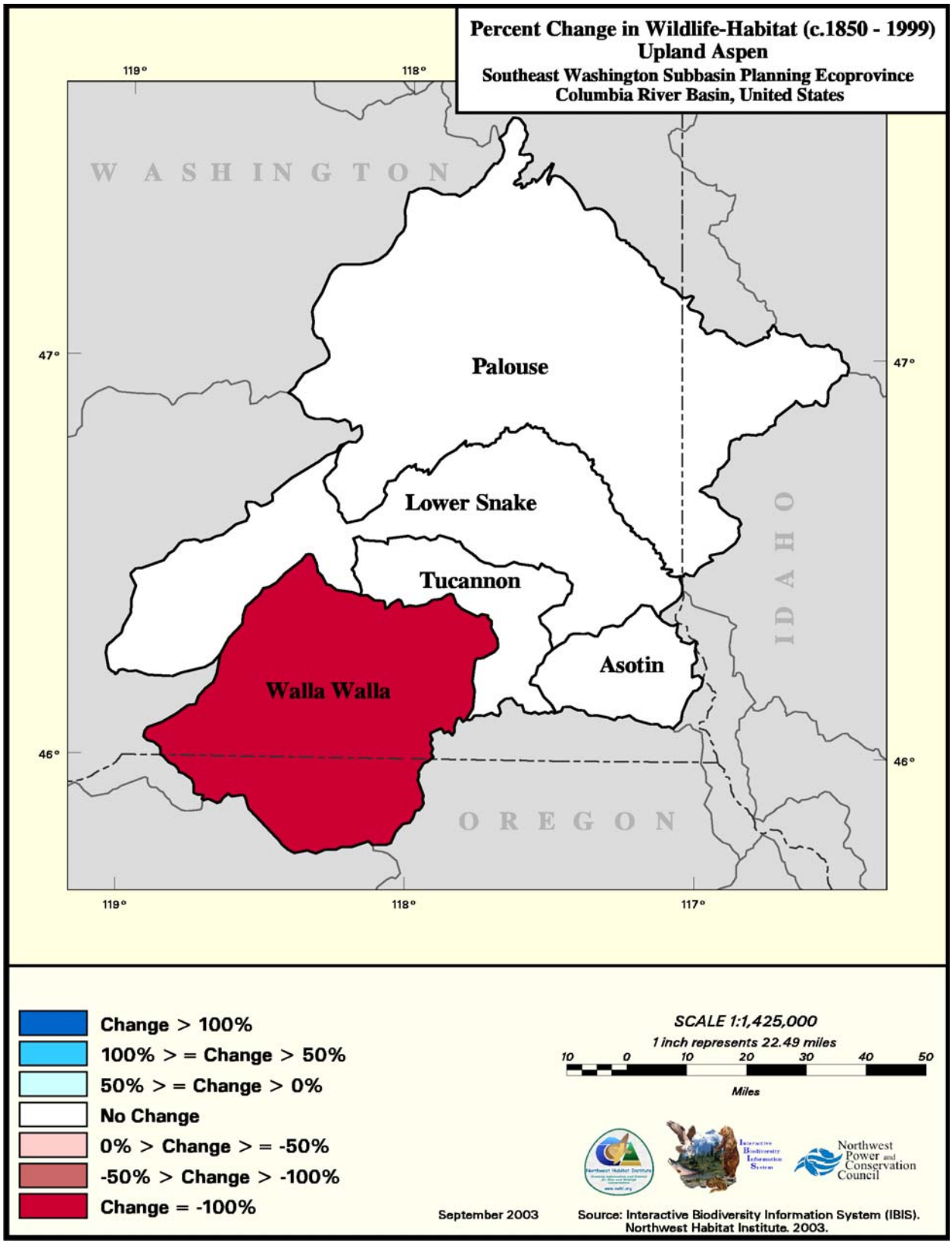

Figure C-5. Percent change in Upland Aspen Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

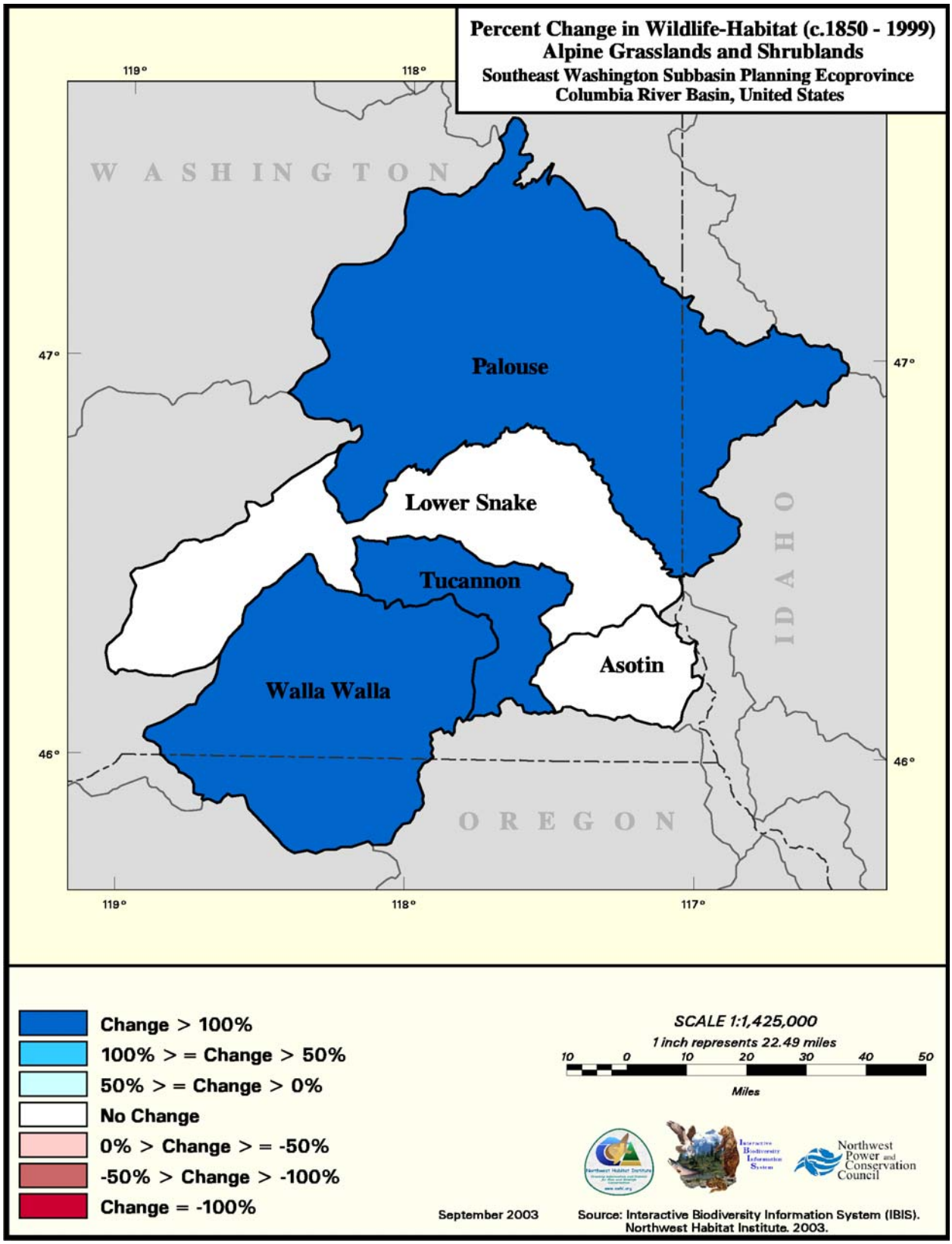

Figure C-6. Percent change in Alpine Grasslands and Shrublands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

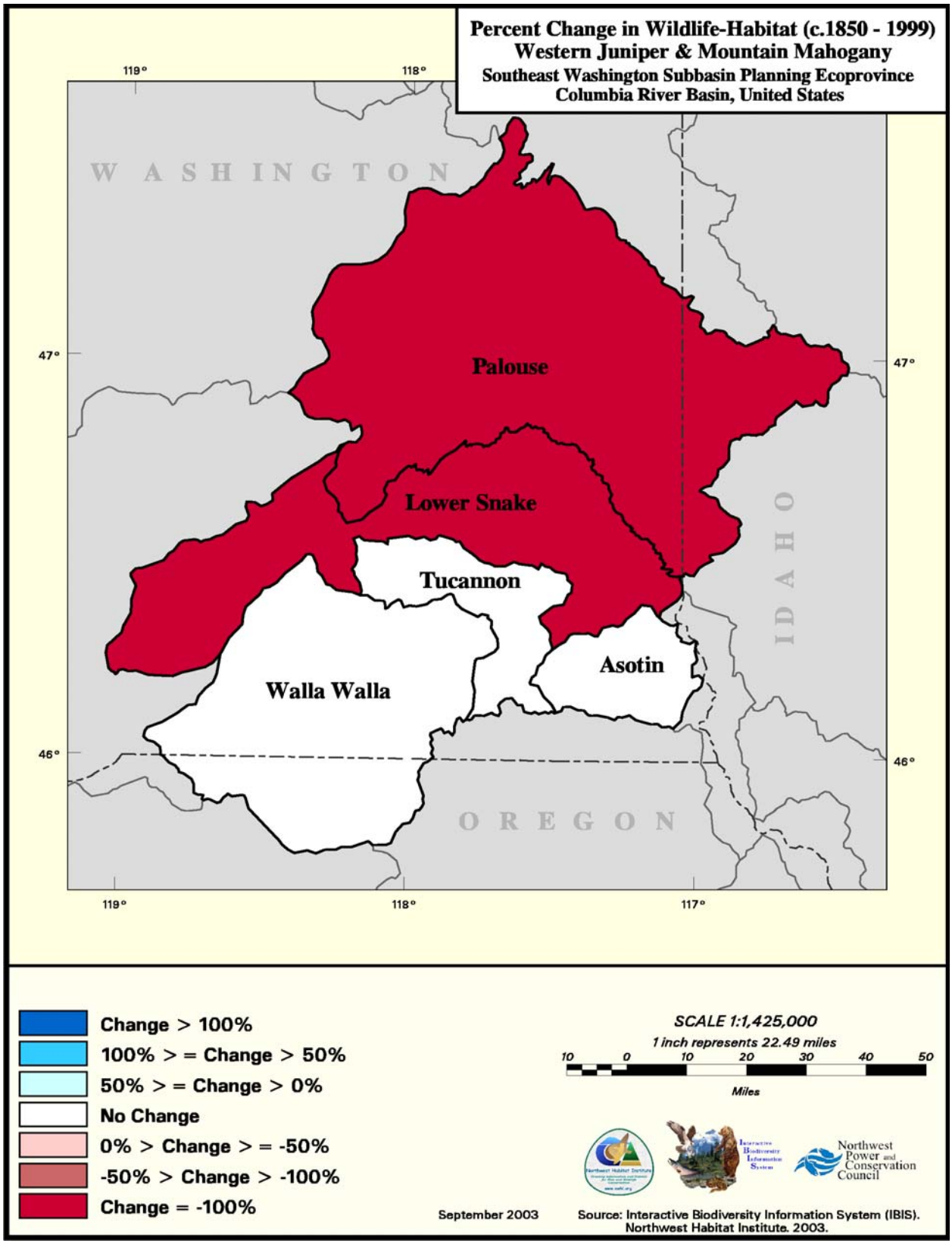

Figure C-7. Percent change in Western Juniper and Mountain Mohogany in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

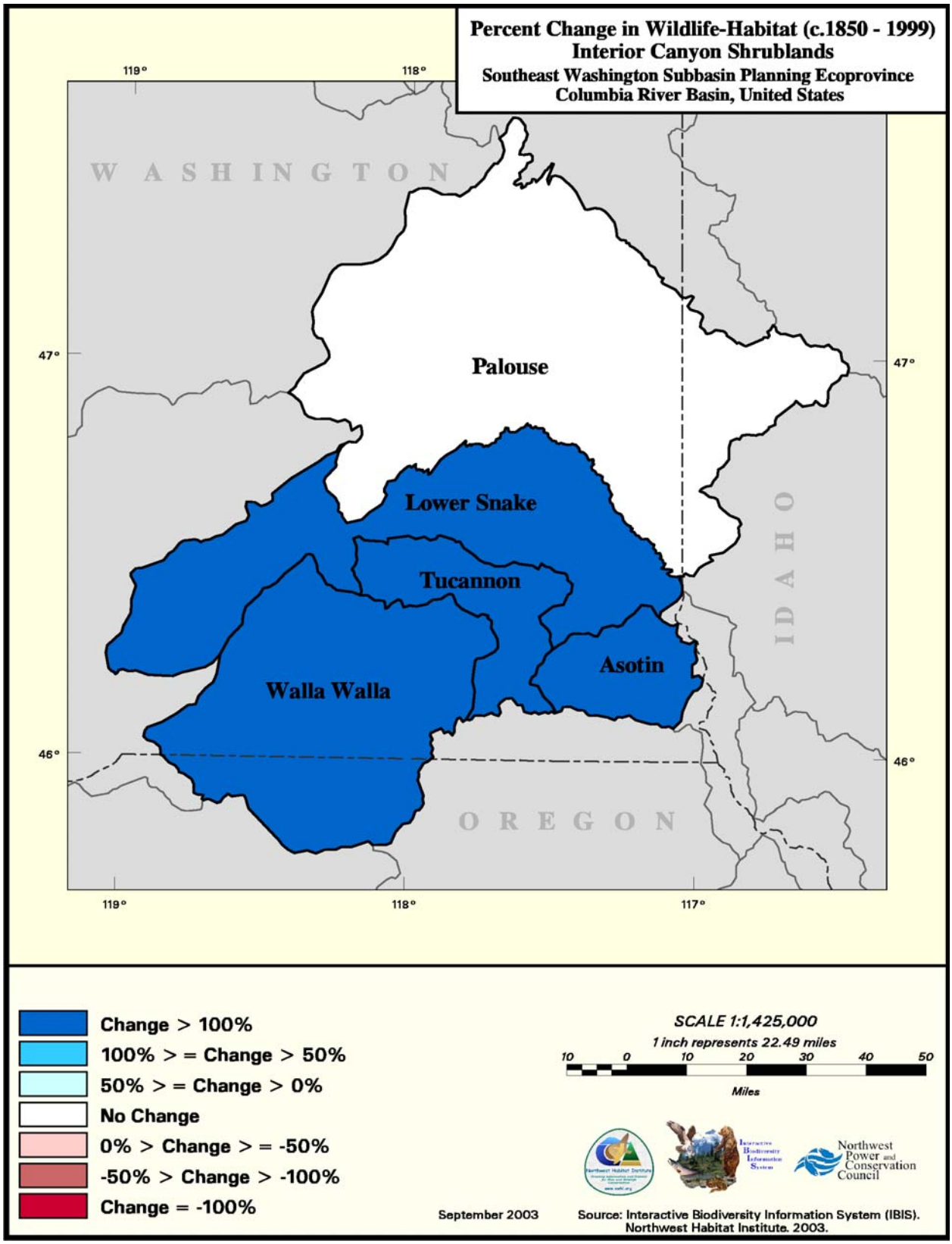

Figure C-8. Percent change in Interior Canyon Shrublands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

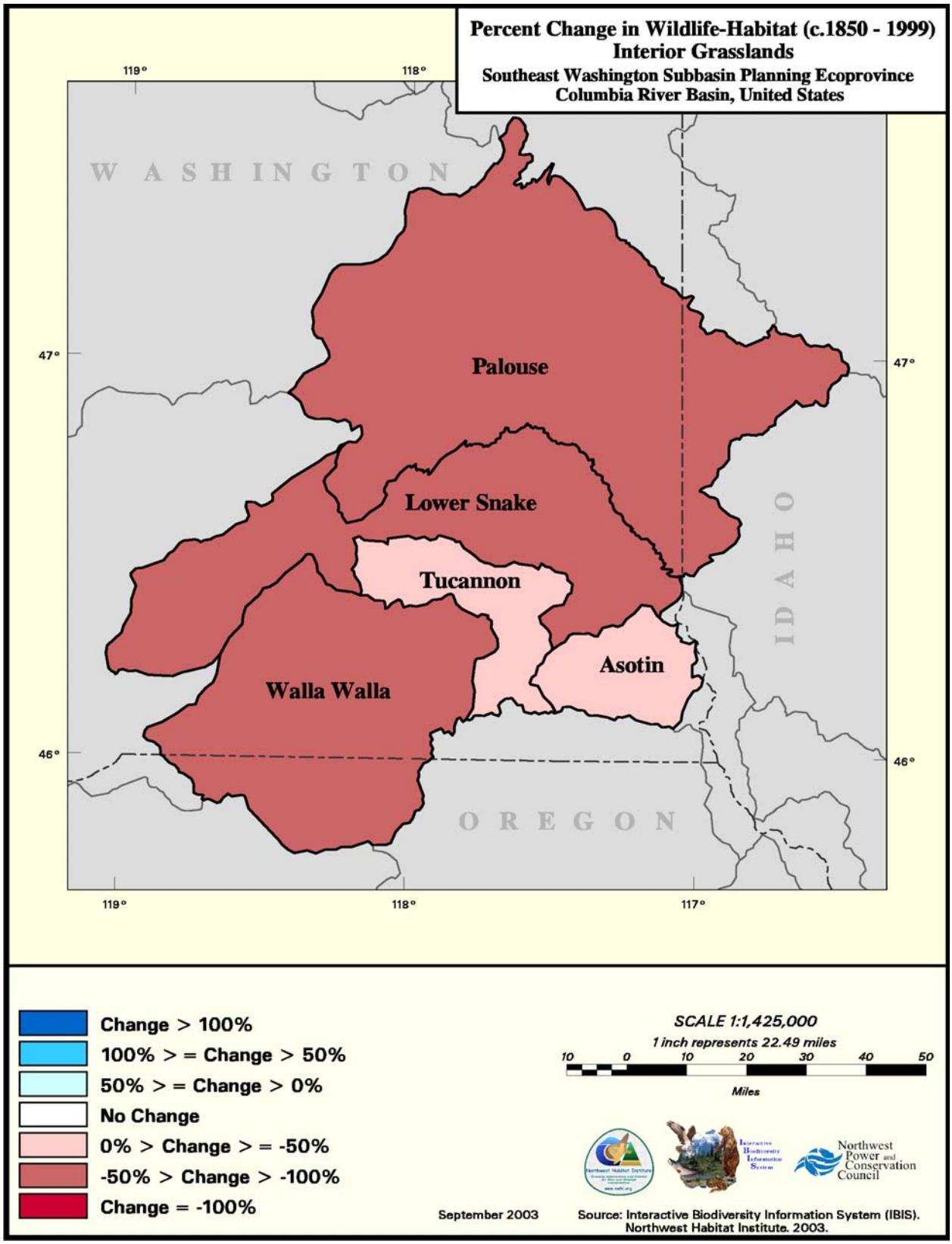

Figure C-9. Percent change in Interior Grasslands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

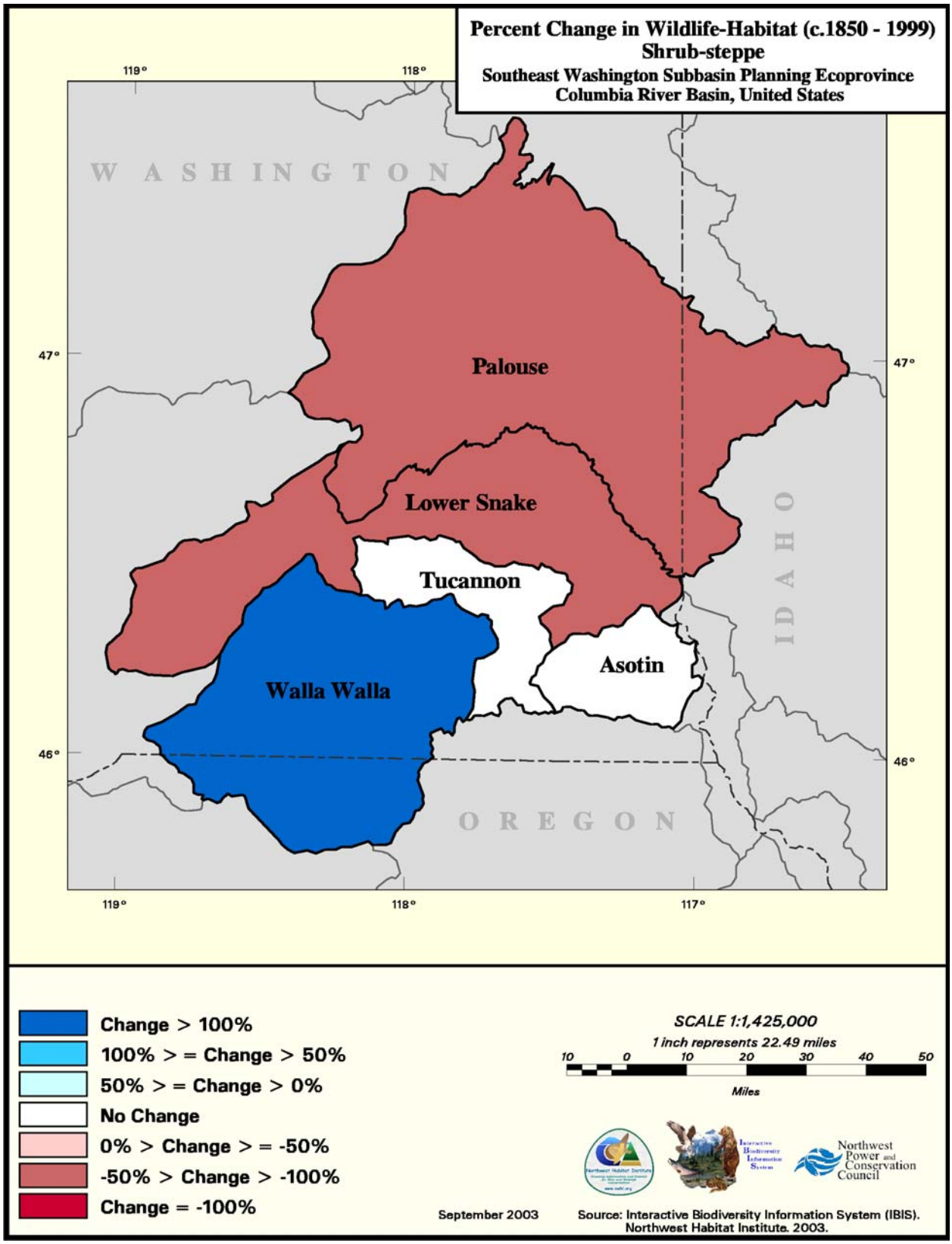

Figure C-10. Percent change in Shrubsteppe in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

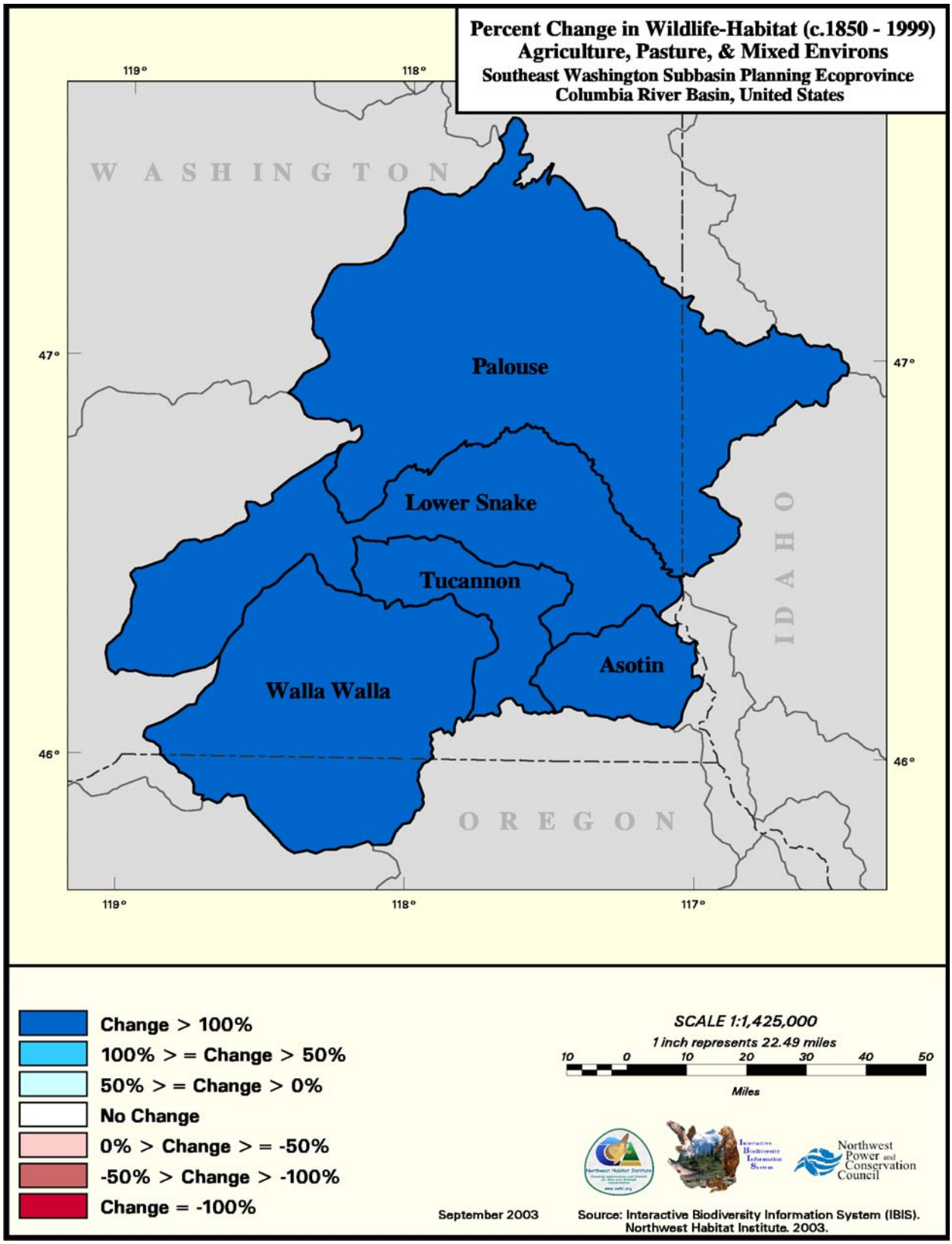

Figure C-11. Percent change in Agriculture, Pasture, and Mixed Environs in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

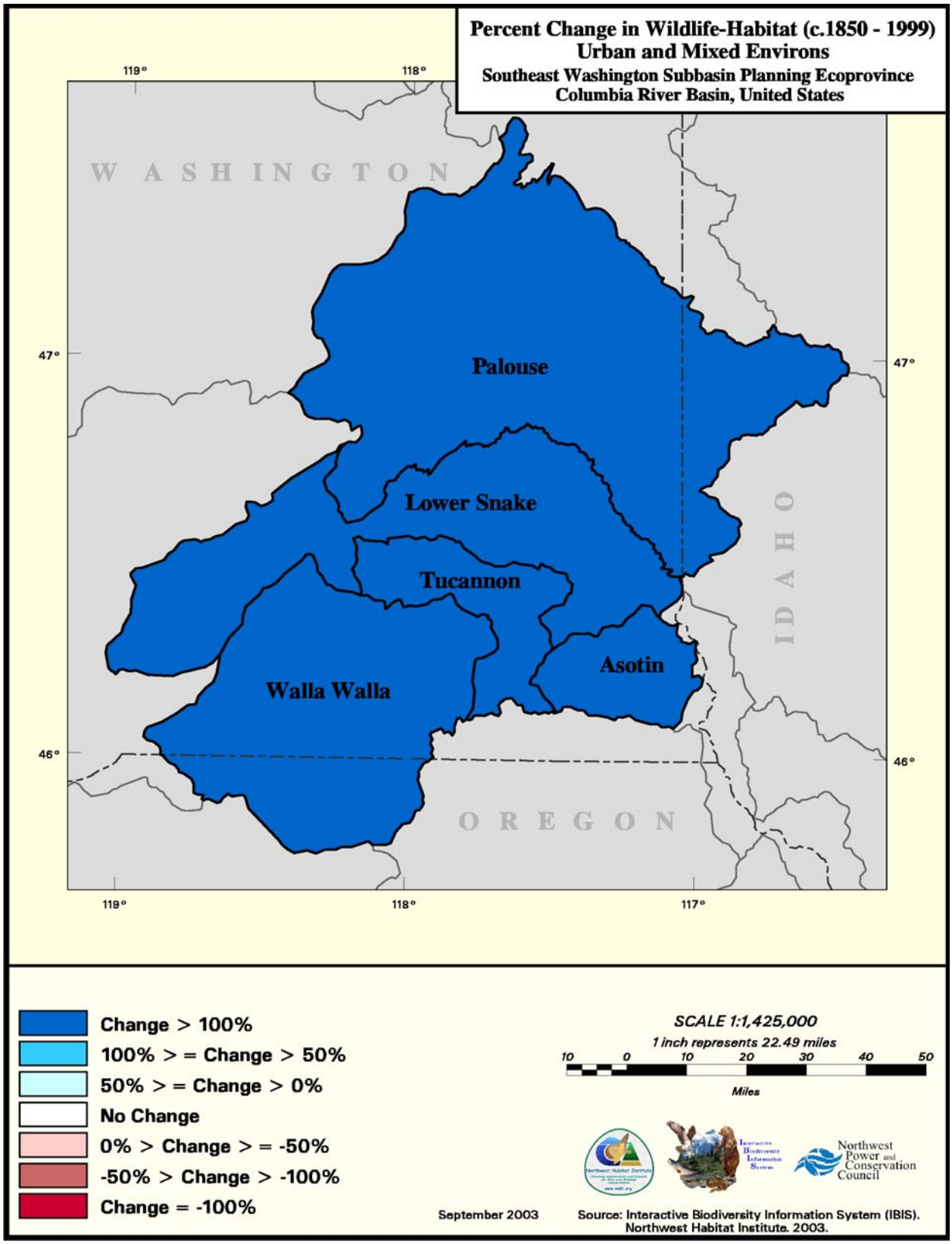

Figure C-12. Percent change in Urban and Mixed Environs in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

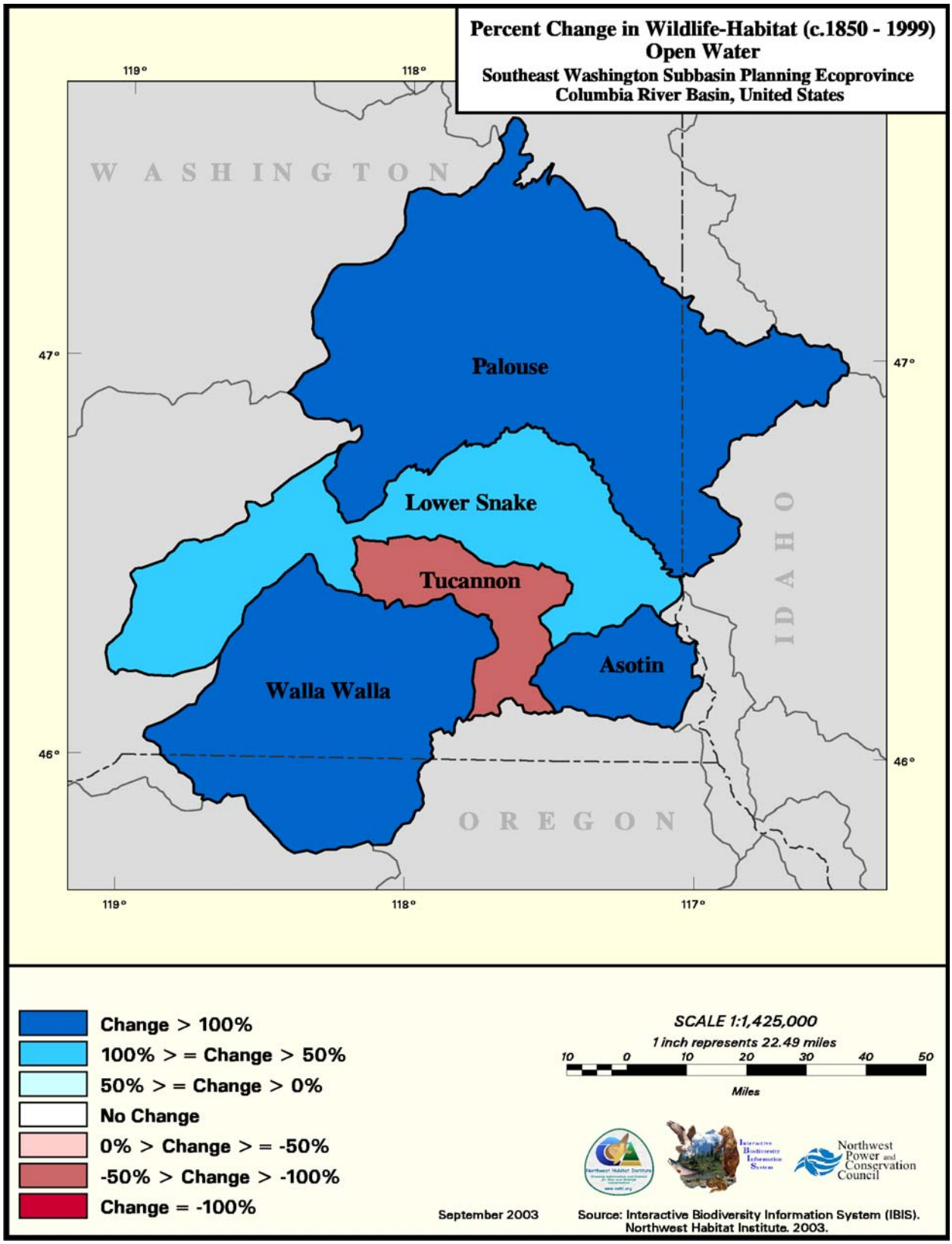

Figure C-13. Percent change in Open Water in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

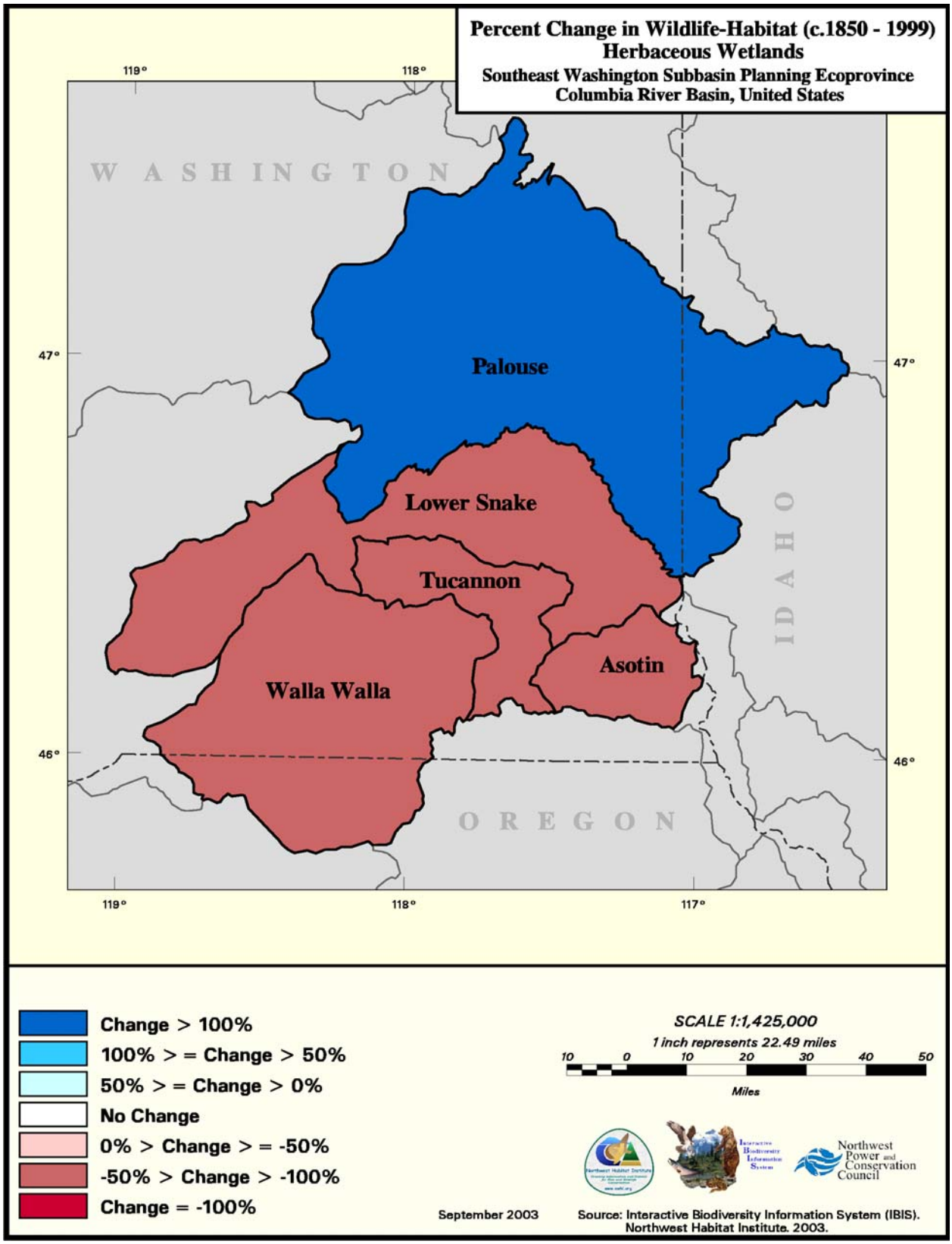

Figure C-14. Percent change in Herbaceous Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

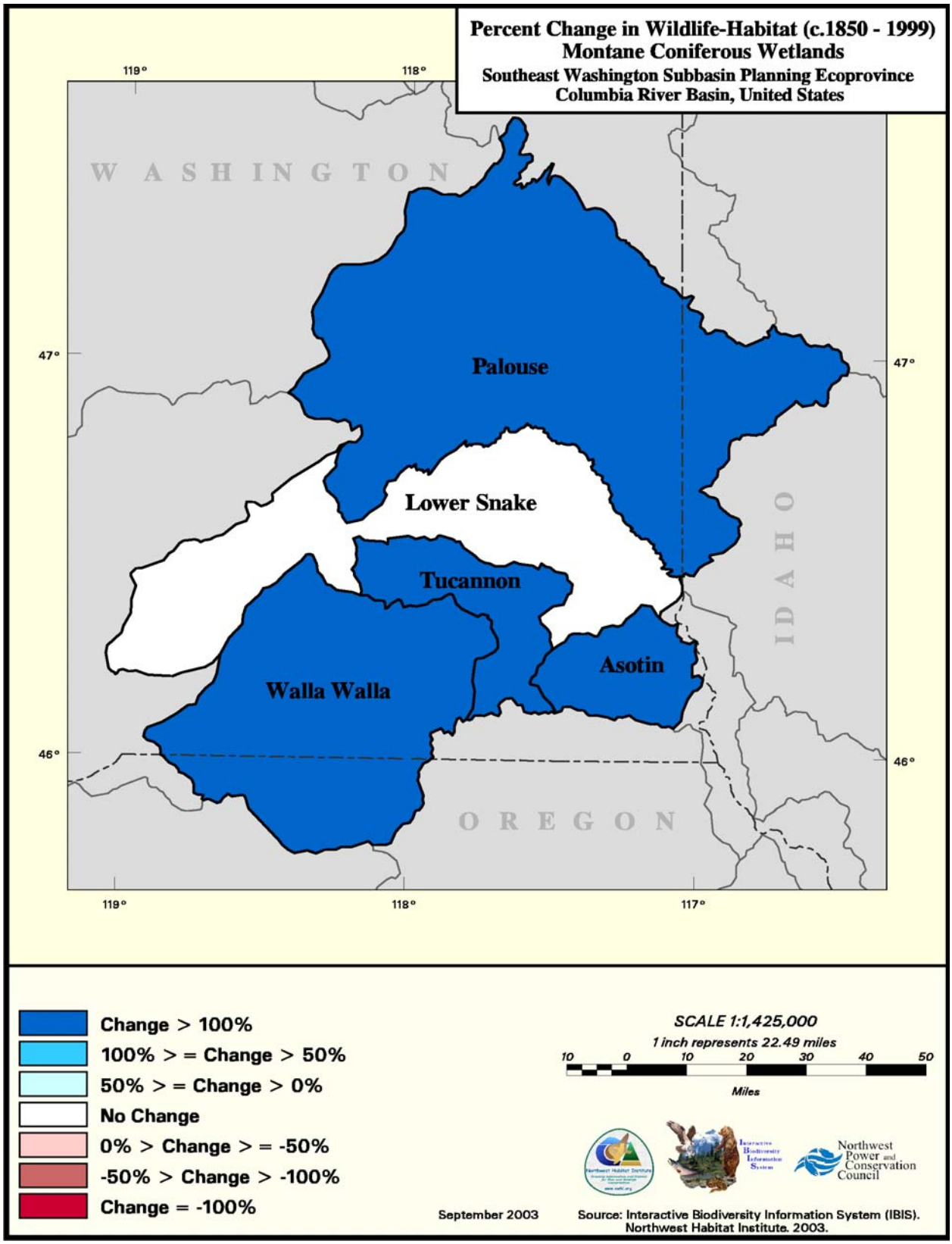

Figure C-15. Percent change in Montane Coniferous Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

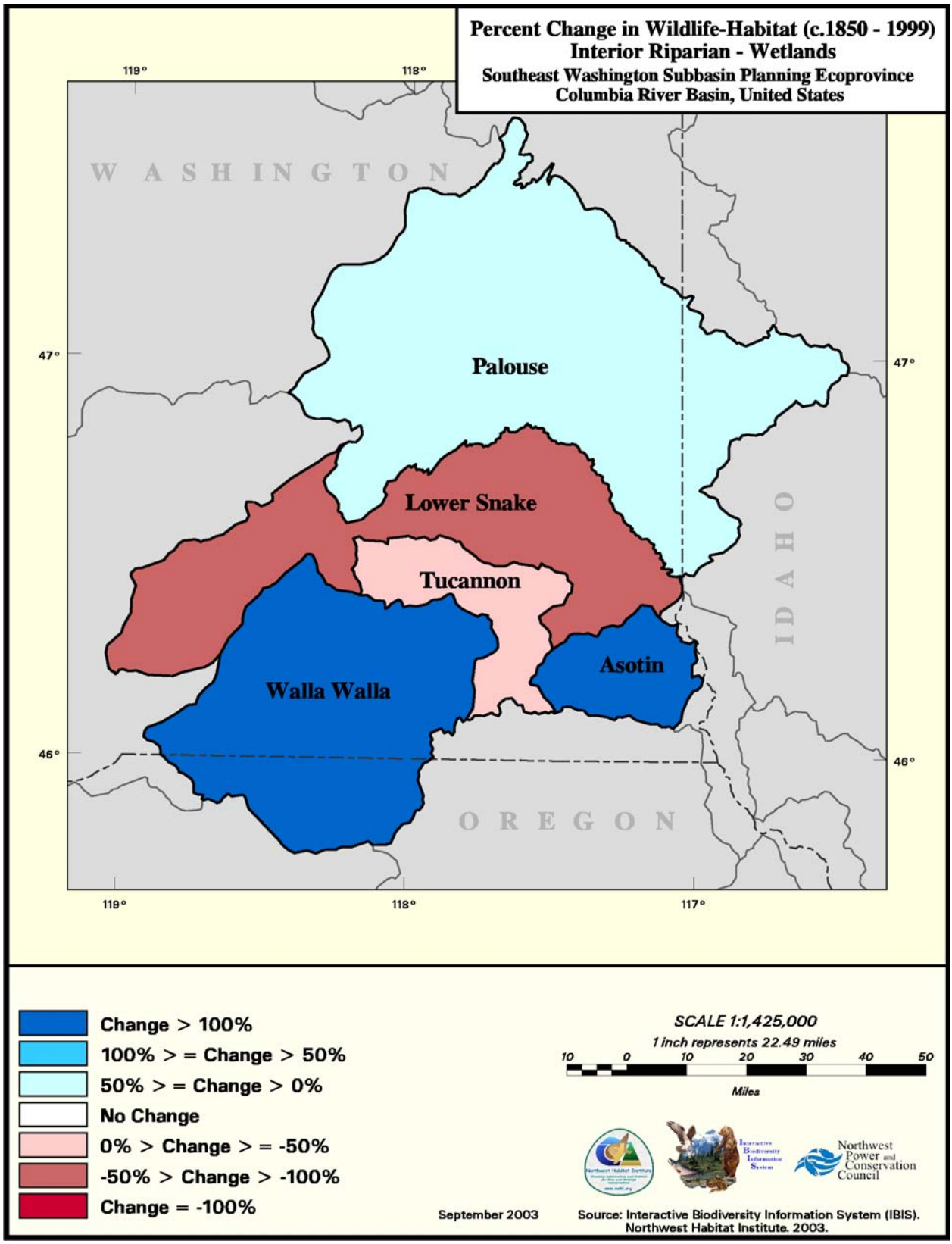

Figure C-16. Percent change in Interior Riparian Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Appendix D: Rare Plants

Table D-1 List of known occurrences of rare plants in the Southeast Washington Subbasin Planning Ecoregion (WNHP 2003).

Scientific Name	Common Name	State Status	Federal Status	Historic Record
Allium campanulatum	Sierra onion	Threatened		
Allium dictuon	Blue mountain onion	Threatened	SC	
Ammannia robusta	Grand redstem	Threatened		
Arabis crucisetosa	Cross-haired rockcress	Threatened		
Aster jessicae	Jessica's aster	Endangered	SC	
Astragalus arrectus	Palouse milk-vetch	Sensitive		
Astragalus arthurii	Arthur's milk-vetch	Sensitive		
Astragalus cusickii var cusickii	Cusick's milk-vetch	Sensitive		
Astragalus misellus var pauper	Pauper milk-vetch	Sensitive		H
Astragalus riparius	Piper's milk-vetch	Endangered		
Bolandra oregana	Bolandra	Sensitive		
Calochortus longebarbatus var longebarbatus	Long-bearded sego lily	Sensitive	SC	H
Calochortus macrocarpus var maculosus	Sagebrush mariposa-lily	Endangered		
Calochortus nitidus	Broad-fruit mariposa	Endangered	SC	
Camissonia pygmaea	Dwarf evening-primrose	Sensitive		
Carex comosa	Bristly sedge	Sensitive		H
Centunculus minimus	Chaffweed	Review		H
Cheilanthes feei	Fee's lip-fern	Extirpated		H
Cryptantha leucophaea	Gray cryptantha	Sensitive	SC	
Cryptantha rostellata	Beaked cryptantha	Threatened		
Cryptantha spiculifera	Snake river cryptantha	Sensitive		H
Cuscuta denticulata	Desert dodder	Threatened		
Cyperus bipartitus	Shining flatsedge	Sensitive		H
Cypripedium fasciculatum	Clustered lady's-slipper	Sensitive	SC	
Erigeron piperianus	Piper's daisy	Sensitive		
Eryngium articulatum	Jointed coyote-thistle	Extirpated		
Gilia leptomeria	Great basin gilia	Sensitive		
Githopsis specularioides	Common blue-cup	Sensitive		H
Hackelia diffusa var diffusa	Diffuse stickseed	Threatened		
Hackelia hispida var hispida	Rough stickseed	Threatened		
Haplopappus liatriformis	Palouse goldenweed	Threatened	SC	
Hypericum majus	Canadian st. john's-wort	Sensitive		
Impatiens aurella	Orange balsam	Review		
Juncus uncialis	Inch-high rush	Sensitive		
Lesquerella tuplashensis	White bluffs bladderpod	Threatened	C	
Lipocarpha aristulata	Awned halfchaff sedge	Threatened		H
Lomatium cusickii	Cusick's desert-parsley	Extirpated		H

Scientific Name	Common Name	State Status	Federal Status	Historic Record
Lomatium rollinsii	Rollins' desert-parsley	Threatened		
Lomatium serpentinum	Snake canyon desert-parsley	Sensitive		
Lupinus cusickii	Prairie lupine	Review	SC	H
Lupinus sabinii	Sabin's lupine	Endangered		H
Lupinus sericeus var asotinensis	Asotin silky lupine	Review		
Mimulus pulsiferae	Pulsifer's monkey-flower	Sensitive		H
Mimulus suksdorfii	Suksdorf's monkey-flower	Sensitive		
Mimulus washingtonensis	Washington monkey-flower	Extirpated		H
Monolepis pusilla	Red poverty-weed	Threatened		H
Nicotiana attenuata	Coyote tobacco	Sensitive		H
Oenothera caespitosa ssp marginata	Tufted evening-primrose	Sensitive		
Penstemon eriantherus var whitedii	Fuzzytongue penstemon	Sensitive		
Physaria didymocarpa var didymocarpa	Common twinpod	Sensitive		
Pilularia americana	American pillwort	Sensitive		
Polemonium pectinatum	Washington polemonium	Threatened	SC	
Ranunculus populago	Mountain buttercup	Sensitive		
Ribes cereum var colubrinum	Squaw currant	Endangered		
Ribes oxyacanthoides ssp irriguum	Idaho gooseberry	Sensitive		
Rorippa columbiae	Persistentsepal yellowcress	Endangered	SC	
Rotala ramosior	Lowland toothcup	Threatened		H
Rubus nigerrimus	Northwest raspberry	Endangered	SC	
Sclerolinon digynum	Northwestern yellowflax	Sensitive		
Silene spaldingii	Spalding's silene	Threatened	LT	
Spartina pectinata	Prairie cordgrass	Sensitive		H
Spiraea densiflora var splendens	Subalpine spiraea	Review		
Trifolium douglasii	Douglas' clover	Endangered		
Trifolium plumosum var plumosum	Plumed clover	Threatened		

State Status
State Status of the species is determined by the Washington Department of Fish and Wildlife. Factors considered include abundance, occurrence patterns, vulnerability, threats, existing protection, and taxonomic distinctness.Values include:

E = Endangered. In danger of becoming extinct or extirpated from Washington.
T = Threatened. Likely to become Endangered in Washington.
S = Sensitive. Vulnerable or declining and could become Endangered or Threatened in the state.
C = Candidate Animal. Under review for listing.
M = Monitor. Taxa of potential concern.
PT = Part. Used when two portions of a taxon have different state status.

Federal Status
Federal Status under the U.S. Endangered Species Act (USESA) as published in the Federal Register:

LE = Listed Endangered. In danger of extinction.
LT = Listed Threatened. Likely to become endangered.
PE = Proposed Endangered.
PT = Proposed Threatened.
C = Candidate species. Sufficient information exists to support listing as Endangered or Threatened.
SC = Species of Concern. An unofficial status, the species appears to be in jeopardy, but insufficient information to support listing.
NL = Not Listed. Used when two portions of a taxon have different federal status.

Table D-2. List of known high-quality or rare plant communities and wetland ecosystems of the Southeast Washington Subbasin Planning Ecoregion (WNHP 2003).

Scientific Name	Common Name
ABIES GRANDIS / CLINTONIA UNIFLORA FOREST	GRAND FIR / QUEEN'S CUP
ABIES GRANDIS / VACCINIUM MEMBRANACEUM FOREST	GRAND FIR / BIG HUCKLEBERRY
ARISTIDA PURPUREA VAR. LONGISETA - POA SECUNDA HERBACEOUS VEGETATION	RED THREEAWN - SANDBERG BLUEGRASS
ARTEMISIA RIGIDA / POA SECUNDA DWARF-SHRUB HERBACEOUS VEGETATION	STIFF SAGEBRUSH / SANDBERG BLUEGRASS
ARTEMISIA TRIDENTATA / FESTUCA IDAHOENSIS SHRUB HERBACEOUS VEGETATION	BIG SAGEBRUSH / IDAHO FESCUE
ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS / POA SECUNDA SHRUBLAND	WYOMING BIG SAGEBRUSH / SANDBERG BLUEGRASS
ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS / PSEUDOROEGNERIA SPICATA SHRUB HERBACEOUS VEGETATION	WYOMING BIG SAGEBRUSH / BLUEBUNCH WHEATGRASS
ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS / STIPA COMATA SHRUBLAND	WYOMING BIG SAGEBRUSH / NEEDLE-AND-THREAD
ARTEMISIA TRIPARTITA / FESTUCA IDAHOENSIS SHRUB HERBACEOUS VEGETATION	THREETIP SAGEBRUSH / IDAHO FESCUE
BETULA OCCIDENTALIS COVER TYPE	WATER BIRCH FOREST
CELTIS LAEVIGATA VAR. RETICULATA / PSEUDOROEGNERIA SPICATA WOODLAND	NETLEAF HACKBERRY / BLUEBUNCH WHEATGRASS
CORNUS SERICEA SHRUBLAND (PROVISIONAL)	RED-OSIER DOGWOOD
CRATAEGUS DOUGLASII / ROSA WOODSII SHRUBLAND	BLACK HAWTHORN / WOOD'S ROSE
CRATAEGUS DOUGLASII COVER TYPE	BLACK HAWTHORN THICKET
DISTICHLIS SPICATA HERBACEOUS VEGETATION	SALTGRASS
ELEOCHARIS PALUSTRIS INTERMITTENTLY FLOODED HERBACEOUS VEGETATION	CREEPING SPIKERUSH
ERIOGONUM NIVEUM / POA SECUNDA DWARF-SHRUB HERBACEOUS VEGETATION	SNOW BUCKWHEAT / SANDBERG BLUEGRASS
ERIOGONUM COMPOSITUM / POA SECUNDA DWARF-SHRUB HERBACEOUS VEGETATION	ARROW-LEAF BUCKWHEAT / SANDBERG BLUEGRASS
ERIOGONUM MICROTHECUM - PHYSARIA OREGONA DWARF-SHRUBLAND	SLENDER BUCKWHEAT - OREGON BLADDERPOD
ERIOGONUM MICROTHECUM COVER TYPE	SLENDER BUCKWHEAT SHRUBLAND
ERIOGONUM NIVEUM / POA SECUNDA DWARF-SHRUB HERBACEOUS VEGETATION	SNOW BUCKWHEAT / SANDBERG BLUEGRASS
FESTUCA CAMPESTRIS - FESTUCA IDAHOENSIS HERBACEOUS VEGETATION	ROUGH FESCUE - IDAHO FESCUE
FESTUCA IDAHOENSIS - KOELERIA MACRANTHA HERBACEOUS VEGETATION	IDAHO FESCUE - PRAIRIE JUNEGRASS
FESTUCA IDAHOENSIS - SYMPHORICARPOS ALBUS HERBACEOUS VEGETATION	IDAHO FESCUE - COMMON SNOWBERRY
GRAYIA SPINOSA / POA SECUNDA SHRUBLAND	SPINY HOPSAGE / SANDBERG BLUEGRASS
JUNIPERUS OCCIDENTALIS COVER TYPE	WESTERN JUNIPER FOREST
LARIX OCCIDENTALIS COVER TYPE	WESTERN LARCH FOREST
LEYMUS CINEREUS - DISTICHLIS SPICATA HERBACEOUS VEGETATION	GREAT BASIN WILDRYE - SALTGRASS

Scientific Name	Common Name
PINUS MONTICOLA / CLINTONIA UNIFLORA FOREST	WESTERN WHITE PINE / QUEEN'S CUP
PINUS PONDEROSA / FESTUCA IDAHOENSIS WOODLAND	PONDEROSA PINE / IDAHO FESCUE
PINUS PONDEROSA / PHYSOCARPUS MALVACEUS FOREST	PONDEROSA PINE / MALLOW-LEAF NINEBARK
PINUS PONDEROSA - PSEUDOTSUGA MENZIESII / CALAMAGROSTIS RUBESCENS WOODLAND	PONDEROSA PINE - DOUGLAS-FIR / PINEGRASS
PINUS PONDEROSA / SYMPHORICARPOS ALBUS FOREST	PONDEROSA PINE / COMMON SNOWBERRY
POPULUS BALSAMIFERA SSP. TRICHOCARPA COVER TYPE	BLACK COTTONWOOD FOREST
POPULUS TREMULOIDES COVER TYPE	QUAKING ASPEN FOREST
POPULUS TREMULOIDES / CORNUS SERICEA FOREST	QUAKING ASPEN / RED-OSIER DOGWOOD
(POPULUS TREMULOIDES) / CRATAEGUS DOUGLASII / HERACLEUM MAXIMUM SHRUBLAND	(QUAKING ASPEN) / BLACK HAWTHORN / COW PARSNIP
(POPULUS TREMULOIDES) / CRATAEGUS DOUGLASII / SYMPHORICARPOS ALBUS SHRUBLAND	(QUAKING ASPEN) / BLACK HAWTHORN / COMMON SNOWBERRY
PSEUDOROEGNERIA SPICATA - FESTUCA IDAHOENSIS CANYON HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - IDAHO FESCUE CANYON
PSEUDOROEGNERIA SPICATA - FESTUCA IDAHOENSIS PALOUSE HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - IDAHO FESCUE PALOUSE
PSEUDOROEGNERIA SPICATA - POA SECUNDA HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - SANDBERG BLUEGRASS
PSEUDOROEGNERIA SPICATA - POA SECUNDA LITHOSOLIC HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - SANDBERG BLUEGRASS LITHOSOL
PSEUDOTSUGA MENZIESII / CALAMAGROSTIS RUBESCENS FOREST	DOUGLAS-FIR / PINEGRASS
PSEUDOTSUGA MENZIESII / PHYSOCARPUS MALVACEUS FOREST	DOUGLAS-FIR / MALLOW-LEAF NINEBARK
PSEUDOTSUGA MENZIESII / SYMPHORICARPOS ALBUS FOREST	DOUGLAS-FIR / COMMON SNOWBERRY
PURSHIA TRIDENTATA / ORYZOPSIS HYMENOIDES SHRUBLAND	BITTERBRUSH / INDIAN RICEGRASS
PURSHIA TRIDENTATA / STIPA COMATA SHRUB HERBACEOUS VEGETATION	BITTERBRUSH / NEEDLE-AND-THREAD
ROSA NUTKANA - FESTUCA IDAHOENSIS HERBACEOUS VEGETATION	NOOTKA ROSE - IDAHO FESCUE
SALIX EXIGUA SHRUBLAND (PROVISIONAL)	SANDBAR WILLOW
SALIX LUCIDA SSP. CAUDATA SHRUBLAND (PROVISIONAL)	SHINING WILLOW
SPOROBOLUS CRYPTANDRUS - POA SECUNDA HERBACEOUS VEGETATION	SAND DROPSEED - SANDBERG BLUEGRASS
STIPA COMATA - POA SECUNDA HERBACEOUS VEGETATION	NEEDLE-AND-THREAD - SANDBERG BLUEGRASS

Appendix E: Wildlife Species of the Southeast Washington Subbasin Planning Ecoregion

Table E-1. Wildlife species occurrence and breeding status of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Tiger Salamander	occurs	breeds	occurs	breeds	occurs	breeds
Long-toed Salamander	occurs	breeds	occurs	breeds	occurs	breeds
Idaho Giant Salamander	does not occur	n/a	does not occur	not applicable	occurs	breeds
Rough-skinned Newt	occurs	breeds	occurs	breeds	occurs	breeds
Tailed Frog	occurs	breeds	occurs	breeds	occurs	breeds
Great Basin Spadefoot	occurs	breeds	occurs	breeds	occurs	breeds
Western Toad	occurs	breeds	occurs	breeds	occurs	breeds
Woodhouse's Toad	occurs	breeds	occurs	breeds	occurs	breeds
Pacific Chorus (Tree) Frog	occurs	breeds	occurs	breeds	occurs	breeds
Oregon Spotted Frog	occurs	breeds	occurs	breeds	does not occur	n/a
Columbia Spotted Frog	occurs	breeds	occurs	breeds	occurs	breeds
Northern Leopard Frog	occurs	breeds	occurs	breeds	occurs	breeds
Bullfrog	non-native	breeds	non-native	breeds	non-native	breeds
Painted Turtle	occurs	breeds	occurs	breeds	occurs	breeds
Northern Alligator Lizard	occurs	breeds	occurs	breeds	occurs	breeds
Short-horned Lizard	occurs	breeds	occurs	breeds	occurs	breeds
Sagebrush Lizard	occurs	breeds	occurs	breeds	occurs	breeds
Western Fence Lizard	occurs	breeds	occurs	breeds	occurs	breeds
Side-blotched Lizard	occurs	breeds	occurs	breeds	occurs	breeds
Western Skink	occurs	breeds	occurs	breeds	occurs	breeds
Rubber Boa	occurs	breeds	occurs	breeds	occurs	breeds
Racer	occurs	breeds	occurs	breeds	occurs	breeds
Ringneck Snake	occurs	breeds	occurs	breeds	occurs	breeds
Night Snake	occurs	breeds	occurs	breeds	occurs	breeds
Striped Whipsnake	occurs	breeds	occurs	breeds	occurs	breeds
Gopher Snake	occurs	breeds	occurs	breeds	occurs	breeds
Western Terrestrial Garter Snake	occurs	breeds	occurs	breeds	occurs	breeds
Common Garter Snake	occurs	breeds	occurs	breeds	occurs	breeds
Western Rattlesnake	occurs	breeds	occurs	breeds	occurs	breeds
Common Loon	occurs	non-breeder	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Pied-billed Grebe	occurs	breeds	occurs	breeds	occurs	breeds
Horned Grebe	occurs	breeds	occurs	breeds	occurs	breeds
Red-necked Grebe	occurs	breeds	occurs	breeds	occurs	breeds
Eared Grebe	occurs	breeds	occurs	breeds	occurs	breeds
Western Grebe	occurs	breeds	occurs	breeds	occurs	breeds
Clark's Grebe	occurs	breeds	occurs	breeds	occurs	breeds
American White Pelican	occurs	breeds	occurs	breeds	occurs	breeds
Double-crested Cormorant	occurs	breeds	occurs	breeds	occurs	breeds
American Bittern	occurs	breeds	occurs	breeds	occurs	breeds
Great Blue Heron	occurs	breeds	occurs	breeds	occurs	breeds
Great Egret	occurs	breeds	occurs	breeds	occurs	breeds
Cattle Egret	occurs	breeds	occurs	non-breeder	occurs	breeds
Green Heron	occurs	breeds	occurs	breeds	accidental	non-breeder
Black-crowned Night-heron	occurs	breeds	occurs	breeds	occurs	breeds
Turkey Vulture	occurs	breeds	occurs	breeds	occurs	breeds
Greater White-fronted Goose	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Snow Goose	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Ross's Goose	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Canada Goose	occurs	breeds	occurs	breeds	occurs	breeds
Trumpeter Swan	occurs	breeds	occurs	breeds	occurs	breeds
Tundra Swan	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Wood Duck	occurs	breeds	occurs	breeds	occurs	breeds
Gadwall	occurs	breeds	occurs	breeds	occurs	breeds
Eurasian Wigeon	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
American Wigeon	occurs	breeds	occurs	breeds	occurs	breeds
Mallard	occurs	breeds	occurs	breeds	occurs	breeds
Blue-winged Teal	occurs	breeds	occurs	breeds	occurs	breeds
Cinnamon Teal	occurs	breeds	occurs	breeds	occurs	breeds
Northern Shoveler	occurs	breeds	occurs	breeds	occurs	breeds
Northern Pintail	occurs	breeds	occurs	breeds	occurs	breeds
Green-winged Teal	occurs	breeds	occurs	breeds	occurs	breeds
Canvasback	occurs	breeds	occurs	breeds	occurs	breeds
Redhead	occurs	breeds	occurs	breeds	occurs	breeds
Ring-necked Duck	occurs	breeds	occurs	breeds	occurs	breeds
Greater Scaup	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Lesser Scaup	occurs	breeds	occurs	breeds	occurs	breeds
Harlequin Duck	occurs	breeds	occurs	breeds	occurs	breeds
Surf Scoter	occurs	non-	occurs	non-breeder	accidental	non-

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
		breeder				breeder
Bufflehead	occurs	breeds	occurs	breeds	occurs	breeds
Common Goldeneye	occurs	non-breeder	occurs	breeds	occurs	breeds
Barrow's Goldeneye	occurs	breeds	occurs	breeds	occurs	breeds
Hooded Merganser	occurs	breeds	occurs	breeds	occurs	breeds
Common Merganser	occurs	breeds	occurs	breeds	occurs	breeds
Red-breasted Merganser	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Ruddy Duck	occurs	breeds	occurs	breeds	occurs	breeds
Osprey	occurs	breeds	occurs	breeds	occurs	breeds
Bald Eagle	occurs	breeds	occurs	breeds	occurs	breeds
Northern Harrier	occurs	breeds	occurs	breeds	occurs	breeds
Sharp-shinned Hawk	occurs	breeds	occurs	breeds	occurs	breeds
Cooper's Hawk	occurs	breeds	occurs	breeds	occurs	breeds
Northern Goshawk	occurs	breeds	occurs	breeds	occurs	breeds
Swainson's Hawk	occurs	breeds	occurs	breeds	occurs	breeds
Red-tailed Hawk	occurs	breeds	occurs	breeds	occurs	breeds
Ferruginous Hawk	occurs	breeds	occurs	breeds	occurs	breeds
Rough-legged Hawk	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Golden Eagle	occurs	breeds	occurs	breeds	occurs	breeds
American Kestrel	occurs	breeds	occurs	breeds	occurs	breeds
Merlin	occurs	bred historically	occurs	breeds	occurs	breeds
Gyrfalcon	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Peregrine Falcon	occurs	breeds	occurs	breeds	occurs	breeds
Prairie Falcon	occurs	breeds	occurs	breeds	occurs	breeds
Chukar	non-native	breeds	non-native	breeds	non-native	breeds
Gray Partridge	non-native	breeds	non-native	breeds	non-native	breeds
Ring-necked Pheasant	non-native	breeds	non-native	breeds	non-native	breeds
Ruffed Grouse	occurs	breeds	occurs	breeds	occurs	breeds
Sage Grouse	occurs	breeds	occurs	breeds	occurs	breeds
Spruce Grouse	occurs	breeds	occurs	breeds	occurs	breeds
Blue Grouse	occurs	breeds	occurs	breeds	occurs	breeds
Sharp-tailed Grouse	reintroduced	breeds	occurs	breeds	occurs	breeds
Wild Turkey	non-native	breeds	non-native	breeds	non-native	breeds
Mountain Quail	occurs	breeds	occurs	breeds	occurs	breeds
Gambel's Quail	does not occur	not applicable	does not occur	not applicable	non-native	breeds
California Quail	occurs	breeds	non-native	breeds	non-native	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Northern Bobwhite	non-native	breeds	non-native	breeds	non-native	breeds
Virginia Rail	occurs	breeds	occurs	breeds	occurs	breeds
Sora	occurs	breeds	occurs	breeds	occurs	breeds
American Coot	occurs	breeds	occurs	breeds	occurs	breeds
Sandhill Crane	occurs	breeds	occurs	breeds	occurs	breeds
Black-bellied Plover	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Pacific Golden-Plover	occurs	non-breeder	occurs	non-breeder	does not occur	n/a
Semipalmated Plover	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Killdeer	occurs	breeds	occurs	breeds	occurs	breeds
Black-necked Stilt	occurs	breeds	occurs	breeds	occurs	breeds
American Avocet	occurs	breeds	occurs	breeds	occurs	breeds
Greater Yellowlegs	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Lesser Yellowlegs	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Solitary Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Willet	occurs	breeds	occurs	non-breeder	occurs	breeds
Spotted Sandpiper	occurs	breeds	occurs	breeds	occurs	breeds
Upland Sandpiper	occurs	breeds	extirpated	bred historically	occurs	breeds
Long-billed Curlew	occurs	breeds	occurs	breeds	occurs	breeds
Marbled Godwit	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Sanderling	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Semipalmated Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Western Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Least Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Baird's Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Pectoral Sandpiper	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Dunlin	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Stilt Sandpiper	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Short-billed Dowitcher	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Long-billed Dowitcher	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Wilson's Snipe	occurs	breeds	occurs	breeds	occurs	breeds
Wilson's Phalarope	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Red-necked Phalarope	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Bonaparte's Gull	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Mew Gull	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Ring-billed Gull	occurs	breeds	occurs	breeds	occurs	breeds
California Gull	occurs	breeds	occurs	breeds	occurs	breeds
Herring Gull	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Thayer's Gull	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Glaucous-winged Gull	occurs	breeds	occurs	breeds	accidental	non-breeder
Glaucous Gull	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Caspian Tern	occurs	breeds	occurs	breeds	occurs	breeds
Common Tern	occurs	non-breeder	occurs	non-breeder	occurs	breeds
Forster's Tern	occurs	breeds	occurs	breeds	occurs	breeds
Black Tern	occurs	breeds	occurs	breeds	occurs	breeds
Rock Dove	non-native	breeds	non-native	breeds	non-native	breeds
Band-tailed Pigeon	occurs	breeds	occurs	breeds	accidental	non-breeder
Mourning Dove	occurs	breeds	occurs	breeds	occurs	breeds
Yellow-billed Cuckoo	occurs	breeds	occurs	bred historically	occurs	bred historically
Barn Owl	occurs	breeds	occurs	breeds	occurs	breeds
Flammulated Owl	occurs	breeds	occurs	breeds	occurs	breeds
Western Screech-owl	occurs	breeds	occurs	breeds	occurs	breeds
Great Horned Owl	occurs	breeds	occurs	breeds	occurs	breeds
Snowy Owl	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Northern Pygmy-owl	occurs	breeds	occurs	breeds	occurs	breeds
Burrowing Owl	occurs	breeds	occurs	breeds	occurs	breeds
Barred Owl	occurs	breeds	occurs	breeds	occurs	breeds
Great Gray Owl	occurs	breeds	occurs	breeds	occurs	breeds
Long-eared Owl	occurs	breeds	occurs	breeds	occurs	breeds
Short-eared Owl	occurs	breeds	occurs	breeds	occurs	breeds
Boreal Owl	occurs	breeds	occurs	breeds	occurs	breeds
Northern Saw-whet Owl	occurs	breeds	occurs	breeds	occurs	breeds
Common Nighthawk	occurs	breeds	occurs	breeds	occurs	breeds
Common Poorwill	occurs	breeds	occurs	breeds	occurs	breeds
Black Swift	occurs	breeds	occurs	breeds	occurs	breeds
Vaux's Swift	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
White-throated Swift	occurs	breeds	occurs	breeds	occurs	breeds
Black-chinned Hummingbird	occurs	breeds	occurs	breeds	occurs	breeds
Calliope Hummingbird	occurs	breeds	occurs	breeds	occurs	breeds
Broad-tailed Hummingbird	occurs	breeds	does not occur	n/a	occurs	breeds
Rufous Hummingbird	occurs	breeds	occurs	breeds	occurs	breeds
Belted Kingfisher	occurs	breeds	occurs	breeds	occurs	breeds
Lewis's Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Williamson's Sapsucker	occurs	breeds	occurs	breeds	occurs	breeds
Red-naped Sapsucker	occurs	breeds	occurs	breeds	occurs	breeds
Red-breasted Sapsucker	occurs	breeds	occurs	breeds	accidental	non-breeder
Downy Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Hairy Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
White-headed Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Three-toed Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Black-backed Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Northern Flicker	occurs	breeds	occurs	breeds	occurs	breeds
Pileated Woodpecker	occurs	breeds	occurs	breeds	occurs	breeds
Olive-sided Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Western Wood-pewee	occurs	breeds	occurs	breeds	occurs	breeds
Willow Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Least Flycatcher	occurs	non-breeder	occurs	breeds	occurs	breeds
Hammond's Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Gray Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Dusky Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Pacific-slope Flycatcher	occurs	breeds	occurs	breeds	does not occur	n/a
Cordilleran Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Say's Phoebe	occurs	breeds	occurs	breeds	occurs	breeds
Ash-throated Flycatcher	occurs	breeds	occurs	breeds	occurs	breeds
Western Kingbird	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Eastern Kingbird	occurs	breeds	occurs	breeds	occurs	breeds
Loggerhead Shrike	occurs	breeds	occurs	breeds	occurs	breeds
Northern Shrike	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Cassin's Vireo	occurs	breeds	occurs	breeds	occurs	breeds
Hutton's Vireo	occurs	breeds	occurs	breeds	does not occur	n/a
Warbling Vireo	occurs	breeds	occurs	breeds	occurs	breeds
Red-eyed Vireo	occurs	breeds	occurs	breeds	occurs	breeds
Gray Jay	occurs	breeds	occurs	breeds	occurs	breeds
Steller's Jay	occurs	breeds	occurs	breeds	occurs	breeds
Western Scrub-Jay	occurs	breeds	occurs	breeds	occurs	breeds
Pinyon Jay	occurs	breeds	accidental	non-breeder	occurs	breeds
Clark's Nutcracker	occurs	breeds	occurs	breeds	occurs	breeds
Black-billed Magpie	occurs	breeds	occurs	breeds	occurs	breeds
American Crow	occurs	breeds	occurs	breeds	occurs	breeds
Northwestern Crow	occurs	non-breeder	occurs	breeds	does not occur	n/a
Common Raven	occurs	breeds	occurs	breeds	occurs	breeds
Horned Lark	occurs	breeds	occurs	breeds	occurs	breeds
Tree Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Violet-green Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Northern Rough-winged Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Bank Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Cliff Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Barn Swallow	occurs	breeds	occurs	breeds	occurs	breeds
Black-capped Chickadee	occurs	breeds	occurs	breeds	occurs	breeds
Mountain Chickadee	occurs	breeds	occurs	breeds	occurs	breeds
Chestnut-backed Chickadee	occurs	breeds	occurs	breeds	occurs	breeds
Bushtit	occurs	breeds	occurs	breeds	occurs	breeds
Red-breasted Nuthatch	occurs	breeds	occurs	breeds	occurs	breeds
White-breasted Nuthatch	occurs	breeds	occurs	breeds	occurs	breeds
Pygmy Nuthatch	occurs	breeds	occurs	breeds	occurs	breeds
Brown Creeper	occurs	breeds	occurs	breeds	occurs	breeds
Rock Wren	occurs	breeds	occurs	breeds	occurs	breeds
Canyon Wren	occurs	breeds	occurs	breeds	occurs	breeds
Bewick's Wren	occurs	breeds	occurs	breeds	occurs	breeds
House Wren	occurs	breeds	occurs	breeds	occurs	breeds
Winter Wren	occurs	breeds	occurs	breeds	occurs	breeds
Marsh Wren	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
American Dipper	occurs	breeds	occurs	breeds	occurs	breeds
Golden-crowned Kinglet	occurs	breeds	occurs	breeds	occurs	breeds
Ruby-crowned Kinglet	occurs	breeds	occurs	breeds	occurs	breeds
Western Bluebird	occurs	breeds	occurs	breeds	occurs	breeds
Mountain Bluebird	occurs	breeds	occurs	breeds	occurs	breeds
Townsend's Solitaire	occurs	breeds	occurs	breeds	occurs	breeds
Veery	occurs	breeds	occurs	breeds	occurs	breeds
Swainson's Thrush	occurs	breeds	occurs	breeds	occurs	breeds
Hermit Thrush	occurs	breeds	occurs	breeds	occurs	breeds
American Robin	occurs	breeds	occurs	breeds	occurs	breeds
Varied Thrush	occurs	breeds	occurs	breeds	occurs	breeds
Gray Catbird	occurs	breeds	occurs	breeds	occurs	breeds
Northern Mockingbird	occurs	non-breeder	occurs	breeds	occurs	breeds
Sage Thrasher	occurs	breeds	occurs	breeds	occurs	breeds
European Starling	non-native	breeds	non-native	breeds	non-native	breeds
American Pipit	occurs	breeds	occurs	breeds	occurs	breeds
Bohemian Waxwing	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Cedar Waxwing	occurs	breeds	occurs	breeds	occurs	breeds
Orange-crowned Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Nashville Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Yellow Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Yellow-rumped Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Townsend's Warbler	occurs	breeds	occurs	breeds	occurs	breeds
American Redstart	occurs	breeds	occurs	breeds	occurs	breeds
Northern Waterthrush	occurs	breeds	occurs	breeds	occurs	breeds
Macgillivray's Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Common Yellowthroat	occurs	breeds	occurs	breeds	occurs	breeds
Wilson's Warbler	occurs	breeds	occurs	breeds	occurs	breeds
Yellow-breasted Chat	occurs	breeds	occurs	breeds	occurs	breeds
Western Tanager	occurs	breeds	occurs	breeds	occurs	breeds
Green-tailed Towhee	occurs	breeds	occurs	breeds	occurs	breeds
Spotted Towhee	occurs	breeds	occurs	breeds	occurs	breeds
American Tree Sparrow	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Chipping Sparrow	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Clay-colored Sparrow	occurs	non-breeder	occurs	breeds	accidental	non-breeder
Brewer's Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Vesper Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Lark Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Black-throated Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Sage Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Savannah Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Grasshopper Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Fox Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Song Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Lincoln's Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Swamp Sparrow	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
White-throated Sparrow	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Harris's Sparow	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Harris's Sparrow	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
White-crowned Sparrow	occurs	breeds	occurs	breeds	occurs	breeds
Golden-crowned Sparrow	occurs	non-breeder	occurs	non-breeder	accidental	non-breeder
Dark-eyed Junco	occurs	breeds	occurs	breeds	occurs	breeds
Lapland Longspur	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Snow Bunting	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Black-headed Grosbeak	occurs	breeds	occurs	breeds	occurs	breeds
Lazuli Bunting	occurs	breeds	occurs	breeds	occurs	breeds
Bobolink	occurs	breeds	occurs	breeds	occurs	breeds
Red-winged Blackbird	occurs	breeds	occurs	breeds	occurs	breeds
Western Meadowlark	occurs	breeds	occurs	breeds	occurs	breeds
Yellow-headed Blackbird	occurs	breeds	occurs	breeds	occurs	breeds
Brewer's Blackbird	occurs	breeds	occurs	breeds	occurs	breeds
Brown-headed Cowbird	occurs	breeds	occurs	breeds	occurs	breeds
Bullock's Oriole	occurs	breeds	occurs	breeds	occurs	breeds
Gray-crowned Rosy-Finch	occurs	breeds	occurs	breeds	occurs	breeds
Black Rosy-finch	occurs	breeds	does not occur	n/a	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Pine Grosbeak	occurs	breeds	occurs	breeds	occurs	breeds
Purple Finch	occurs	breeds	occurs	breeds	accidental	non-breeder
Cassin's Finch	occurs	breeds	occurs	breeds	occurs	breeds
House Finch	occurs	breeds	occurs	breeds	occurs	breeds
Red Crossbill	occurs	breeds	occurs	breeds	occurs	breeds
White-winged Crossbill	occurs	non-breeder	occurs	breeds	occurs	breeds
Common Redpoll	occurs	non-breeder	occurs	non-breeder	occurs	non-breeder
Pine Siskin	occurs	breeds	occurs	breeds	occurs	breeds
Lesser Goldfinch	occurs	breeds	occurs	breeds	occurs	breeds
American Goldfinch	occurs	breeds	occurs	breeds	occurs	breeds
Evening Grosbeak	occurs	breeds	occurs	breeds	occurs	breeds
House Sparrow	non-native	breeds	non-native	breeds	non-native	breeds
Virginia Opossum	non-native	breeds	non-native	breeds	non-native	breeds
Masked Shrew	does not occur	n/a	occurs	breeds	occurs	breeds
Preble's Shrew	occurs	breeds	occurs	breeds	does not occur	n/a
Vagrant Shrew	occurs	breeds	occurs	breeds	occurs	breeds
Montane Shrew	occurs	breeds	occurs	breeds	occurs	breeds
Water Shrew	occurs	breeds	occurs	breeds	occurs	breeds
Merriam's Shrew	occurs	breeds	occurs	breeds	occurs	breeds
Pygmy Shrew	does not occur	n/a	occurs	breeds	occurs	breeds
Coast Mole	occurs	breeds	occurs	breeds	occurs	breeds
California Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Western Small-footed Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Yuma Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Little Brown Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Long-legged Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Fringed Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Long-eared Myotis	occurs	breeds	occurs	breeds	occurs	breeds
Silver-haired Bat	occurs	breeds	occurs	breeds	occurs	breeds
Western Pipistrelle	occurs	breeds	occurs	breeds	occurs	breeds
Big Brown Bat	occurs	breeds	occurs	breeds	occurs	breeds
Hoary Bat	occurs	non-breeder	occurs	non-breeder	occurs	breeds
Spotted Bat	accidental	non-breeder	occurs	breeds	occurs	breeds
Townsend's Big-eared Bat	occurs	breeds	occurs	breeds	occurs	breeds
Pallid Bat	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
American Pika	occurs	breeds	occurs	breeds	occurs	breeds
Eastern Cottontail	non-native	breeds	non-native	breeds	does not occur	n/a
Nuttall's (Mountain) Cottontail	occurs	breeds	occurs	breeds	occurs	breeds
Snowshoe Hare	occurs	breeds	occurs	breeds	occurs	breeds
White-tailed Jackrabbit	occurs	breeds	occurs	breeds	occurs	breeds
Black-tailed Jackrabbit	occurs	breeds	occurs	breeds	occurs	breeds
Least Chipmunk	occurs	breeds	occurs	breeds	occurs	breeds
Yellow-pine Chipmunk	occurs	breeds	occurs	breeds	occurs	breeds
Red-tailed Chipmunk	does not occur	not applicable	occurs	breeds	occurs	breeds
Yellow-bellied Marmot	occurs	breeds	occurs	breeds	occurs	breeds
Townsend's Ground Squirrel	occurs	breeds	occurs	breeds	occurs	breeds
Washington Ground Squirrel	occurs	breeds	occurs	breeds	does not occur	n/a
Belding's Ground Squirrel	occurs	breeds	does not occur	not applicable	occurs	breeds
Columbian Ground Squirrel	occurs	breeds	occurs	breeds	occurs	breeds
Golden-mantled Ground Squirrel	occurs	breeds	occurs	breeds	occurs	breeds
Eastern Gray Squirrel	non-native	breeds	non-native	breeds	non-native	breeds
Eastern Fox Squirrel	non-native	breeds	non-native	breeds	non-native	breeds
Red Squirrel	occurs	breeds	occurs	breeds	occurs	breeds
Northern Flying Squirrel	occurs	breeds	occurs	breeds	occurs	breeds
Northern Pocket Gopher	occurs	breeds	occurs	breeds	occurs	breeds
Great Basin Pocket Mouse	occurs	breeds	occurs	breeds	occurs	breeds
Ord's Kangaroo Rat	occurs	breeds	occurs	breeds	occurs	breeds
American Beaver	occurs	breeds	occurs	breeds	occurs	breeds
Western Harvest Mouse	occurs	breeds	occurs	breeds	occurs	breeds
Deer Mouse	occurs	breeds	occurs	breeds	occurs	breeds
Northern Grasshopper Mouse	occurs	breeds	occurs	breeds	occurs	breeds
Bushy-tailed Woodrat	occurs	breeds	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Southern Red-backed Vole	occurs	breeds	occurs	breeds	occurs	breeds
Heather Vole	occurs	breeds	occurs	breeds	occurs	breeds
Meadow Vole	does not occur	not applicable	occurs	breeds	occurs	breeds
Montane Vole	occurs	breeds	occurs	breeds	occurs	breeds
Long-tailed Vole	occurs	breeds	occurs	breeds	occurs	breeds
Water Vole	occurs	breeds	occurs	breeds	occurs	breeds
Sagebrush Vole	occurs	breeds	occurs	breeds	occurs	breeds
Muskrat	occurs	breeds	occurs	breeds	occurs	breeds
Norway Rat	non-native	breeds	non-native	breeds	non-native	breeds
House Mouse	non-native	breeds	non-native	breeds	non-native	breeds
Western Jumping Mouse	occurs	breeds	occurs	breeds	occurs	breeds
Common Porcupine	occurs	breeds	occurs	breeds	occurs	breeds
Nutria	non-native	breeds	non-native	breeds	non-native	breeds
Coyote	occurs	breeds	occurs	breeds	occurs	breeds
Gray Wolf	extirpated	bred-historically	occurs	breeds	occurs	breeds
Red Fox	occurs	breeds	occurs	breeds	occurs	breeds
Black Bear	occurs	breeds	occurs	breeds	occurs	breeds
Grizzly Bear	extirpated	bred-historically	occurs	breeds	occurs	breeds
Raccoon	occurs	breeds	occurs	breeds	occurs	breeds
American Marten	occurs	breeds	occurs	breeds	occurs	breeds
Fisher	occurs	breeds	occurs	breeds	occurs	breeds
Ermine	occurs	breeds	occurs	breeds	occurs	breeds
Long-tailed Weasel	occurs	breeds	occurs	breeds	occurs	breeds
Mink	occurs	breeds	occurs	breeds	occurs	breeds
Wolverine	occurs	breeds	occurs	breeds	occurs	breeds
American Badger	occurs	breeds	occurs	breeds	occurs	breeds
Western Spotted Skunk	occurs	breeds	occurs	breeds	occurs	breeds
Striped Skunk	occurs	breeds	occurs	breeds	occurs	breeds
Northern River Otter	occurs	breeds	occurs	breeds	occurs	breeds
Mountain Lion	occurs	breeds	occurs	breeds	occurs	breeds
Lynx	occurs	breeds	occurs	breeds	occurs	breeds
Bobcat	occurs	breeds	occurs	breeds	occurs	breeds
Rocky Mountain Elk	occurs	breeds	occurs	breeds	occurs	breeds
Mule Deer	occurs	breeds	occurs	breeds	occurs	breeds
White-tailed Deer (Eastside)	occurs	breeds	occurs	breeds	occurs	breeds
Moose	accidental	non-breeder	occurs	breeds	occurs	breeds

Common Name	Oregon	Oregon Breeding Status	Washington	Washington Breeding Status	Idaho	Idaho Breeding Status
Pronghorn Antelope	occurs	breeds	extirpated	bred-historically	occurs	breeds
Mountain Goat	reintroduced	breeds	occurs	breeds	occurs	breeds
Rocky Mountain Bighorn Sheep	occurs	breeds	reintroduced	breeds	occurs	breeds

Table E-2. Threatened and endangered species of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Federal Species List			
Common Name	**Oregon**	**Idaho**	**Washington**
Oregon Spotted Frog	FC*		FC*
Columbia Spotted Frog	FC*	FC*	
Bald Eagle	FT	FT	FT
Sage Grouse			FC*
Yellow-billed Cuckoo	FC*	FC*	FC*
Horned Lark	FC		FC
Washington Ground Squirrel	FC*		FC*
Gray Wolf		FE	FE
Grizzly Bear		FT	FT
Lynx	FT	FT	FT
State Species List			
Common Name	**Oregon**	**Idaho**	**Washington**
Tiger Salamander	SS-US		
Tailed Frog	SS-V		
Western Toad	SS-V	SC	SC
Woodhouse's Toad	SS-PN		
Oregon Spotted Frog	SS-C		SE
Columbia Spotted Frog	SS-US	SC	SC
Northern Leopard Frog	SS-C	SC	SE
Painted Turtle	SS-C		
Northern Alligator Lizard			
Sagebrush Lizard	SS-V		
Western Skink			
Ringneck Snake		SC	
Striped Whipsnake			SC
Western Rattlesnake	SS-V		
Common Loon		SC	SS
Horned Grebe	SS-PN		
Red-necked Grebe	SS-C		
Western Grebe			SC
Clark's Grebe			
American White Pelican	SS-V	SC	SE
American Bittern			
Great Blue Heron			
Great Egret		SC	
Black-crowned Night-heron			
Trumpeter Swan		SC	
Harlequin Duck	SS-US	SC	
Bufflehead	SS-US		
Barrow's Goldeneye	SS-US		
Bald Eagle	ST	SE	ST
Northern Goshawk	SS-C	SC	SC

Swainson's Hawk	SS-V		
Ferruginous Hawk	SS-C		ST
Golden Eagle			SC
Merlin			SC
Peregrine Falcon	SE	SE	SS
Sage Grouse	SS-V		ST
Spruce Grouse	SS-US		
Sharp-tailed Grouse		SC	ST
Mountain Quail	SS-US	SC	
Sandhill Crane	SS-V		SE
Upland Sandpiper	SS-C	SC	SE
Long-billed Curlew	SS-V		
Caspian Tern			
Common Tern			
Forster's Tern			
Black Tern		SC	
Yellow-billed Cuckoo	SS-C	SC	SC
Barn Owl			
Flammulated Owl	SS-C	SC	SC
Northern Pygmy-owl	SS-C	SC	
Burrowing Owl	SS-C		SC
Great Gray Owl	SS-V	SC	
Boreal Owl	SS-US	SC	
Common Nighthawk	SS-C		
Black Swift	SS-PN		
Vaux's Swift			SC
Broad-tailed Hummingbird			
Lewis's Woodpecker	SS-C		SC
Williamson's Sapsucker	SS-US		
White-headed Woodpecker	SS-C	SC	SC
Three-toed Woodpecker	SS-C	SC	
Black-backed Woodpecker	SS-C	SC	SC
Pileated Woodpecker	SS-V		SC
Olive-sided Flycatcher	SS-V		
Willow Flycatcher	SS-V/US		
Ash-throated Flycatcher			
Loggerhead Shrike	SS-V	SC	SC
Western Scrub-Jay			
Horned Lark	SS-C		SC
Bank Swallow	SS-US		
Bushtit			
White-breasted Nuthatch			SC
Pygmy Nuthatch	SS-V	SC	
Western Bluebird	SS-V		
Veery			
Sage Thrasher			SC
Orange-crowned Warbler			
American Redstart			

Common Yellowthroat			
Yellow-breasted Chat	SS-C		
Vesper Sparrow	SS-C		SC
Black-throated Sparrow	SS-PN		
Sage Sparrow	SS-C		SC
Grasshopper Sparrow	SS-V/PN		
Bobolink	SS-V		
Western Meadowlark	SS-C		
Gray-crowned Rosy-Finch			
Black Rosy-finch	SS-PN		
Preble's Shrew			
Vagrant Shrew			
Merriam's Shrew			SC
Pygmy Shrew			
Coast Mole		SC	
Western Small-footed Myotis	SS-US		
Little Brown Myotis			
Long-legged Myotis	SS-US		
Fringed Myotis	SS-V	SC	
Long-eared Myotis	SS-US		
Silver-haired Bat	SS-US		
Western Pipistrelle		SC	
Big Brown Bat			
Spotted Bat		SC	
Townsend's Big-eared Bat	SS-C	SC	SC
Pallid Bat	SS-V		
White-tailed Jackrabbit	SS-US		SC
Black-tailed Jackrabbit			SC
Washington Ground Squirrel	SE		SC
Northern Pocket Gopher			SC
Great Basin Pocket Mouse			
Heather Vole			
Water Vole			
Gray Wolf	SE	SE	SE
Grizzly Bear		ST	SE
American Marten	SS-V		
Fisher	SS-C	SC	SE
Wolverine	ST	SC	SC
Western Spotted Skunk			
Lynx		SC	ST

Table E-3. Partners in Flight species of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	PIF 1998-1999 Continental Watchlist	PIF ranking by super region draft 2002	Oregon PIF Priority & Focal Species	Idaho PIF Priority & Focal Species	Washington PIF Priority & Focal Species
Western Grebe				PIF	
American White Pelican				PIF	
Ross's Goose	PIF				
Canada Goose					
Trumpeter Swan	PIF			PIF	
Cinnamon Teal				PIF	
Redhead				PIF	
Barrow's Goldeneye				PIF	
Hooded Merganser				PIF	
Northern Harrier			PIF		PIF
Sharp-shinned Hawk				PIF	
Northern Goshawk				PIF	
Swainson's Hawk		MO (Intermountain West, Prairies)	PIF	PIF	PIF
Red-tailed Hawk					
Ferruginous Hawk			PIF	PIF	PIF
Rough-legged Hawk		PR (Arctic)			
Golden Eagle				PIF	
American Kestrel			PIF		PIF
Gyrfalcon		PR (Arctic)			
Peregrine Falcon		PR (Arctic)			
Prairie Falcon				PIF	
Ruffed Grouse				PIF	
Sage Grouse		MA (Intermountain West, Prairies)		PIF	
Spruce Grouse		PR (Northern Forests)			
Blue Grouse		MA (Pacific, Intermountain West)		PIF	
Sharp-tailed Grouse		MO (Prairies)	PIF	PIF	PIF
Wild Turkey					
Mountain Quail		MO (Pacific)		PIF	
Gambel's Quail		MO (Southwest)			
Sandhill Crane				PIF	
Killdeer				PIF	
Black-necked Stilt				PIF	
American Avocet				PIF	
Willet	PIF				
Long-billed Curlew	PIF			PIF	
Stilt Sandpiper	PIF				
Short-billed Dowitcher	PIF				

Common Name	PIF 1998-1999 Continental Watchlist	PIF ranking by super region draft 2002	Oregon PIF Priority & Focal Species	Idaho PIF Priority & Focal Species	Washington PIF Priority & Focal Species
Band-tailed Pigeon	PIF	MA (Pacific)	PIF		PIF
Mourning Dove					
Yellow-billed Cuckoo			PIF		PIF
Flammulated Owl		MO (Pacific, Intermountain West, Southwest)	PIF	PIF	PIF
Western Screech-owl					
Great Horned Owl					
Snowy Owl		PR (Arctic)			
Northern Pygmy-owl		PR (Pacific)			
Burrowing Owl			PIF		PIF
Barred Owl					
Great Gray Owl			PIF		PIF
Short-eared Owl	PIF	MA (Arctic, Northern Forests, Intermountain West, Prairies)	PIF	PIF	PIF
Boreal Owl					
Northern Saw-whet Owl					
Common Nighthawk					
Common Poorwill			PIF		PIF
Black Swift	PIF	IM (Pacific, Intermountain West)	PIF	PIF	PIF
Vaux's Swift			PIF	PIF	PIF
White-throated Swift		MA (Intermountain West, Southwest)	PIF		PIF
Black-chinned Hummingbird				PIF	
Calliope Hummingbird		MO (Intermountain West)	PIF	PIF	PIF
Broad-tailed Hummingbird					
Rufous Hummingbird	PIF	MA (Pacific, Intermountain West)	PIF	PIF	PIF
Belted Kingfisher					
Lewis's Woodpecker	PIF	MO (Intermountain West, Prairies)	PIF	PIF	PIF
Williamson's Sapsucker		MO (Intermountain West)	PIF	PIF	PIF
Red-naped Sapsucker		MO (Intermountain West)	PIF		PIF
Red-breasted Sapsucker		MO (Pacific)	PIF		PIF
Downy Woodpecker			PIF		PIF
Hairy Woodpecker					

Common Name	PIF 1998-1999 Continental Watchlist	PIF ranking by super region draft 2002	Oregon PIF Priority & Focal Species	Idaho PIF Priority & Focal Species	Washington PIF Priority & Focal Species
White-headed Woodpecker	PIF	PR (Pacific, Intermountain West)	PIF	PIF	PIF
Three-toed Woodpecker		PR (Northern Forests)			
Black-backed Woodpecker		PR (Northern Forests)	PIF	PIF	PIF
Northern Flicker					
Pileated Woodpecker			PIF		PIF
Olive-sided Flycatcher		MA (Pacific, Northern Forests, Intermountain West)	PIF	PIF	PIF
Western Wood-pewee			PIF		PIF
Willow Flycatcher		MA (Prairies, East)	PIF	PIF	PIF
Least Flycatcher					
Hammond's Flycatcher			PIF	PIF	PIF
Gray Flycatcher		PR (Intermountain West)	PIF	PIF	PIF
Dusky Flycatcher		MA (Intermountain West)	PIF	PIF	PIF
Pacific-slope Flycatcher		PR (Pacific)	PIF		PIF
Ash-throated Flycatcher			PIF		PIF
Loggerhead Shrike			PIF	PIF	PIF
Northern Shrike		PR (Northern Forests)			
Cassin's Vireo					
Hutton's Vireo			PIF		PIF
Warbling Vireo			PIF		PIF
Red-eyed Vireo			PIF		PIF
Gray Jay		PR (Northern Forests)			
Pinyon Jay		MA (Intermountain West)		PIF	
Clark's Nutcracker		PR (Intermountain West)	PIF		PIF
Black-billed Magpie				PIF	
Horned Lark			PIF		PIF
Bank Swallow			PIF		PIF
Chestnut-backed Chickadee		PR (Pacific)			
Bushtit			PIF		PIF
Red-breasted Nuthatch					
White-breasted Nuthatch			PIF		PIF
Brown Creeper			PIF	PIF	PIF
Rock Wren				PIF	
House Wren			PIF		PIF
Winter Wren			PIF		PIF
American Dipper			PIF	PIF	PIF
Western Bluebird			PIF		PIF
Mountain Bluebird		PR (Intermountain			

Common Name	PIF 1998-1999 Continental Watchlist	PIF ranking by super region draft 2002	Oregon PIF Priority & Focal Species	Idaho PIF Priority & Focal Species	Washington PIF Priority & Focal Species
		West)			
Townsend's Solitaire			PIF		PIF
Veery			PIF		PIF
Swainson's Thrush			PIF		PIF
Hermit Thrush			PIF		PIF
Varied Thrush			PIF	PIF	PIF
Sage Thrasher		PR (Intermountain West)	PIF	PIF	PIF
European Starling					
American Pipit		PR (Arctic)	PIF		PIF
Bohemian Waxwing		MA (Northern Forests)			
Orange-crowned Warbler			PIF		PIF
Nashville Warbler		PR (Northern Forests)	PIF		PIF
Yellow Warbler			PIF	PIF	PIF
Yellow-rumped Warbler			PIF		PIF
Townsend's Warbler			PIF	PIF	PIF
Macgillivray's Warbler			PIF	PIF	PIF
Wilson's Warbler			PIF		PIF
Yellow-breasted Chat			PIF		PIF
Western Tanager			PIF	PIF	PIF
Green-tailed Towhee		MO (Intermountain West)	PIF		PIF
Chipping Sparrow			PIF		PIF
Clay-colored Sparrow	PIF				
Brewer's Sparrow	PIF	MA (Intermountain West)	PIF	PIF	PIF
Vesper Sparrow			PIF		PIF
Lark Sparrow			PIF	PIF	PIF
Black-throated Sparrow			PIF		PIF
Sage Sparrow	PIF	PR (Intermountain West)	PIF	PIF	PIF
Savannah Sparrow					
Grasshopper Sparrow		MA (Prairies)	PIF	PIF	PIF
Fox Sparrow			PIF		PIF
Lincoln's Sparrow		PR (Northern Forests)	PIF		PIF
Swamp Sparrow		PR (Northern Forests)			
White-throated Sparrow		MA (Northern Forests)			
Harris's Sparow	PIF	MA (Arctic, Northern Forests)			
Harris's Sparrow	PIF	MA (Arctic, Northern Forests)			

Common Name	PIF 1998-1999 Continental Watchlist	PIF ranking by super region draft 2002	Oregon PIF Priority & Focal Species	Idaho PIF Priority & Focal Species	Washington PIF Priority & Focal Species
Golden-crowned Sparrow		PR (Arctic)			
Lapland Longspur		PR (Arctic)			
Snow Bunting		PR (Arctic)			
Black-headed Grosbeak			PIF		PIF
Bobolink	PIF				
Western Meadowlark			PIF		PIF
Bullock's Oriole			PIF		PIF
Gray-crowned Rosy-Finch					
Black Rosy-finch		IM (Intermountain West)		PIF	
Pine Grosbeak		MO (Northern Forests)			
Purple Finch			PIF		PIF
Cassin's Finch		MA (Intermountain West)			
Red Crossbill			PIF		PIF
White-winged Crossbill		PR (Northern Forests)			
Lesser Goldfinch			PIF		PIF

Table E-4. Wildlife game species of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	Oregon Game Species	Idaho Game Species	Washington Game Species
Bullfrog	Game Fish		Game Species
Greater White-fronted Goose	Game Bird	Game Bird	Game Bird
Snow Goose	Game Bird	Game Bird	Game Bird
Ross's Goose	Game Bird	Game Bird	Game Bird
Canada Goose	Game Bird	Game Bird	Game Bird
Wood Duck	Game Bird	Game Bird	Game Bird
Gadwall	Game Bird	Game Bird	Game Bird
Eurasian Wigeon	Game Bird		Game Bird
American Wigeon	Game Bird	Game Bird	Game Bird
Mallard	Game Bird	Game Bird	Game Bird
Blue-winged Teal	Game Bird	Game Bird	Game Bird
Cinnamon Teal	Game Bird	Game Bird	Game Bird
Northern Shoveler	Game Bird	Game Bird	Game Bird
Northern Pintail	Game Bird	Game Bird	Game Bird
Green-winged Teal	Game Bird	Game Bird	Game Bird
Canvasback	Game Bird	Game Bird	Game Bird
Redhead	Game Bird	Game Bird	Game Bird
Ring-necked Duck	Game Bird	Game Bird	Game Bird
Greater Scaup	Game Bird		Game Bird
Lesser Scaup	Game Bird	Game Bird	Game Bird
Harlequin Duck	Game Bird	Game Bird	Game Bird
Surf Scoter	Game Bird		Game Bird
Bufflehead	Game Bird	Game Bird	Game Bird
Common Goldeneye	Game Bird	Game Bird	Game Bird
Barrow's Goldeneye	Game Bird	Game Bird	Game Bird
Hooded Merganser	Game Bird	Game Bird	Game Bird
Common Merganser	Game Bird	Game Bird	Game Bird
Red-breasted Merganser	Game Bird	Game Bird	Game Bird
Ruddy Duck	Game Bird	Game Bird	Game Bird
Chukar	Game Bird	Game Bird	Game Bird
Gray Partridge	Game Bird	Game Bird	Game Bird
Ring-necked Pheasant	Game Bird	Game Bird	Game Bird
Ruffed Grouse	Game Bird	Game Bird	Game Bird
Sage Grouse	Game Bird	Game Bird	
Spruce Grouse	Game Bird	Game Bird	Game Bird
Blue Grouse	Game Bird	Game Bird	Game Bird
Sharp-tailed Grouse		Game Bird	
Wild Turkey	Game Bird	Game Bird	Game Bird
Mountain Quail	Game Bird	Game Bird	Game Bird
Gambel's Quail		Game Bird	
California Quail	Game Bird	Game Bird	Game Bird
Northern Bobwhite	Game Bird	Game Bird	Game Bird
American Coot	Game Bird	Game Bird	Game Bird

Common Name	Oregon Game Species	Idaho Game Species	Washington Game Species
Wilson's Snipe	Game Bird	Game Bird	Game Bird
Band-tailed Pigeon	Game Bird		Game Bird
Mourning Dove	Game Bird	Game Bird	Game Bird
American Crow		Game Bird	
Eastern Cottontail			Game Mammal
Nuttall's (Mountain) Cottontail		Game Mammal	Game Mammal
Snowshoe Hare		Game Mammal	Game Mammal
White-tailed Jackrabbit			Game Mammal
Black-tailed Jackrabbit			Game Mammal
American Beaver		Game Mammal	
Muskrat	Game Mammal	Game Mammal	
Red Fox		Game Mammal	
Black Bear	Game Mammal	Game Mammal	Game Mammal
Grizzly Bear			
Raccoon		Game Mammal	
American Marten		Game Mammal	
Mink		Game Mammal	
Wolverine			
American Badger		Game Mammal	
Northern River Otter		Game Mammal	
Mountain Lion	Game Mammal	Game Mammal	Game Mammal
Lynx			
Bobcat		Game Mammal	
Rocky Mountain Elk	Game Mammal	Game Mammal	Game Mammal
Mule Deer	Game Mammal	Game Mammal	Game Mammal
White-tailed Deer (Eastside)	Game Mammal	Game Mammal	Game Mammal
Moose		Game Mammal	Game Mammal
Pronghorn Antelope	Game Mammal	Game Mammal	Game Mammal
Mountain Goat	Game Mammal	Game Mammal	Game Mammal
Rocky Mountain Bighorn Sheep	Game Mammal	Game Mammal	Game Mammal

Table E-5. Wildlife species used in the Habitat Evaluation Procedure (HEP) to assess habitat losses associated with federal hydroelectric facilities on the Lower Snake and Columbia Rivers (NHI 2003).

Chief Joseph	Grand Coulee	Lower Snake River
Common Name	**Common Name**	**Common Name**
Sharp-tailed Grouse	Sage Grouse	Downy Woodpecker
Mule Deer	Sharp-tailed Grouse	Song Sparrow
Spotted Sandpiper	Ruffed Grouse	Yellow Warbler
Sage Grouse	Mourning Dove	California Quail
Mink	Mule Deer	Ring-necked Pheasant
Bobcat	White-tailed Deer	Canada Goose
Lewis' Woodpecker	Riparian Forest	
Ring-necked Pheasant	Riparian Shrub	
Canada Goose	Canada Goose Nest Sites	
Yellow Warbler		

Table E-6. Wildlife species in the Southeast Washington Subbasin Planning Ecoregion that eat salmonids (NHI 2003).

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
Amphibians				
	Idaho Giant Salamander	*Dicamptodon aterrimus*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Incubation - eggs and alevin
	Total Amphibians:1			
Birds				
	Common Loon	*Gavia immer*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
			Rare	Carcasses
	Pied-billed Grebe	*Podilymbus podiceps*	Recurrent	Freshwater rearing - fry, fingerling, and parr
	Horned Grebe	*Podiceps auritus*	Rare	Saltwater - smolts, immature adults, and adults
			Rare	Incubation - eggs and alevin
	Red-necked Grebe	*Podiceps grisegena*	Rare	Saltwater - smolts, immature adults, and adults
			Rare	Carcasses
	Western Grebe	*Aechmophorus occidentalis*	Recurrent	Saltwater - smolts, immature adults, and adults
			Rare	Carcasses
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Clark's Grebe	*Aechmophorus clarkii*	Recurrent	Saltwater - smolts, immature adults, and adults
	American White Pelican	*Pelecanus erythrorhynchos*	Recurrent	Freshwater rearing - fry, fingerling, and parr
	Double-crested Cormorant	*Phalacrocorax auritus*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Great Blue Heron	*Ardea herodias*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Saltwater - smolts, immature adults, and adults
	Great Egret	*Ardea alba*	Rare	Freshwater rearing - fry,

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
				fingerling, and parr
			Rare	Saltwater - smolts, immature adults, and adults
	Green Heron	*Butorides virescens*	Recurrent	Saltwater - smolts, immature adults, and adults
			Rare	Freshwater rearing - fry, fingerling, and parr
	Black-crowned Night-heron	*Nycticorax nycticorax*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Turkey Vulture	*Cathartes aura*	Recurrent	Carcasses
	Trumpeter Swan	*Cygnus buccinator*	Rare	Freshwater rearing - fry, fingerling, and parr
			Rare	Incubation - eggs and alevin
			Rare	Carcasses
	Mallard	*Anas platyrhynchos*	Rare	Incubation - eggs and alevin
			Rare	Carcasses
	Green-winged Teal	*Anas crecca*	Rare	Incubation - eggs and alevin
	Canvasback	*Aythya valisineria*	Rare	Carcasses
	Greater Scaup	*Aythya marila*	Rare	Incubation - eggs and alevin
			Rare	Carcasses
	Harlequin Duck	*Histrionicus histrionicus*	Strong, consistent	Saltwater - smolts, immature adults, and adults
			Strong, consistent	Incubation - eggs and alevin
			Indirect	Carcasses
	Surf Scoter	*Melanitta perspicillata*	Rare	Carcasses
			Rare	Saltwater - smolts, immature adults, and adults
	Common Goldeneye	*Bucephala clangula*	Recurrent	Incubation - eggs and alevin
			Recurrent	Freshwater rearing - fry, fingerling, and parr
			Rare	Saltwater - smolts, immature adults, and adults

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
			Recurrent	Carcasses
	Barrow's Goldeneye	*Bucephala islandica*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Incubation - eggs and alevin
			Rare	Saltwater - smolts, immature adults, and adults
			Recurrent	Carcasses
	Hooded Merganser	*Lophodytes cucullatus*	Rare	Incubation - eggs and alevin
			Rare	Freshwater rearing - fry, fingerling, and parr
			Rare	Carcasses
	Common Merganser	*Mergus merganser*	Strong, consistent	Saltwater - smolts, immature adults, and adults
			Recurrent	Carcasses
			Strong, consistent	Incubation - eggs and alevin
			Strong, consistent	Freshwater rearing - fry, fingerling, and parr
	Red-breasted Merganser	*Mergus serrator*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Incubation - eggs and alevin
			Recurrent	Saltwater - smolts, immature adults, and adults
	Osprey	*Pandion haliaetus*	Strong, consistent	Freshwater rearing - fry, fingerling, and parr
			Strong, consistent	Saltwater - smolts, immature adults, and adults
			Strong, consistent	Spawning - freshwater
	Bald Eagle	*Haliaeetus leucocephalus*	Indirect	Incubation - eggs and alevin
			Indirect	Freshwater rearing - fry, fingerling, and parr
			Strong, consistent	Spawning - freshwater
			Strong, consistent	Carcasses
			Strong, consistent	Saltwater - smolts, immature adults, and adults
			Indirect	Saltwater - smolts, immature adults, and adults
			Indirect	Carcasses
	Red-tailed Hawk	*Buteo*	Rare	Carcasses

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
		jamaicensis		
	Golden Eagle	*Aquila chrysaetos*	Recurrent	Spawning - freshwater
			Recurrent	Carcasses
	Gyrfalcon	*Falco rusticolus*	Indirect	Saltwater - smolts, immature adults, and adults
			Indirect	Freshwater rearing - fry, fingerling, and parr
			Indirect	Carcasses
	Peregrine Falcon	*Falco peregrinus*	Indirect	Freshwater rearing - fry, fingerling, and parr
			Indirect	Carcasses
			Indirect	Saltwater - smolts, immature adults, and adults
	Killdeer	*Charadrius vociferus*	Indirect	Carcasses
	Greater Yellowlegs	*Tringa melanoleuca*	Rare	Incubation - eggs and alevin
	Spotted Sandpiper	*Actitis macularia*	Indirect	Carcasses
	Franklin's Gull	*Larus pipixcan*	Rare	Freshwater rearing - fry, fingerling, and parr
	Bonaparte's Gull	*Larus philadelphia*	Recurrent	Carcasses
			Recurrent	Incubation - eggs and alevin
			Recurrent	Saltwater - smolts, immature adults, and adults
	Mew Gull	*Larus canus*	Rare	Incubation - eggs and alevin
	Ring-billed Gull	*Larus delawarensis*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Carcasses
			Recurrent	Saltwater - smolts, immature adults, and adults
	California Gull	*Larus californicus*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Carcasses
	Herring Gull	*Larus argentatus*	Recurrent	Carcasses
			Recurrent	Saltwater - smolts, immature adults, and adults

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Thayer's Gull	*Larus thayeri*	Recurrent	Saltwater - smolts, immature adults, and adults
	Glaucous-winged Gull	*Larus glaucescens*	Recurrent	Carcasses
			Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Incubation - eggs and alevin
			Recurrent	Spawning - freshwater
	Glaucous Gull	*Larus hyperboreus*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Carcasses
	Caspian Tern	*Sterna caspia*	Strong, consistent	Freshwater rearing - fry, fingerling, and parr
			Strong, consistent	Saltwater - smolts, immature adults, and adults
	Common Tern	*Sterna hirundo*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Forster's Tern	*Sterna forsteri*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Snowy Owl	*Nyctea scandiaca*	Indirect	Freshwater rearing - fry, fingerling, and parr
	Belted Kingfisher	*Ceryle alcyon*	Recurrent	Spawning - freshwater
			Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Willow Flycatcher	*Empidonax traillii*	Indirect	Carcasses
	Gray Jay	*Perisoreus canadensis*	Rare	Carcasses
	Steller's Jay	*Cyanocitta stelleri*	Recurrent	Carcasses
	Black-billed Magpie	*Pica pica*	Recurrent	Freshwater rearing - fry, fingerling, and parr

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
			Recurrent	Carcasses
	American Crow	*Corvus brachyrhynchos*	Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Carcasses
	Northwestern Crow	*Corvus caurinus*	Recurrent	Saltwater - smolts, immature adults, and adults
			Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Carcasses
	Common Raven	*Corvus corax*	Recurrent	Spawning - freshwater
			Recurrent	Carcasses
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	Tree Swallow	*Tachycineta bicolor*	Indirect	Carcasses
	Violet-green Swallow	*Tachycineta thalassina*	Indirect	Carcasses
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Indirect	Carcasses
	Bank Swallow	*Riparia riparia*	Indirect	Carcasses
	Cliff Swallow	*Petrochelidon pyrrhonota*	Indirect	Carcasses
	Barn Swallow	*Hirundo rustica*	Indirect	Carcasses
	Winter Wren	*Troglodytes troglodytes*	Rare	Carcasses
	American Dipper	*Cinclus mexicanus*	Recurrent	Carcasses
			Indirect	Carcasses
			Recurrent	Incubation - eggs and alevin
			Recurrent	Freshwater rearing - fry, fingerling, and parr
	American Robin	*Turdus migratorius*	Rare	Incubation - eggs and alevin
	Varied Thrush	*Ixoreus naevius*	Rare	Carcasses
			Rare	Incubation - eggs and alevin

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
	Spotted Towhee	*Pipilo maculatus*	Rare	Carcasses
	Song Sparrow	*Melospiza melodia*	Rare	Carcasses
		Total Birds: 67		
Mammals				
	Virginia Opossum	*Didelphis virginiana*	Recurrent	Carcasses
	Masked Shrew	*Sorex cinereus*	Rare	Carcasses
			Indirect	Carcasses
	Vagrant Shrew	*Sorex vagrans*	Rare	Carcasses
			Indirect	Carcasses
	Montane Shrew	*Sorex monticolus*	Rare	Carcasses
			Indirect	Carcasses
	Water Shrew	*Sorex palustris*	Recurrent	Carcasses
			Recurrent	Freshwater rearing - fry, fingerling, and parr
			Indirect	Carcasses
			Recurrent	Incubation - eggs and alevin
	Douglas' Squirrel	*Tamiasciurus douglasii*	Rare	Carcasses
	Northern Flying Squirrel	*Glaucomys sabrinus*	Rare	Carcasses
	Deer Mouse	*Peromyscus maniculatus*	Rare	Carcasses
	Coyote	*Canis latrans*	Recurrent	Carcasses
	Gray Wolf	*Canis lupus*	Recurrent	Carcasses
			Recurrent	Spawning - freshwater
	Red Fox	*Vulpes vulpes*	Rare	Carcasses
	Black Bear	*Ursus americanus*	Strong, consistent	Spawning - freshwater
			Strong, consistent	Carcasses
	Raccoon	*Procyon lotor*	Recurrent	Carcasses
			Recurrent	Freshwater rearing - fry,

	Common Name	Scientific Name	Relationship Type	Salmonid Stage
				fingerling, and parr
	American Marten	*Martes americana*	Rare	Carcasses
	Fisher	*Martes pennanti*	Rare	Carcasses
	Long-tailed Weasel	*Mustela frenata*	Rare	Carcasses
	Mink	*Mustela vison*	Recurrent	Spawning - freshwater
			Recurrent	Freshwater rearing - fry, fingerling, and parr
			Recurrent	Carcasses
	Wolverine	*Gulo gulo*	Rare	Carcasses
	Striped Skunk	*Mephitis mephitis*	Rare	Carcasses
	Northern River Otter	*Lutra canadensis*	Strong, consistent	Carcasses
			Strong, consistent	Spawning - freshwater
			Strong, consistent	Freshwater rearing - fry, fingerling, and parr
	Mountain Lion	*Puma concolor*	Rare	Spawning - freshwater
	Bobcat	*Lynx rufus*	Recurrent	Spawning - freshwater
			Recurrent	Carcasses
	White-tailed Deer (eastside)	*Odocoileus virginianus ochrourus*	Rare	Carcasses
		Total Mammals: 23		
Reptiles				
	Western Pond Turtle	*Clemmys marmorata*	Rare	Freshwater rearing - fry, fingerling, and parr
			Rare	Carcasses
	Western Terrestrial Garter Snake	*Thamnophis elegans*	Rare	Freshwater rearing - fry, fingerling, and parr
	Common Garter Snake	*Thamnophis sirtalis*	Rare	Freshwater rearing - fry, fingerling, and parr
		Total Reptiles: 3		
		Total Species: 94		

Table E-7. Wildlife species occurrence in ponderosa pine habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
American Badger	American Badger	American Badger	American Badger	American Badger
American Beaver	American Beaver	American Beaver	American Beaver	American Beaver
American Crow	American Crow	American Crow	American Crow	American Crow
American Goldfinch	American Goldfinch	American Goldfinch	American Goldfinch	American Goldfinch
American Kestrel	American Kestrel	American Kestrel	American Kestrel	American Kestrel
American Robin	American Marten	American Marten	American Marten	American Marten
Bald Eagle	American Robin	American Robin	American Robin	American Robin
Bank Swallow	Bald Eagle	Bank Swallow	Bank Swallow	Ash-throated Flycatcher
Barn Swallow	Bank Swallow	Barn Swallow	Barn Swallow	Bald Eagle
Barred Owl	Barn Swallow	Barred Owl	Barred Owl	Band-tailed Pigeon
Big Brown Bat	Barred Owl	Big Brown Bat	Big Brown Bat	Bank Swallow
Black Bear	Big Brown Bat	Black Bear	Black Bear	Barn Swallow
Black Swift	Black Bear	Black-backed Woodpecker	Black-backed Woodpecker	Barred Owl
Black-backed Woodpecker	Black Swift	Black-billed Magpie	Black-billed Magpie	Big Brown Bat
Black-billed Magpie	Black-backed Woodpecker	Black-capped Chickadee	Black-capped Chickadee	Black Bear
Black-capped Chickadee	Black-billed Magpie	Black-chinned Hummingbird	Black-chinned Hummingbird	Black Swift
Black-chinned Hummingbird	Black-capped Chickadee	Black-headed Grosbeak	Black-headed Grosbeak	Black-backed Woodpecker
Black-headed Grosbeak	Black-chinned Hummingbird	Blue Grouse	Blue Grouse	Black-billed Magpie
Blue Grouse	Black-headed Grosbeak	Bobcat	Bobcat	Black-capped Chickadee
Bobcat	Blue Grouse	Brewer's Blackbird	Brewer's Blackbird	Black-chinned Hummingbird
Brewer's Blackbird	Bobcat	Brown Creeper	Brewer's Sparrow	Black-headed Grosbeak
Brewer's Sparrow	Brewer's Blackbird	Brown-headed Cowbird	Brown Creeper	Blue Grouse
Brown Creeper	Brewer's Sparrow	Bullfrog	Brown-headed Cowbird	Bobcat
Brown-headed Cowbird	Brown Creeper	Bushy-tailed Woodrat	Bullfrog	Brewer's Blackbird
Bullfrog	Brown-headed Cowbird	California Myotis	Bushy-tailed Woodrat	Brewer's Sparrow
Bushy-tailed Woodrat	Bullfrog	California Quail	California Myotis	Brown Creeper
California Myotis	Bushy-tailed Woodrat	Calliope Hummingbird	California Quail	Brown-headed Cowbird
California Quail	California Myotis	Canyon Wren	Calliope Hummingbird	Bullfrog
Calliope	California Quail	Cassin's Finch	Canyon Wren	Bushtit

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Hummingbird				
Canyon Wren	Calliope Hummingbird	Cassin's Vireo	Cassin's Finch	Bushy-tailed Woodrat
Cassin's Finch	Canyon Wren	Cedar Waxwing	Cassin's Vireo	California Myotis
Cassin's Vireo	Cassin's Finch	Chipping Sparrow	Cedar Waxwing	California Quail
Cedar Waxwing	Cassin's Vireo	Clark's Nutcracker	Chipping Sparrow	Calliope Hummingbird
Chipping Sparrow	Cedar Waxwing	Cliff Swallow	Clark's Nutcracker	Canyon Wren
Clark's Nutcracker	Chipping Sparrow	Coast Mole	Cliff Swallow	Cassin's Finch
Cliff Swallow	Clark's Nutcracker	Columbia Spotted Frog	Coast Mole	Cassin's Vireo
Columbia Spotted Frog	Cliff Swallow	Columbian Ground Squirrel	Columbia Spotted Frog	Cedar Waxwing
Columbian Ground Squirrel	Coast Mole	Common Garter Snake	Columbian Ground Squirrel	Chipping Sparrow
Common Garter Snake	Columbia Spotted Frog	Common Nighthawk	Common Garter Snake	Clark's Nutcracker
Common Nighthawk	Columbian Ground Squirrel	Common Poorwill	Common Nighthawk	Cliff Swallow
Common Poorwill	Common Garter Snake	Common Porcupine	Common Poorwill	Coast Mole
Common Porcupine	Common Nighthawk	Common Raven	Common Porcupine	Columbia Spotted Frog
Common Raven	Common Poorwill	Cooper's Hawk	Common Raven	Columbian Ground Squirrel
Cooper's Hawk	Common Porcupine	Coyote	Cooper's Hawk	Common Garter Snake
Coyote	Common Raven	Dark-eyed Junco	Coyote	Common Nighthawk
Dark-eyed Junco	Cooper's Hawk	Deer Mouse	Dark-eyed Junco	Common Poorwill
Deer Mouse	Coyote	Downy Woodpecker	Deer Mouse	Common Porcupine
Downy Woodpecker	Dark-eyed Junco	Dusky Flycatcher	Downy Woodpecker	Common Raven
Dusky Flycatcher	Deer Mouse	Eastern Kingbird	Dusky Flycatcher	Cooper's Hawk
Eastern Kingbird	Downy Woodpecker	Ermine	Eastern Kingbird	Coyote
Ermine	Dusky Flycatcher	European Starling	Ermine	Dark-eyed Junco
European Starling	Eastern Kingbird	Evening Grosbeak	European Starling	Deer Mouse
Evening Grosbeak	Ermine	Flammulated Owl	Evening Grosbeak	Downy Woodpecker
Fisher	European Starling	Fox Sparrow	Flammulated Owl	Dusky Flycatcher
Flammulated Owl	Evening Grosbeak	Fringed Myotis	Fox Sparrow	Eastern Kingbird
Fox Sparrow	Fisher	Golden Eagle	Fringed Myotis	Ermine
Fringed Myotis	Flammulated Owl	Golden-crowned Kinglet	Golden Eagle	European Starling
Golden Eagle	Fox Sparrow	Golden-mantled Ground Squirrel	Golden-crowned Kinglet	Evening Grosbeak
Golden-crowned Kinglet	Fringed Myotis	Gopher Snake	Golden-mantled Ground Squirrel	Flammulated Owl
Golden-mantled	Golden Eagle	Gray Jay	Gopher Snake	Fox Sparrow

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Ground Squirrel				
Gopher Snake	Golden-crowned Kinglet	Great Basin Spadefoot	Gray Jay	Fringed Myotis
Gray Flycatcher	Golden-mantled Ground Squirrel	Great Horned Owl	Great Basin Spadefoot	Golden Eagle
Gray Jay	Gopher Snake	Green-tailed Towhee	Great Horned Owl	Golden-crowned Kinglet
Gray Wolf	Gray Jay	Hairy Woodpecker	Green-tailed Towhee	Golden-crowned Sparrow
Great Basin Spadefoot	Gray Wolf	Hammond's Flycatcher	Hairy Woodpecker	Golden-mantled Ground Squirrel
Great Gray Owl	Great Basin Spadefoot	Hermit Thrush	Hammond's Flycatcher	Gopher Snake
Great Horned Owl	Great Gray Owl	Hoary Bat	Hermit Thrush	Gray Flycatcher
Hairy Woodpecker	Great Horned Owl	House Finch	Hoary Bat	Gray Jay
Hammond's Flycatcher	Green-tailed Towhee	House Wren	House Finch	Great Basin Spadefoot
Hermit Thrush	Hairy Woodpecker	Killdeer	House Wren	Great Gray Owl
Hoary Bat	Hammond's Flycatcher	Lark Sparrow	Killdeer	Great Horned Owl
House Finch	Hermit Thrush	Lazuli Bunting	Lark Sparrow	Green-tailed Towhee
House Wren	Hoary Bat	Lewis's Woodpecker	Lazuli Bunting	Grizzly Bear
Killdeer	House Finch	Little Brown Myotis	Lewis's Woodpecker	Hairy Woodpecker
Lark Sparrow	House Wren	Long-eared Myotis	Little Brown Myotis	Hammond's Flycatcher
Lazuli Bunting	Killdeer	Long-eared Owl	Long-eared Myotis	Hermit Thrush
Least Chipmunk	Lark Sparrow	Long-legged Myotis	Long-eared Owl	Hoary Bat
Lewis's Woodpecker	Lazuli Bunting	Long-tailed Vole	Long-legged Myotis	House Finch
Little Brown Myotis	Least Chipmunk	Long-tailed Weasel	Long-tailed Vole	House Wren
Long-eared Myotis	Lewis's Woodpecker	Long-toed Salamander	Long-tailed Weasel	Killdeer
Long-eared Owl	Little Brown Myotis	Macgillivray's Warbler	Long-toed Salamander	Lark Sparrow
Long-legged Myotis	Long-eared Myotis	Mink	Macgillivray's Warbler	Lazuli Bunting
Long-tailed Vole	Long-eared Owl	Montane Vole	Mink	Least Chipmunk
Long-tailed Weasel	Long-legged Myotis	Mountain Bluebird	Montane Vole	Least Flycatcher
Long-toed Salamander	Long-tailed Vole	Mountain Chickadee	Mountain Bluebird	Lesser Goldfinch
Macgillivray's Warbler	Long-tailed Weasel	Mountain Lion	Mountain Chickadee	Lewis's Woodpecker
Masked Shrew	Long-toed Salamander	Mountain Quail	Mountain Lion	Little Brown Myotis
Merlin	Macgillivray's	Mourning Dove	Mountain Quail	Long-eared

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
	Warbler			Myotis
Mink	Masked Shrew	Mule Deer	Mourning Dove	Long-eared Owl
Montane Vole	Merlin	Night Snake	Mule Deer	Long-legged Myotis
Mountain Bluebird	Mink	Northern Flicker	Night Snake	Long-tailed Vole
Mountain Chickadee	Montane Vole	Northern Flying Squirrel	Northern Flicker	Long-tailed Weasel
Mountain Lion	Mountain Bluebird	Northern Goshawk	Northern Flying Squirrel	Long-toed Salamander
Mountain Quail	Mountain Chickadee	Northern Pocket Gopher	Northern Goshawk	Macgillivray's Warbler
Mourning Dove	Mountain Lion	Northern Pygmy-owl	Northern Pocket Gopher	Merlin
Mule Deer	Mountain Quail	Northern Rough-winged Swallow	Northern Pygmy-owl	Mink
Nashville Warbler	Mourning Dove	Northern Saw-whet Owl	Northern Rough-winged Swallow	Montane Vole
Night Snake	Mule Deer	Olive-sided Flycatcher	Northern Saw-whet Owl	Mountain Bluebird
Northern Alligator Lizard	Nashville Warbler	Orange-crowned Warbler	Olive-sided Flycatcher	Mountain Chickadee
Northern Flicker	Night Snake	Osprey	Orange-crowned Warbler	Mountain Lion
Northern Flying Squirrel	Northern Alligator Lizard	Pacific Chorus (Tree) Frog	Osprey	Mountain Quail
Northern Goshawk	Northern Flicker	Painted Turtle	Pacific Chorus (Tree) Frog	Mourning Dove
Northern Pocket Gopher	Northern Flying Squirrel	Pallid Bat	Painted Turtle	Mule Deer
Northern Pygmy-owl	Northern Goshawk	Pileated Woodpecker	Pallid Bat	Nashville Warbler
Northern Rough-winged Swallow	Northern Pocket Gopher	Pine Siskin	Pileated Woodpecker	Night Snake
Northern Saw-whet Owl	Northern Pygmy-owl	Prairie Falcon	Pine Siskin	Northern Flicker
Olive-sided Flycatcher	Northern Rough-winged Swallow	Pygmy Nuthatch	Prairie Falcon	Northern Flying Squirrel
Orange-crowned Warbler	Northern Saw-whet Owl	Racer	Pygmy Nuthatch	Northern Goshawk
Oregon Spotted Frog	Olive-sided Flycatcher	Red Crossbill	Racer	Northern Pocket Gopher
Osprey	Orange-crowned Warbler	Red Squirrel	Red Crossbill	Northern Pygmy-owl
Pacific Chorus (Tree) Frog	Oregon Spotted Frog	Red-breasted Nuthatch	Red Squirrel	Northern Rough-winged Swallow
Painted Turtle	Osprey	Red-naped Sapsucker	Red-breasted Nuthatch	Northern Saw-whet Owl
Pallid Bat	Pacific Chorus (Tree) Frog	Red-tailed Hawk	Red-naped Sapsucker	Olive-sided Flycatcher
Peregrine Falcon	Painted Turtle	Ringneck Snake	Red-tailed Hawk	Orange-crowned Warbler
Pileated	Pallid Bat	Ring-necked	Ringneck Snake	Osprey

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Woodpecker		Pheasant		
Pine Siskin	Peregrine Falcon	Rock Wren	Ring-necked Pheasant	Pacific Chorus (Tree) Frog
Prairie Falcon	Pileated Woodpecker	Rocky Mountain Elk	Rock Wren	Painted Turtle
Pygmy Nuthatch	Pine Siskin	Rough-legged Hawk	Rocky Mountain Elk	Pallid Bat
Pygmy Shrew	Prairie Falcon	Rubber Boa	Rough-legged Hawk	Peregrine Falcon
Racer	Pygmy Nuthatch	Ruby-crowned Kinglet	Rubber Boa	Pileated Woodpecker
Red Crossbill	Racer	Ruffed Grouse	Ruby-crowned Kinglet	Pine Siskin
Red Fox	Red Crossbill	Rufous Hummingbird	Ruffed Grouse	Pinyon Jay
Red Squirrel	Red Fox	Sagebrush Lizard	Rufous Hummingbird	Prairie Falcon
Red-breasted Nuthatch	Red Squirrel	Say's Phoebe	Sagebrush Lizard	Pronghorn Antelope
Red-naped Sapsucker	Red-breasted Nuthatch	Sharp-shinned Hawk	Say's Phoebe	Purple Finch
Red-tailed Hawk	Red-naped Sapsucker	Short-horned Lizard	Sharp-shinned Hawk	Pygmy Nuthatch
Ringneck Snake	Red-tailed Hawk	Silver-haired Bat	Short-horned Lizard	Racer
Ring-necked Pheasant	Ringneck Snake	Snowshoe Hare	Silver-haired Bat	Red Crossbill
Rock Wren	Ring-necked Pheasant	Song Sparrow	Snowshoe Hare	Red Fox
Rocky Mountain Elk	Rock Wren	Spotted Towhee	Song Sparrow	Red Squirrel
Rough-legged Hawk	Rocky Mountain Elk	Steller's Jay	Spotted Towhee	Red-breasted Nuthatch
Rough-skinned Newt	Rough-legged Hawk	Striped Skunk	Steller's Jay	Red-breasted Sapsucker
Rubber Boa	Rubber Boa	Tailed Frog	Striped Skunk	Red-naped Sapsucker
Ruby-crowned Kinglet	Ruby-crowned Kinglet	Three-toed Woodpecker	Tailed Frog	Red-tailed Hawk
Ruffed Grouse	Ruffed Grouse	Townsend's Big-eared Bat	Three-toed Woodpecker	Ringneck Snake
Rufous Hummingbird	Rufous Hummingbird	Townsend's Solitaire	Townsend's Big-eared Bat	Ring-necked Pheasant
Sagebrush Lizard	Sagebrush Lizard	Townsend's Warbler	Townsend's Solitaire	Rock Wren
Say's Phoebe	Say's Phoebe	Tree Swallow	Townsend's Warbler	Rocky Mountain Elk
Sharp-shinned Hawk	Sharp-shinned Hawk	Vagrant Shrew	Tree Swallow	Rough-legged Hawk
Short-horned Lizard	Short-horned Lizard	Varied Thrush	Vagrant Shrew	Rubber Boa
Silver-haired Bat	Silver-haired Bat	Vaux's Swift	Varied Thrush	Ruby-crowned

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
				Kinglet
Snowshoe Hare	Snowshoe Hare	Violet-green Swallow	Vaux's Swift	Ruffed Grouse
Song Sparrow	Song Sparrow	Warbling Vireo	Violet-green Swallow	Rufous Hummingbird
Spotted Bat	Spotted Towhee	Western Bluebird	Warbling Vireo	Sagebrush Lizard
Spotted Towhee	Steller's Jay	Western Fence Lizard	Western Bluebird	Say's Phoebe
Steller's Jay	Striped Skunk	Western Jumping Mouse	Western Fence Lizard	Sharp-shinned Hawk
Striped Skunk	Striped Whipsnake	Western Kingbird	Western Jumping Mouse	Short-horned Lizard
Striped Whipsnake	Tailed Frog	Western Pipistrelle	Western Kingbird	Silver-haired Bat
Tailed Frog	Three-toed Woodpecker	Western Rattlesnake	Western Pipistrelle	Snowshoe Hare
Three-toed Woodpecker	Tiger Salamander	Western Screech-owl	Western Rattlesnake	Song Sparrow
Tiger Salamander	Townsend's Big-eared Bat	Western Skink	Western Screech-owl	Spotted Towhee
Townsend's Big-eared Bat	Townsend's Solitaire	Western Small-footed Myotis	Western Skink	Steller's Jay
Townsend's Solitaire	Townsend's Warbler	Western Tanager	Western Small-footed Myotis	Striped Skunk
Townsend's Warbler	Tree Swallow	Western Terrestrial Garter Snake	Western Tanager	Striped Whipsnake
Tree Swallow	Turkey Vulture	Western Toad	Western Terrestrial Garter Snake	Tailed Frog
Turkey Vulture	Vagrant Shrew	Western Wood-pewee	Western Toad	Three-toed Woodpecker
Vagrant Shrew	Varied Thrush	White-breasted Nuthatch	Western Wood-pewee	Tiger Salamander
Varied Thrush	Vaux's Swift	White-crowned Sparrow	White-breasted Nuthatch	Townsend's Big-eared Bat
Vaux's Swift	Violet-green Swallow	White-tailed Deer (Eastside)	White-crowned Sparrow	Townsend's Solitaire
Violet-green Swallow	Warbling Vireo	White-throated Swift	White-headed Woodpecker	Townsend's Warbler
Warbling Vireo	Western Bluebird	Wild Turkey	White-throated Swift	Tree Swallow
Western Bluebird	Western Fence Lizard	Williamson's Sapsucker	Wild Turkey	Turkey Vulture
Western Fence Lizard	Western Jumping Mouse	Willow Flycatcher	Williamson's Sapsucker	Vagrant Shrew
Western Jumping Mouse	Western Kingbird	Wilson's Warbler	Willow Flycatcher	Varied Thrush
Western Kingbird	Western Pipistrelle	Yellow-bellied Marmot	Wilson's Warbler	Vaux's Swift
Western Pipistrelle	Western Rattlesnake	Yellow-pine Chipmunk	Yellow-bellied Marmot	Violet-green Swallow

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Western Rattlesnake	Western Screech-owl	Yellow-rumped Warbler	Yellow-pine Chipmunk	Warbling Vireo
Western Screech-owl	Western Skink	Yuma Myotis	Yellow-rumped Warbler	Western Bluebird
Western Skink	Western Small-footed Myotis		Yuma Myotis	Western Fence Lizard
Western Small-footed Myotis	Western Tanager			Western Jumping Mouse
Western Tanager	Western Terrestrial Garter Snake			Western Kingbird
Western Terrestrial Garter Snake	Western Toad			Western Pipistrelle
Western Toad	Western Wood-pewee			Western Rattlesnake
Western Wood-pewee	White-breasted Nuthatch			Western Screech-owl
White-breasted Nuthatch	White-crowned Sparrow			Western Scrub-Jay
White-crowned Sparrow	White-headed Woodpecker			Western Skink
White-headed Woodpecker	White-throated Swift			Western Small-footed Myotis
White-throated Swift	Wild Turkey			Western Tanager
Wild Turkey	Williamson's Sapsucker			Western Terrestrial Garter Snake
Williamson's Sapsucker	Willow Flycatcher			Western Toad
Willow Flycatcher	Wilson's Warbler			Western Wood-pewee
Wilson's Warbler	Yellow-bellied Marmot			White-breasted Nuthatch
Yellow-bellied Marmot	Yellow-pine Chipmunk			White-crowned Sparrow
Yellow-pine Chipmunk	Yellow-rumped Warbler			White-headed Woodpecker
Yellow-rumped Warbler	Yuma Myotis			White-tailed Deer (Eastside)
Yuma Myotis				White-throated Swift
				Wild Turkey
				Williamson's Sapsucker
				Willow Flycatcher
				Wilson's Warbler
				Yellow-bellied Marmot
				Yellow-pine Chipmunk

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
				Yellow-rumped Warbler
				Yuma Myotis

Table E-8. Wildlife species occurrence in Shrubsteppe habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
American Avocet	American Avocet	American Avocet	American Badger	American Avocet
American Badger	American Badger	American Badger	American Crow	American Badger
American Crow	American Crow	American Crow	American Goldfinch	American Crow
American Goldfinch	American Goldfinch	American Goldfinch	American Kestrel	American Goldfinch
American Kestrel	American Kestrel	American Kestrel	American Robin	American Kestrel
American Robin	American Robin	American Robin	Bank Swallow	American Robin
Bald Eagle	Bald Eagle	Bank Swallow	Barn Owl	Bald Eagle
Bank Swallow	Bank Swallow	Barn Owl	Barn Swallow	Bank Swallow
Barn Owl	Barn Owl	Barn Swallow	Big Brown Bat	Barn Owl
Barn Swallow	Barn Swallow	Big Brown Bat	Black Bear	Barn Swallow
Barrow's Goldeneye	Big Brown Bat	Black Bear	Black-billed Magpie	Barrow's Goldeneye
Big Brown Bat	Black Bear	Black-billed Magpie	Black-chinned Hummingbird	Belding's Ground Squirrel
Black Bear	Black-billed Magpie	Black-chinned Hummingbird	Black-tailed Jackrabbit	Bewick's Wren
Black-billed Magpie	Black-chinned Hummingbird	Black-tailed Jackrabbit	Blue Grouse	Big Brown Bat
Black-chinned Hummingbird	Black-necked Stilt	Blue Grouse	Bobcat	Black Bear
Black-necked Stilt	Black-tailed Jackrabbit	Bobcat	Brewer's Blackbird	Black-billed Magpie
Black-tailed Jackrabbit	Black-throated Sparrow	Brewer's Blackbird	Brewer's Sparrow	Black-chinned Hummingbird
Black-throated Sparrow	Blue Grouse	Brown-headed Cowbird	Brown-headed Cowbird	Black-necked Stilt
Blue Grouse	Bobcat	Bushy-tailed Woodrat	Bushy-tailed Woodrat	Black-tailed Jackrabbit
Bobcat	Brewer's Blackbird	California Myotis	California Myotis	Blue Grouse
Brewer's Blackbird	Brewer's Sparrow	Canada Goose	Canada Goose	Bobcat
Brewer's Sparrow	Brown-headed Cowbird	Canyon Wren	Canyon Wren	Brewer's Blackbird
Brown-headed Cowbird	Burrowing Owl	Chipping Sparrow	Chipping Sparrow	Brewer's Sparrow
Burrowing Owl	Bushy-tailed Woodrat	Cliff Swallow	Cliff Swallow	Brown-headed Cowbird
Bushy-tailed Woodrat	California Myotis	Columbia Spotted Frog	Columbia Spotted Frog	Burrowing Owl
California Myotis	Canada Goose	Columbian Ground Squirrel	Columbian Ground Squirrel	Bushy-tailed Woodrat
Canada Goose	Canyon Wren	Common Garter Snake	Common Garter Snake	California Myotis
Canyon Wren	Chipping Sparrow	Common Nighthawk	Common Nighthawk	Canada Goose
Chipping Sparrow	Cliff Swallow	Common Poorwill	Common Poorwill	Canyon Wren
Cliff Swallow	Columbia Spotted	Common	Common	Chipping Sparrow

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
	Frog	Porcupine	Porcupine	
Columbia Spotted Frog	Columbian Ground Squirrel	Common Raven	Common Raven	Cliff Swallow
Columbian Ground Squirrel	Common Garter Snake	Cooper's Hawk	Cooper's Hawk	Columbia Spotted Frog
Common Garter Snake	Common Nighthawk	Coyote	Coyote	Columbian Ground Squirrel
Common Nighthawk	Common Poorwill	Deer Mouse	Deer Mouse	Common Garter Snake
Common Poorwill	Common Porcupine	Eastern Kingbird	Eastern Kingbird	Common Nighthawk
Common Porcupine	Common Raven	Ferruginous Hawk	Ferruginous Hawk	Common Poorwill
Common Raven	Cooper's Hawk	Fringed Myotis	Fringed Myotis	Common Porcupine
Cooper's Hawk	Coyote	Golden Eagle	Golden Eagle	Common Raven
Coyote	Deer Mouse	Golden-mantled Ground Squirrel	Golden-mantled Ground Squirrel	Cooper's Hawk
Deer Mouse	Eastern Kingbird	Gopher Snake	Gopher Snake	Coyote
Eastern Kingbird	Ferruginous Hawk	Grasshopper Sparrow	Grasshopper Sparrow	Deer Mouse
Ferruginous Hawk	Fringed Myotis	Great Basin Pocket Mouse	Great Basin Pocket Mouse	Eastern Kingbird
Fringed Myotis	Golden Eagle	Great Basin Spadefoot	Great Basin Spadefoot	Ferruginous Hawk
Golden Eagle	Golden-mantled Ground Squirrel	Great Horned Owl	Great Horned Owl	Fringed Myotis
Golden-mantled Ground Squirrel	Gopher Snake	Greater Yellowlegs	Greater Yellowlegs	Golden Eagle
Gopher Snake	Grasshopper Sparrow	Green-tailed Towhee	Green-tailed Towhee	Golden-mantled Ground Squirrel
Grasshopper Sparrow	Great Basin Pocket Mouse	Hoary Bat	Hoary Bat	Gopher Snake
Gray Flycatcher	Great Basin Spadefoot	Horned Lark	Horned Lark	Grasshopper Sparrow
Great Basin Pocket Mouse	Great Horned Owl	Killdeer	Killdeer	Gray Flycatcher
Great Basin Spadefoot	Greater Yellowlegs	Lark Sparrow	Lark Sparrow	Great Basin Pocket Mouse
Great Horned Owl	Green-tailed Towhee	Lesser Yellowlegs	Lesser Yellowlegs	Great Basin Spadefoot
Greater Yellowlegs	Hoary Bat	Little Brown Myotis	Little Brown Myotis	Great Horned Owl
Hoary Bat	Horned Lark	Long-billed Curlew	Long-eared Myotis	Greater Yellowlegs
Horned Lark	Killdeer	Long-eared Myotis	Long-eared Owl	Green-tailed Towhee
Killdeer	Lark Sparrow	Long-eared Owl	Long-legged Myotis	Hoary Bat
Lark Sparrow	Least Chipmunk	Long-legged Myotis	Long-tailed Vole	Horned Lark
Least Chipmunk	Lesser Yellowlegs	Long-tailed Vole	Long-tailed	Killdeer

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
			Weasel	
Lesser Yellowlegs	Little Brown Myotis	Long-tailed Weasel	Long-toed Salamander	Lark Sparrow
Little Brown Myotis	Loggerhead Shrike	Long-toed Salamander	Mallard	Least Chipmunk
Loggerhead Shrike	Long-billed Curlew	Mallard	Merriam's Shrew	Lesser Yellowlegs
Long-billed Curlew	Long-eared Myotis	Merriam's Shrew	Mink	Little Brown Myotis
Long-eared Myotis	Long-eared Owl	Mink	Montane Vole	Loggerhead Shrike
Long-eared Owl	Long-legged Myotis	Montane Vole	Mountain Bluebird	Long-billed Curlew
Long-legged Myotis	Long-tailed Vole	Mountain Bluebird	Mountain Quail	Long-eared Myotis
Long-tailed Vole	Long-tailed Weasel	Mountain Quail	Mourning Dove	Long-eared Owl
Long-tailed Weasel	Long-toed Salamander	Mourning Dove	Mule Deer	Long-legged Myotis
Long-toed Salamander	Mallard	Mule Deer	Night Snake	Long-nosed Leopard Lizard
Mallard	Merlin	Night Snake	Northern Flicker	Long-tailed Vole
Merlin	Merriam's Shrew	Northern Flicker	Northern Goshawk	Long-tailed Weasel
Merriam's Shrew	Mink	Northern Goshawk	Northern Grasshopper Mouse	Long-toed Salamander
Mink	Montane Vole	Northern Grasshopper Mouse	Northern Harrier	Mallard
Montane Vole	Mountain Bluebird	Northern Harrier	Northern Pocket Gopher	Merlin
Mountain Bluebird	Mountain Quail	Northern Pocket Gopher	Northern Rough-winged Swallow	Merriam's Ground Squirrel
Mountain Quail	Mourning Dove	Northern Rough-winged Swallow	Northern Shrike	Merriam's Shrew
Mourning Dove	Mule Deer	Northern Shrike	Nuttall's (Mountain) Cottontail	Mink
Mule Deer	Nashville Warbler	Nuttall's (Mountain) Cottontail	Orange-crowned Warbler	Montane Vole
Nashville Warbler	Night Snake	Orange-crowned Warbler	Osprey	Mountain Bluebird
Night Snake	Northern Flicker	Osprey	Pacific Chorus (Tree) Frog	Mountain Quail
Northern Flicker	Northern Goshawk	Pacific Chorus (Tree) Frog	Painted Turtle	Mourning Dove
Northern Goshawk	Northern Grasshopper Mouse	Painted Turtle	Pallid Bat	Mule Deer
Northern	Northern Harrier	Pallid Bat	Prairie Falcon	Nashville Warbler

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Grasshopper Mouse				
Northern Harrier	Northern Leopard Frog	Prairie Falcon	Preble's Shrew	Night Snake
Northern Leopard Frog	Northern Pocket Gopher	Preble's Shrew	Racer	Northern Flicker
Northern Pocket Gopher	Northern Rough-winged Swallow	Racer	Red-tailed Hawk	Northern Goshawk
Northern Rough-winged Swallow	Northern Shrike	Red-tailed Hawk	Ringneck Snake	Northern Grasshopper Mouse
Northern Shrike	Nuttall's (Mountain) Cottontail	Ringneck Snake	Rock Wren	Northern Harrier
Nuttall's (Mountain) Cottontail	Orange-crowned Warbler	Rock Wren	Rocky Mountain Elk	Northern Leopard Frog
Orange-crowned Warbler	Ord's Kangaroo Rat	Rocky Mountain Elk	Rough-legged Hawk	Northern Pocket Gopher
Ord's Kangaroo Rat	Osprey	Rough-legged Hawk	Rubber Boa	Northern Rough-winged Swallow
Osprey	Pacific Chorus (Tree) Frog	Rubber Boa	Sage Thrasher	Northern Shrike
Pacific Chorus (Tree) Frog	Painted Turtle	Sagebrush Lizard	Sagebrush Lizard	Nuttall's (Mountain) Cottontail
Painted Turtle	Pallid Bat	Savannah Sparrow	Savannah Sparrow	Orange-crowned Warbler
Pallid Bat	Peregrine Falcon	Say's Phoebe	Say's Phoebe	Ord's Kangaroo Rat
Peregrine Falcon	Prairie Falcon	Sharp-shinned Hawk	Sharp-shinned Hawk	Osprey
Prairie Falcon	Preble's Shrew	Short-eared Owl	Short-eared Owl	Pacific Chorus (Tree) Frog
Preble's Shrew	Racer	Short-horned Lizard	Short-horned Lizard	Painted Turtle
Racer	Red-tailed Hawk	Solitary Sandpiper	Solitary Sandpiper	Pallid Bat
Red-tailed Hawk	Ringneck Snake	Spotted Sandpiper	Spotted Sandpiper	Peregrine Falcon
Ringneck Snake	Rock Wren	Swainson's Hawk	Swainson's Hawk	Piute Ground Squirrel
Rock Wren	Rocky Mountain Elk	Townsend's Big-eared Bat	Townsend's Big-eared Bat	Prairie Falcon
Rocky Mountain Elk	Rough-legged Hawk	Townsend's Solitaire	Townsend's Solitaire	Preble's Shrew
Rough-legged Hawk	Rubber Boa	Vagrant Shrew	Vagrant Shrew	Pronghorn Antelope
Rough-skinned Newt	Sage Sparrow	Vesper Sparrow	Vesper Sparrow	Racer
Rubber Boa	Sage Thrasher	Washington Ground Squirrel	Western Fence Lizard	Red-tailed Hawk
Sage Grouse	Sagebrush Lizard	Western Fence	Western Harvest	Ringneck Snake

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
		Lizard	Mouse	
Sage Sparrow	Sagebrush Vole	Western Harvest Mouse	Western Kingbird	Rock Wren
Sage Thrasher	Savannah Sparrow	Western Kingbird	Western Meadowlark	Rocky Mountain Elk
Sagebrush Lizard	Say's Phoebe	Western Meadowlark	Western Pipistrelle	Rough-legged Hawk
Sagebrush Vole	Sharp-shinned Hawk	Western Pipistrelle	Western Rattlesnake	Rubber Boa
Savannah Sparrow	Short-eared Owl	Western Rattlesnake	Western Skink	Sage Grouse
Say's Phoebe	Short-horned Lizard	Western Skink	Western Small-footed Myotis	Sage Sparrow
Sharp-shinned Hawk	Side-blotched Lizard	Western Small-footed Myotis	Western Terrestrial Garter Snake	Sage Thrasher
Sharp-tailed Grouse	Snow Bunting	Western Terrestrial Garter Snake	Western Toad	Sagebrush Lizard
Short-eared Owl	Solitary Sandpiper	Western Toad	White-crowned Sparrow	Sagebrush Vole
Short-horned Lizard	Spotted Sandpiper	White-crowned Sparrow	White-tailed Jackrabbit	Savannah Sparrow
Side-blotched Lizard	Striped Whipsnake	White-tailed Deer (Eastside)	White-throated Swift	Say's Phoebe
Snow Bunting	Swainson's Hawk	White-tailed Jackrabbit	Woodhouse's Toad	Sharp-shinned Hawk
Solitary Sandpiper	Tiger Salamander	White-throated Swift	Yellow-bellied Marmot	Sharp-tailed Grouse
Spotted Sandpiper	Townsend's Big-eared Bat	Woodhouse's Toad	Yuma Myotis	Short-eared Owl
Striped Whipsnake	Townsend's Ground Squirrel	Yellow-bellied Marmot		Short-horned Lizard
Swainson's Hawk	Townsend's Solitaire	Yuma Myotis		Side-blotched Lizard
Tiger Salamander	Turkey Vulture			Snow Bunting
Townsend's Big-eared Bat	Vagrant Shrew			Solitary Sandpiper
Townsend's Ground Squirrel	Vesper Sparrow			Spotted Sandpiper
Townsend's Solitaire	Washington Ground Squirrel			Striped Whipsnake
Turkey Vulture	Western Fence Lizard			Swainson's Hawk
Vagrant Shrew	Western Harvest Mouse			Tiger Salamander
Vesper Sparrow	Western Kingbird			Townsend's Big-eared Bat
Washington Ground Squirrel	Western Meadowlark			Townsend's Solitaire
Western Fence Lizard	Western Pipistrelle			Turkey Vulture

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Western Harvest Mouse	Western Rattlesnake			Vagrant Shrew
Western Kingbird	Western Skink			Vesper Sparrow
Western Meadowlark	Western Small-footed Myotis			Washington Ground Squirrel
Western Pipistrelle	Western Terrestrial Garter Snake			Western Fence Lizard
Western Rattlesnake	Western Toad			Western Harvest Mouse
Western Skink	White-crowned Sparrow			Western Kingbird
Western Small-footed Myotis	White-tailed Jackrabbit			Western Meadowlark
Western Terrestrial Garter Snake	White-throated Swift			Western Pipistrelle
Western Toad	Woodhouse's Toad			Western Rattlesnake
White-crowned Sparrow	Yellow-bellied Marmot			Western Skink
White-tailed Jackrabbit	Yuma Myotis			Western Small-footed Myotis
White-throated Swift				Western Terrestrial Garter Snake
Woodhouse's Toad				Western Toad
Yellow-bellied Marmot				White-crowned Sparrow
Yuma Myotis				White-tailed Deer (Eastside)
				White-tailed Jackrabbit
				White-throated Swift
				Willet
				Woodhouse's Toad
				Yellow-bellied Marmot
				Yuma Myotis

Table E-9. Wildlife species occurrence in Eastside (Interior) Grassland habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Tiger Salamander	Tiger Salamander	Long-toed Salamander	Long-toed Salamander	Tiger Salamander
Long-toed Salamander	Long-toed Salamander	Great Basin Spadefoot	Great Basin Spadefoot	Long-toed Salamander
Great Basin Spadefoot	Great Basin Spadefoot	Western Toad	Western Toad	Great Basin Spadefoot
Western Toad	Western Toad	Woodhouse's Toad	Woodhouse's Toad	Western Toad
Woodhouse's Toad	Woodhouse's Toad	Pacific Chorus (Tree) Frog	Pacific Chorus (Tree) Frog	Woodhouse's Toad
Pacific Chorus (Tree) Frog	Pacific Chorus (Tree) Frog	Columbia Spotted Frog	Columbia Spotted Frog	Pacific Chorus (Tree) Frog
Columbia Spotted Frog	Columbia Spotted Frog	Bullfrog	Bullfrog	Columbia Spotted Frog
Northern Leopard Frog	Northern Leopard Frog	Painted Turtle	Painted Turtle	Northern Leopard Frog
Bullfrog	Bullfrog	Short-horned Lizard	Short-horned Lizard	Bullfrog
Painted Turtle	Painted Turtle	Sagebrush Lizard	Sagebrush Lizard	Painted Turtle
Short-horned Lizard	Short-horned Lizard	Western Fence Lizard	Western Fence Lizard	Short-horned Lizard
Sagebrush Lizard	Sagebrush Lizard	Western Skink	Western Skink	Sagebrush Lizard
Western Fence Lizard	Western Fence Lizard	Rubber Boa	Rubber Boa	Western Fence Lizard
Side-blotched Lizard	Side-blotched Lizard	Racer	Racer	Side-blotched Lizard
Western Skink	Western Skink	Night Snake	Night Snake	Western Skink
Rubber Boa	Rubber Boa	Gopher Snake	Gopher Snake	Rubber Boa
Racer	Racer	Western Terrestrial Garter Snake	Western Terrestrial Garter Snake	Racer
Night Snake	Night Snake	Common Garter Snake	Common Garter Snake	Night Snake
Gopher Snake	Gopher Snake	Western Rattlesnake	Western Rattlesnake	Gopher Snake
Western Terrestrial Garter Snake	Western Terrestrial Garter Snake	Canada Goose	Canada Goose	Western Terrestrial Garter Snake
Common Garter Snake	Common Garter Snake	Gadwall	Mallard	Common Garter Snake
Western Rattlesnake	Western Rattlesnake	Mallard	Cinnamon Teal	Western Rattlesnake
Turkey Vulture	Turkey Vulture	Blue-winged Teal	Northern Harrier	Turkey Vulture
Canada Goose	Canada Goose	Cinnamon Teal	Sharp-shinned Hawk	Canada Goose
Gadwall	Gadwall	Northern Shoveler	Cooper's Hawk	Gadwall
American Wigeon	American Wigeon	Northern Pintail	Swainson's Hawk	American Wigeon
Mallard	Mallard	Green-winged	Red-tailed Hawk	Mallard

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
		Teal		
Blue-winged Teal	Blue-winged Teal	Northern Harrier	Ferruginous Hawk	Blue-winged Teal
Cinnamon Teal	Cinnamon Teal	Sharp-shinned Hawk	Rough-legged Hawk	Cinnamon Teal
Northern Shoveler	Northern Shoveler	Cooper's Hawk	Golden Eagle	Northern Shoveler
Northern Pintail	Northern Pintail	Swainson's Hawk	American Kestrel	Northern Pintail
Green-winged Teal	Green-winged Teal	Red-tailed Hawk	Prairie Falcon	Green-winged Teal
Northern Harrier	Northern Harrier	Ferruginous Hawk	Chukar	Northern Harrier
Sharp-shinned Hawk	Sharp-shinned Hawk	Rough-legged Hawk	Gray Partridge	Sharp-shinned Hawk
Cooper's Hawk	Cooper's Hawk	Golden Eagle	Ring-necked Pheasant	Cooper's Hawk
Swainson's Hawk	Swainson's Hawk	American Kestrel	Wild Turkey	Swainson's Hawk
Red-tailed Hawk	Red-tailed Hawk	Prairie Falcon	Mountain Quail	Red-tailed Hawk
Ferruginous Hawk	Ferruginous Hawk	Chukar	California Quail	Ferruginous Hawk
Rough-legged Hawk	Rough-legged Hawk	Gray Partridge	Killdeer	Rough-legged Hawk
Golden Eagle	Golden Eagle	Ring-necked Pheasant	Greater Yellowlegs	Golden Eagle
American Kestrel	American Kestrel	Wild Turkey	Lesser Yellowlegs	American Kestrel
Merlin	Merlin	Mountain Quail	Solitary Sandpiper	Merlin
Gyrfalcon	Gyrfalcon	California Quail	Spotted Sandpiper	Gyrfalcon
Peregrine Falcon	Peregrine Falcon	Killdeer	Rock Dove	Peregrine Falcon
Prairie Falcon	Prairie Falcon	American Avocet	Mourning Dove	Prairie Falcon
Chukar	Chukar	Greater Yellowlegs	Barn Owl	Chukar
Gray Partridge	Gray Partridge	Lesser Yellowlegs	Great Horned Owl	Gray Partridge
Ring-necked Pheasant	Ring-necked Pheasant	Solitary Sandpiper	Long-eared Owl	Ring-necked Pheasant
Sage Grouse	Wild Turkey	Spotted Sandpiper	Short-eared Owl	Sage Grouse
Sharp-tailed Grouse	Mountain Quail	Long-billed Curlew	Common Nighthawk	Sharp-tailed Grouse
Wild Turkey	California Quail	Rock Dove	Common Poorwill	Wild Turkey
Mountain Quail	Killdeer	Mourning Dove	White-throated Swift	Mountain Quail
California Quail	Black-necked Stilt	Barn Owl	Lewis's Woodpecker	California Quail
Killdeer	American Avocet	Great Horned Owl	Say's Phoebe	Northern Bobwhite
Black-necked Stilt	Greater Yellowlegs	Long-eared Owl	Western Kingbird	Sandhill Crane
American Avocet	Lesser Yellowlegs	Short-eared Owl	Eastern Kingbird	Killdeer
Greater Yellowlegs	Solitary Sandpiper	Common Nighthawk	Northern Shrike	Black-necked Stilt
Lesser Yellowlegs	Spotted Sandpiper	Common Poorwill	Black-billed Magpie	American Avocet
Solitary Sandpiper	Long-billed Curlew	White-throated Swift	American Crow	Greater Yellowlegs

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Spotted Sandpiper	Rock Dove	Lewis's Woodpecker	Common Raven	Lesser Yellowlegs
Upland Sandpiper	Mourning Dove	Say's Phoebe	Horned Lark	Solitary Sandpiper
Long-billed Curlew	Barn Owl	Western Kingbird	Northern Rough-winged Swallow	Spotted Sandpiper
Rock Dove	Great Horned Owl	Eastern Kingbird	Bank Swallow	Upland Sandpiper
Mourning Dove	Snowy Owl	Northern Shrike	Cliff Swallow	Long-billed Curlew
Barn Owl	Burrowing Owl	Black-billed Magpie	Barn Swallow	Rock Dove
Great Horned Owl	Long-eared Owl	American Crow	Rock Wren	Mourning Dove
Snowy Owl	Short-eared Owl	Common Raven	Canyon Wren	Barn Owl
Burrowing Owl	Common Nighthawk	Horned Lark	Western Bluebird	Great Horned Owl
Long-eared Owl	Common Poorwill	Northern Rough-winged Swallow	Mountain Bluebird	Snowy Owl
Short-eared Owl	White-throated Swift	Bank Swallow	Townsend's Solitaire	Burrowing Owl
Common Nighthawk	Lewis's Woodpecker	Cliff Swallow	American Robin	Long-eared Owl
Common Poorwill	Say's Phoebe	Barn Swallow	Sage Thrasher	Short-eared Owl
White-throated Swift	Western Kingbird	Rock Wren	European Starling	Common Nighthawk
Lewis's Woodpecker	Eastern Kingbird	Canyon Wren	Green-tailed Towhee	Common Poorwill
Say's Phoebe	Loggerhead Shrike	Western Bluebird	Chipping Sparrow	White-throated Swift
Western Kingbird	Northern Shrike	Mountain Bluebird	Brewer's Sparrow	Lewis's Woodpecker
Eastern Kingbird	Black-billed Magpie	Townsend's Solitaire	Vesper Sparrow	Say's Phoebe
Loggerhead Shrike	American Crow	American Robin	Lark Sparrow	Western Kingbird
Northern Shrike	Common Raven	European Starling	Savannah Sparrow	Eastern Kingbird
Black-billed Magpie	Horned Lark	Green-tailed Towhee	Grasshopper Sparrow	Loggerhead Shrike
American Crow	Northern Rough-winged Swallow	Chipping Sparrow	White-crowned Sparrow	Northern Shrike
Common Raven	Bank Swallow	Vesper Sparrow	Lapland Longspur	Black-billed Magpie
Horned Lark	Cliff Swallow	Lark Sparrow	Western Meadowlark	American Crow
Northern Rough-winged Swallow	Barn Swallow	Savannah Sparrow	Brewer's Blackbird	Common Raven
Bank Swallow	Rock Wren	Grasshopper Sparrow	Brown-headed Cowbird	Horned Lark
Cliff Swallow	Canyon Wren	White-crowned Sparrow	American Goldfinch	Northern Rough-winged Swallow
Barn Swallow	Western Bluebird	Lapland Longspur	Preble's Shrew	Bank Swallow
Rock Wren	Mountain Bluebird	Western Meadowlark	Vagrant Shrew	Cliff Swallow

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Canyon Wren	Townsend's Solitaire	Brewer's Blackbird	Merriam's Shrew	Barn Swallow
Western Bluebird	American Robin	Brown-headed Cowbird	Coast Mole	Rock Wren
Mountain Bluebird	Sage Thrasher	American Goldfinch	California Myotis	Canyon Wren
Townsend's Solitaire	European Starling	Preble's Shrew	Western Small-footed Myotis	Western Bluebird
American Robin	Green-tailed Towhee	Vagrant Shrew	Yuma Myotis	Mountain Bluebird
Sage Thrasher	Chipping Sparrow	Merriam's Shrew	Little Brown Myotis	Townsend's Solitaire
European Starling	Brewer's Sparrow	Coast Mole	Long-legged Myotis	American Robin
Chipping Sparrow	Vesper Sparrow	California Myotis	Fringed Myotis	Sage Thrasher
Brewer's Sparrow	Lark Sparrow	Western Small-footed Myotis	Long-eared Myotis	European Starling
Vesper Sparrow	Sage Sparrow	Yuma Myotis	Silver-haired Bat	American Pipit
Lark Sparrow	Savannah Sparrow	Little Brown Myotis	Western Pipistrelle	Green-tailed Towhee
Sage Sparrow	Grasshopper Sparrow	Long-legged Myotis	Big Brown Bat	Chipping Sparrow
Savannah Sparrow	White-crowned Sparrow	Fringed Myotis	Hoary Bat	Clay-colored Sparrow
Grasshopper Sparrow	Lapland Longspur	Long-eared Myotis	Townsend's Big-eared Bat	Brewer's Sparrow
White-crowned Sparrow	Snow Bunting	Silver-haired Bat	Pallid Bat	Vesper Sparrow
Lapland Longspur	Bobolink	Western Pipistrelle	Nuttall's (Mountain) Cottontail	Lark Sparrow
Snow Bunting	Western Meadowlark	Big Brown Bat	White-tailed Jackrabbit	Sage Sparrow
Bobolink	Brewer's Blackbird	Hoary Bat	Black-tailed Jackrabbit	Savannah Sparrow
Western Meadowlark	Brown-headed Cowbird	Townsend's Big-eared Bat	Yellow-bellied Marmot	Grasshopper Sparrow
Brewer's Blackbird	American Goldfinch	Pallid Bat	Columbian Ground Squirrel	White-crowned Sparrow
Brown-headed Cowbird	Preble's Shrew	Nuttall's (Mountain) Cottontail	Golden-mantled Ground Squirrel	Lapland Longspur
American Goldfinch	Vagrant Shrew	White-tailed Jackrabbit	Northern Pocket Gopher	Snow Bunting
Preble's Shrew	Merriam's Shrew	Black-tailed Jackrabbit	Great Basin Pocket Mouse	Bobolink
Vagrant Shrew	Coast Mole	Yellow-bellied Marmot	Western Harvest Mouse	Western Meadowlark
Merriam's Shrew	California Myotis	Washington Ground Squirrel	Deer Mouse	Brewer's Blackbird
California Myotis	Western Small-footed Myotis	Columbian Ground Squirrel	Northern Grasshopper	Brown-headed Cowbird

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
			Mouse	
Western Small-footed Myotis	Yuma Myotis	Golden-mantled Ground Squirrel	Montane Vole	American Goldfinch
Yuma Myotis	Little Brown Myotis	Northern Pocket Gopher	Long-tailed Vole	Preble's Shrew
Little Brown Myotis	Long-legged Myotis	Great Basin Pocket Mouse	Western Jumping Mouse	Vagrant Shrew
Long-legged Myotis	Fringed Myotis	Western Harvest Mouse	Coyote	Merriam's Shrew
Fringed Myotis	Long-eared Myotis	Deer Mouse	Black Bear	Coast Mole
Long-eared Myotis	Silver-haired Bat	Northern Grasshopper Mouse	Ermine	California Myotis
Silver-haired Bat	Western Pipistrelle	Montane Vole	Long-tailed Weasel	Western Small-footed Myotis
Western Pipistrelle	Big Brown Bat	Long-tailed Vole	Mink	Yuma Myotis
Big Brown Bat	Hoary Bat	Western Jumping Mouse	American Badger	Little Brown Myotis
Hoary Bat	Townsend's Big-eared Bat	Coyote	Bobcat	Long-legged Myotis
Spotted Bat	Pallid Bat	Black Bear	Rocky Mountain Elk	Fringed Myotis
Townsend's Big-eared Bat	Nuttall's (Mountain) Cottontail	Ermine	Mule Deer	Long-eared Myotis
Pallid Bat	White-tailed Jackrabbit	Long-tailed Weasel	Rocky Mountain Bighorn Sheep	Silver-haired Bat
Nuttall's (Mountain) Cottontail	Black-tailed Jackrabbit	Mink		Western Pipistrelle
White-tailed Jackrabbit	Yellow-bellied Marmot	American Badger		Big Brown Bat
Black-tailed Jackrabbit	Washington Ground Squirrel	Bobcat		Hoary Bat
Yellow-bellied Marmot	Columbian Ground Squirrel	Rocky Mountain Elk		Townsend's Big-eared Bat
Washington Ground Squirrel	Golden-mantled Ground Squirrel	Mule Deer		Pallid Bat
Columbian Ground Squirrel	Northern Pocket Gopher	White-tailed Deer (Eastside)		Nuttall's (Mountain) Cottontail
Golden-mantled Ground Squirrel	Great Basin Pocket Mouse	Rocky Mountain Bighorn Sheep		White-tailed Jackrabbit
Northern Pocket Gopher	Ord's Kangaroo Rat			Black-tailed Jackrabbit
Great Basin Pocket Mouse	Western Harvest Mouse			Yellow-bellied Marmot
Ord's Kangaroo Rat	Deer Mouse			Washington Ground Squirrel
Western Harvest Mouse	Northern Grasshopper			Belding's Ground Squirrel

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
	Mouse			
Deer Mouse	Montane Vole			Columbian Ground Squirrel
Northern Grasshopper Mouse	Long-tailed Vole			Golden-mantled Ground Squirrel
Montane Vole	Sagebrush Vole			Northern Pocket Gopher
Long-tailed Vole	Western Jumping Mouse			Great Basin Pocket Mouse
Sagebrush Vole	Coyote			Ord's Kangaroo Rat
Western Jumping Mouse	Black Bear			Western Harvest Mouse
Coyote	Ermine			Deer Mouse
Black Bear	Long-tailed Weasel			Northern Grasshopper Mouse
Ermine	Mink			Montane Vole
Long-tailed Weasel	American Badger			Long-tailed Vole
Mink	Bobcat			Sagebrush Vole
American Badger	Rocky Mountain Elk			Western Jumping Mouse
Bobcat	Mule Deer			Coyote
Rocky Mountain Elk	Rocky Mountain Bighorn Sheep			Black Bear
Mule Deer				Grizzly Bear
Rocky Mountain Bighorn Sheep				Ermine
				Long-tailed Weasel
				Mink
				American Badger
				Bobcat
				Rocky Mountain Elk
				Mule Deer
				White-tailed Deer (Eastside)
				Pronghorn Antelope
				Rocky Mountain Bighorn Sheep

Table E-10. Wildlife species occurrence in Eastside (Interior) Riparian Wetland habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
American Badger	American Badger	American Badger	American Badger	American Badger
American Beaver	American Beaver	American Beaver	American Beaver	American Beaver
American Crow	American Crow	American Crow	American Crow	American Crow
American Dipper	American Dipper	American Dipper	American Dipper	American Dipper
American Goldfinch	American Goldfinch	American Goldfinch	American Goldfinch	American Goldfinch
American Kestrel	American Kestrel	American Kestrel	American Kestrel	American Kestrel
American Redstart	American Marten	American Marten	American Marten	American Marten
American Robin	American Redstart	American Robin	American Robin	American Redstart
American Tree Sparrow	American Robin	American Tree Sparrow	American Tree Sparrow	American Robin
American Wigeon	American Tree Sparrow	Bank Swallow	Bank Swallow	American Tree Sparrow
Bald Eagle	American Wigeon	Barn Owl	Barn Owl	American Wigeon
Bank Swallow	Bald Eagle	Barn Swallow	Barn Swallow	Ash-throated Flycatcher
Barn Owl	Bank Swallow	Barred Owl	Barred Owl	Bald Eagle
Barn Swallow	Barn Owl	Belted Kingfisher	Belted Kingfisher	Bank Swallow
Barred Owl	Barn Swallow	Big Brown Bat	Big Brown Bat	Barn Owl
Belted Kingfisher	Barred Owl	Black Bear	Black Bear	Barn Swallow
Big Brown Bat	Belted Kingfisher	Black-backed Woodpecker	Black-backed Woodpecker	Barred Owl
Black Bear	Big Brown Bat	Black-billed Magpie	Black-billed Magpie	Belted Kingfisher
Black Swift	Black Bear	Black-capped Chickadee	Black-capped Chickadee	Big Brown Bat
Black-backed Woodpecker	Black Swift	Black-chinned Hummingbird	Black-chinned Hummingbird	Black Bear
Black-billed Magpie	Black-backed Woodpecker	Black-crowned Night-heron	Black-headed Grosbeak	Black Swift
Black-capped Chickadee	Black-billed Magpie	Black-headed Grosbeak	Blue Grouse	Black-backed Woodpecker
Black-chinned Hummingbird	Black-capped Chickadee	Blue Grouse	Bobcat	Black-billed Magpie
Black-crowned Night-heron	Black-chinned Hummingbird	Bobcat	Bohemian Waxwing	Black-capped Chickadee
Black-headed Grosbeak	Black-crowned Night-heron	Bohemian Waxwing	Brewer's Blackbird	Black-chinned Hummingbird
Blue Grouse	Black-headed Grosbeak	Brewer's Blackbird	Brown Creeper	Black-crowned Night-heron
Bobcat	Blue Grouse	Brown Creeper	Brown-headed Cowbird	Black-headed Grosbeak
Bobolink	Bobcat	Brown-headed Cowbird	Bullock's Oriole	Blue Grouse
Bohemian Waxwing	Bobolink	Bullock's Oriole	Bushy-tailed Woodrat	Bobcat
Brewer's Blackbird	Bohemian Waxwing	Bushy-tailed Woodrat	California Myotis	Bobolink

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Broad-tailed Hummingbird	Brewer's Blackbird	California Myotis	Calliope Hummingbird	Bohemian Waxwing
Brown Creeper	Brown Creeper	Calliope Hummingbird	Canada Goose	Brewer's Blackbird
Brown-headed Cowbird	Brown-headed Cowbird	Canada Goose	Canyon Wren	Broad-tailed Hummingbird
Bufflehead	Bullock's Oriole	Canyon Wren	Cassin's Finch	Brown Creeper
Bullock's Oriole	Bushy-tailed Woodrat	Cassin's Finch	Cassin's Vireo	Brown-headed Cowbird
Bushy-tailed Woodrat	California Myotis	Cassin's Vireo	Cedar Waxwing	Bufflehead
California Myotis	Calliope Hummingbird	Cedar Waxwing	Chipping Sparrow	Bullock's Oriole
Calliope Hummingbird	Canada Goose	Chipping Sparrow	Cliff Swallow	Bushtit
Canada Goose	Canyon Wren	Cliff Swallow	Coast Mole	Bushy-tailed Woodrat
Canyon Wren	Cassin's Finch	Coast Mole	Columbia Spotted Frog	California Myotis
Cassin's Finch	Cassin's Vireo	Columbia Spotted Frog	Columbian Ground Squirrel	Calliope Hummingbird
Cassin's Vireo	Cedar Waxwing	Columbian Ground Squirrel	Common Garter Snake	Canada Goose
Cedar Waxwing	Chipping Sparrow	Common Garter Snake	Common Merganser	Canyon Wren
Chipping Sparrow	Cliff Swallow	Common Merganser	Common Nighthawk	Cassin's Finch
Cliff Swallow	Coast Mole	Common Nighthawk	Common Porcupine	Cassin's Vireo
Columbia Spotted Frog	Columbia Spotted Frog	Common Porcupine	Common Raven	Cattle Egret
Columbian Ground Squirrel	Columbian Ground Squirrel	Common Raven	Cooper's Hawk	Cedar Waxwing
Common Garter Snake	Common Garter Snake	Cooper's Hawk	Cordilleran Flycatcher	Chipping Sparrow
Common Merganser	Common Merganser	Cordilleran Flycatcher	Coyote	Cliff Swallow
Common Nighthawk	Common Nighthawk	Coyote	Dark-eyed Junco	Coast Mole
Common Porcupine	Common Porcupine	Dark-eyed Junco	Deer Mouse	Columbia Spotted Frog
Common Raven	Common Raven	Deer Mouse	Downy Woodpecker	Columbian Ground Squirrel
Common Redpoll	Common Redpoll	Double-crested Cormorant	Dusky Flycatcher	Common Garter Snake
Common Yellowthroat	Common Yellowthroat	Downy Woodpecker	Eastern Kingbird	Common Merganser
Cooper's Hawk	Cooper's Hawk	Dusky Flycatcher	Ermine	Common Nighthawk
Cordilleran Flycatcher	Cordilleran Flycatcher	Eastern Kingbird	Evening Grosbeak	Common Porcupine
Coyote	Coyote	Ermine	Flammulated Owl	Common Raven

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Dark-eyed Junco	Dark-eyed Junco	Evening Grosbeak	Fox Sparrow	Common Redpoll
Deer Mouse	Deer Mouse	Flammulated Owl	Fringed Myotis	Common Yellowthroat
Double-crested Cormorant	Double-crested Cormorant	Fox Sparrow	Golden Eagle	Cooper's Hawk
Downy Woodpecker	Downy Woodpecker	Fringed Myotis	Golden-crowned Kinglet	Cordilleran Flycatcher
Dusky Flycatcher	Dusky Flycatcher	Golden Eagle	Golden-mantled Ground Squirrel	Coyote
Eastern Kingbird	Eastern Kingbird	Golden-crowned Kinglet	Gopher Snake	Dark-eyed Junco
Ermine	Ermine	Golden-mantled Ground Squirrel	Gray Catbird	Deer Mouse
Evening Grosbeak	Evening Grosbeak	Gopher Snake	Gray Jay	Double-crested Cormorant
Fisher	Fisher	Gray Catbird	Great Basin Spadefoot	Downy Woodpecker
Flammulated Owl	Flammulated Owl	Gray Jay	Great Blue Heron	Dusky Flycatcher
Fox Sparrow	Fox Sparrow	Great Basin Spadefoot	Great Horned Owl	Eastern Kingbird
Fringed Myotis	Fringed Myotis	Great Blue Heron	Greater Yellowlegs	Ermine
Golden Eagle	Golden Eagle	Great Horned Owl	Green-tailed Towhee	Evening Grosbeak
Golden-crowned Kinglet	Golden-crowned Kinglet	Greater Yellowlegs	Hairy Woodpecker	Flammulated Owl
Golden-mantled Ground Squirrel	Golden-mantled Ground Squirrel	Green-tailed Towhee	Heather Vole	Fox Sparrow
Gopher Snake	Gopher Snake	Green-winged Teal	Hermit Thrush	Fringed Myotis
Gray Catbird	Gray Catbird	Hairy Woodpecker	Hoary Bat	Golden Eagle
Gray Jay	Gray Jay	Heather Vole	House Finch	Golden-crowned Kinglet
Great Basin Spadefoot	Great Basin Spadefoot	Hermit Thrush	House Wren	Golden-mantled Ground Squirrel
Great Blue Heron	Great Blue Heron	Hoary Bat	Killdeer	Gopher Snake
Great Egret	Great Egret	House Finch	Lazuli Bunting	Gray Catbird
Great Horned Owl	Great Horned Owl	House Wren	Lesser Yellowlegs	Gray Jay
Greater Yellowlegs	Greater Yellowlegs	Killdeer	Lewis's Woodpecker	Great Basin Spadefoot
Green-winged Teal	Green-tailed Towhee	Lazuli Bunting	Lincoln's Sparrow	Great Blue Heron
Hairy Woodpecker	Green-winged Teal	Lesser Yellowlegs	Little Brown Myotis	Great Egret
Harlequin Duck	Hairy Woodpecker	Lewis's Woodpecker	Long-eared Myotis	Great Horned Owl
Heather Vole	Heather Vole	Lincoln's Sparrow	Long-eared Owl	Greater Yellowlegs
Hermit Thrush	Hermit Thrush	Little Brown Myotis	Long-legged Myotis	Green-tailed Towhee
Hoary Bat	Hoary Bat	Long-eared Myotis	Long-tailed Vole	Green-winged Teal
Hooded	Hooded	Long-eared Owl	Long-tailed	Grizzly Bear

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Merganser	Merganser		Weasel	
House Finch	House Finch	Long-legged Myotis	Long-toed Salamander	Hairy Woodpecker
House Wren	House Wren	Long-tailed Vole	Macgillivray's Warbler	Harlequin Duck
Idaho Giant Salamander	Idaho Giant Salamander	Long-tailed Weasel	Mallard	Heather Vole
Killdeer	Killdeer	Long-toed Salamander	Mink	Hermit Thrush
Lazuli Bunting	Lazuli Bunting	Macgillivray's Warbler	Montane Shrew	Hoary Bat
Least Chipmunk	Least Chipmunk	Mallard	Montane Vole	Hooded Merganser
Lesser Yellowlegs	Lesser Yellowlegs	Mink	Mountain Bluebird	House Finch
Lewis's Woodpecker	Lewis's Woodpecker	Montane Shrew	Mountain Chickadee	House Wren
Lincoln's Sparrow	Lincoln's Sparrow	Montane Vole	Mountain Lion	Killdeer
Little Brown Myotis	Little Brown Myotis	Mountain Bluebird	Mountain Quail	Lazuli Bunting
Long-eared Myotis	Long-eared Myotis	Mountain Chickadee	Mourning Dove	Least Chipmunk
Long-eared Owl	Long-eared Owl	Mountain Lion	Mule Deer	Least Flycatcher
Long-legged Myotis	Long-legged Myotis	Mountain Quail	Muskrat	Lesser Goldfinch
Long-tailed Vole	Long-tailed Vole	Mourning Dove	Northern Flicker	Lesser Yellowlegs
Long-tailed Weasel	Long-tailed Weasel	Mule Deer	Northern Flying Squirrel	Lewis's Woodpecker
Long-toed Salamander	Long-toed Salamander	Muskrat	Northern Goshawk	Lincoln's Sparrow
Macgillivray's Warbler	Macgillivray's Warbler	Northern Flicker	Northern Harrier	Little Brown Myotis
Mallard	Mallard	Northern Flying Squirrel	Northern Pocket Gopher	Long-eared Myotis
Masked Shrew	Masked Shrew	Northern Goshawk	Northern Pygmy-owl	Long-eared Owl
Meadow Vole	Meadow Vole	Northern Harrier	Northern Rough-winged Swallow	Long-legged Myotis
Merlin	Merlin	Northern Pocket Gopher	Northern Saw-whet Owl	Long-tailed Vole
Mink	Mink	Northern Pygmy-owl	Olive-sided Flycatcher	Long-tailed Weasel
Montane Shrew	Montane Shrew	Northern Rough-winged Swallow	Orange-crowned Warbler	Long-toed Salamander
Montane Vole	Montane Vole	Northern Saw-whet Owl	Osprey	Macgillivray's Warbler
Mountain Bluebird	Mountain Bluebird	Olive-sided Flycatcher	Pacific Chorus (Tree) Frog	Mallard
Mountain Chickadee	Mountain Chickadee	Orange-crowned Warbler	Painted Turtle	Merlin
Mountain Lion	Mountain Lion	Osprey	Pallid Bat	Mink
Mountain Quail	Mountain Quail	Pacific Chorus (Tree) Frog	Pileated Woodpecker	Montane Shrew

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Mourning Dove	Mourning Dove	Painted Turtle	Pine Siskin	Montane Vole
Mule Deer	Mule Deer	Pallid Bat	Prairie Falcon	Mountain Bluebird
Muskrat	Muskrat	Pied-billed Grebe	Preble's Shrew	Mountain Chickadee
Nashville Warbler	Nashville Warbler	Pileated Woodpecker	Pygmy Nuthatch	Mountain Lion
Northern Alligator Lizard	Northern Alligator Lizard	Pine Siskin	Raccoon	Mountain Quail
Northern Flicker	Northern Flicker	Prairie Falcon	Racer	Mourning Dove
Northern Flying Squirrel	Northern Flying Squirrel	Preble's Shrew	Red Crossbill	Mule Deer
Northern Goshawk	Northern Goshawk	Pygmy Nuthatch	Red-breasted Nuthatch	Muskrat
Northern Harrier	Northern Harrier	Raccoon	Red-eyed Vireo	Nashville Warbler
Northern Leopard Frog	Northern Leopard Frog	Racer	Red-naped Sapsucker	Northern Flicker
Northern Pocket Gopher	Northern Pocket Gopher	Red Crossbill	Red-tailed Hawk	Northern Flying Squirrel
Northern Pygmy-owl	Northern Pygmy-owl	Red-breasted Nuthatch	Red-winged Blackbird	Northern Goshawk
Northern River Otter	Northern River Otter	Red-eyed Vireo	Rocky Mountain Elk	Northern Harrier
Northern Rough-winged Swallow	Northern Rough-winged Swallow	Red-naped Sapsucker	Rough-legged Hawk	Northern Leopard Frog
Northern Saw-whet Owl	Northern Saw-whet Owl	Red-tailed Hawk	Rubber Boa	Northern Pocket Gopher
Northern Waterthrush	Northern Waterthrush	Red-winged Blackbird	Ruby-crowned Kinglet	Northern Pygmy-owl
Olive-sided Flycatcher	Olive-sided Flycatcher	Rocky Mountain Elk	Ruffed Grouse	Northern River Otter
Orange-crowned Warbler	Orange-crowned Warbler	Rough-legged Hawk	Rufous Hummingbird	Northern Rough-winged Swallow
Osprey	Osprey	Rubber Boa	Savannah Sparrow	Northern Saw-whet Owl
Pacific Chorus (Tree) Frog	Pacific Chorus (Tree) Frog	Ruby-crowned Kinglet	Say's Phoebe	Northern Waterthrush
Painted Turtle	Painted Turtle	Ruffed Grouse	Silver-haired Bat	Olive-sided Flycatcher
Pallid Bat	Pallid Bat	Rufous Hummingbird	Snowshoe Hare	Orange-crowned Warbler
Peregrine Falcon	Peregrine Falcon	Savannah Sparrow	Solitary Sandpiper	Osprey
Pied-billed Grebe	Pied-billed Grebe	Say's Phoebe	Song Sparrow	Pacific Chorus (Tree) Frog
Pileated Woodpecker	Pileated Woodpecker	Silver-haired Bat	Southern Red-backed Vole	Painted Turtle
Pine Siskin	Pine Siskin	Snowshoe Hare	Spotted Sandpiper	Pallid Bat
Prairie Falcon	Prairie Falcon	Solitary Sandpiper	Spotted Towhee	Peregrine Falcon
Preble's Shrew	Preble's Shrew	Song Sparrow	Steller's Jay	Pied-billed Grebe
Pygmy Nuthatch	Pygmy Nuthatch	Southern Red-backed Vole	Striped Skunk	Pileated Woodpecker

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Raccoon	Raccoon	Spotted Sandpiper	Swainson's Hawk	Pine Siskin
Racer	Racer	Spotted Towhee	Swainson's Thrush	Prairie Falcon
Red Crossbill	Red Crossbill	Steller's Jay	Tailed Frog	Preble's Shrew
Red Fox	Red Fox	Striped Skunk	Three-toed Woodpecker	Pronghorn Antelope
Red-breasted Nuthatch	Red-breasted Nuthatch	Swainson's Hawk	Townsend's Big-eared Bat	Pygmy Nuthatch
Red-eyed Vireo	Red-eyed Vireo	Swainson's Thrush	Townsend's Solitaire	Raccoon
Red-naped Sapsucker	Red-naped Sapsucker	Tailed Frog	Townsend's Warbler	Racer
Red-tailed Hawk	Red-tailed Hawk	Three-toed Woodpecker	Tree Swallow	Red Crossbill
Red-winged Blackbird	Red-winged Blackbird	Townsend's Big-eared Bat	Vagrant Shrew	Red Fox
Ring-necked Duck	Ring-necked Duck	Townsend's Solitaire	Vaux's Swift	Red-breasted Nuthatch
Rocky Mountain Elk	Rocky Mountain Elk	Townsend's Warbler	Veery	Red-eyed Vireo
Rough-legged Hawk	Rough-legged Hawk	Tree Swallow	Violet-green Swallow	Red-naped Sapsucker
Rough-skinned Newt	Rubber Boa	Vagrant Shrew	Warbling Vireo	Red-tailed Hawk
Rubber Boa	Ruby-crowned Kinglet	Vaux's Swift	Water Shrew	Red-winged Blackbird
Ruby-crowned Kinglet	Ruffed Grouse	Veery	Water Vole	Ring-necked Duck
Ruffed Grouse	Rufous Hummingbird	Violet-green Swallow	Western Bluebird	Rocky Mountain Elk
Rufous Hummingbird	Savannah Sparrow	Warbling Vireo	Western Harvest Mouse	Rough-legged Hawk
Savannah Sparrow	Say's Phoebe	Water Shrew	Western Jumping Mouse	Rubber Boa
Say's Phoebe	Silver-haired Bat	Water Vole	Western Pipistrelle	Ruby-crowned Kinglet
Sharp-tailed Grouse	Snowshoe Hare	Western Bluebird	Western Rattlesnake	Ruffed Grouse
Silver-haired Bat	Solitary Sandpiper	Western Harvest Mouse	Western Screech-owl	Rufous Hummingbird
Snowshoe Hare	Song Sparrow	Western Jumping Mouse	Western Small-footed Myotis	Sandhill Crane
Solitary Sandpiper	Southern Red-backed Vole	Western Pipistrelle	Western Spotted Skunk	Savannah Sparrow
Song Sparrow	Spotted Sandpiper	Western Rattlesnake	Western Tanager	Say's Phoebe
Southern Red-backed Vole	Spotted Towhee	Western Screech-owl	Western Terrestrial Garter Snake	Sharp-tailed Grouse
Spotted Sandpiper	Steller's Jay	Western Small-footed Myotis	Western Toad	Silver-haired Bat
Spotted Towhee	Striped Skunk	Western Spotted Skunk	Western Wood-pewee	Snowshoe Hare

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Steller's Jay	Swainson's Hawk	Western Tanager	White-breasted Nuthatch	Solitary Sandpiper
Striped Skunk	Swainson's Thrush	Western Terrestrial Garter Snake	White-crowned Sparrow	Song Sparrow
Swainson's Hawk	Tailed Frog	Western Toad	White-headed Woodpecker	Southern Red-backed Vole
Swainson's Thrush	Three-toed Woodpecker	Western Wood-pewee	White-tailed Jackrabbit	Spotted Sandpiper
Tailed Frog	Tiger Salamander	White-breasted Nuthatch	White-throated Swift	Spotted Towhee
Three-toed Woodpecker	Townsend's Big-eared Bat	White-crowned Sparrow	Williamson's Sapsucker	Steller's Jay
Tiger Salamander	Townsend's Solitaire	White-tailed Deer (Eastside)	Willow Flycatcher	Striped Skunk
Townsend's Big-eared Bat	Townsend's Warbler	White-tailed Jackrabbit	Wilson's Warbler	Swainson's Hawk
Townsend's Solitaire	Tree Swallow	White-throated Swift	Winter Wren	Swainson's Thrush
Townsend's Warbler	Turkey Vulture	Williamson's Sapsucker	Woodhouse's Toad	Tailed Frog
Tree Swallow	Vagrant Shrew	Willow Flycatcher	Yellow Warbler	Three-toed Woodpecker
Turkey Vulture	Vaux's Swift	Wilson's Warbler	Yellow-bellied Marmot	Tiger Salamander
Vagrant Shrew	Veery	Winter Wren	Yellow-breasted Chat	Townsend's Big-eared Bat
Vaux's Swift	Violet-green Swallow	Woodhouse's Toad	Yellow-pine Chipmunk	Townsend's Solitaire
Veery	Warbling Vireo	Yellow Warbler	Yellow-rumped Warbler	Townsend's Warbler
Violet-green Swallow	Water Shrew	Yellow-bellied Marmot	Yuma Myotis	Tree Swallow
Warbling Vireo	Water Vole	Yellow-breasted Chat		Turkey Vulture
Water Shrew	Western Bluebird	Yellow-pine Chipmunk		Vagrant Shrew
Water Vole	Western Harvest Mouse	Yellow-rumped Warbler		Vaux's Swift
Western Bluebird	Western Jumping Mouse	Yuma Myotis		Veery
Western Harvest Mouse	Western Pipistrelle			Violet-green Swallow
Western Jumping Mouse	Western Rattlesnake			Warbling Vireo
Western Pipistrelle	Western Screech-owl			Water Shrew
Western Rattlesnake	Western Small-footed Myotis			Water Vole
Western Screech-owl	Western Spotted Skunk			Western Bluebird
Western Small-	Western Tanager			Western Harvest

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
footed Myotis				Mouse
Western Spotted Skunk	Western Terrestrial Garter Snake			Western Jumping Mouse
Western Tanager	Western Toad			Western Pipistrelle
Western Terrestrial Garter Snake	Western Wood-pewee			Western Rattlesnake
Western Toad	White-breasted Nuthatch			Western Screech-owl
Western Wood-pewee	White-crowned Sparrow			Western Small-footed Myotis
White-breasted Nuthatch	White-headed Woodpecker			Western Spotted Skunk
White-crowned Sparrow	White-tailed Jackrabbit			Western Tanager
White-headed Woodpecker	White-throated Swift			Western Terrestrial Garter Snake
White-tailed Jackrabbit	Williamson's Sapsucker			Western Toad
White-throated Swift	Willow Flycatcher			Western Wood-pewee
Williamson's Sapsucker	Wilson's Warbler			White-breasted Nuthatch
Willow Flycatcher	Winter Wren			White-crowned Sparrow
Wilson's Warbler	Wood Duck			White-headed Woodpecker
Winter Wren	Woodhouse's Toad			White-tailed Deer (Eastside)
Wood Duck	Yellow Warbler			White-tailed Jackrabbit
Woodhouse's Toad	Yellow-bellied Marmot			White-throated Swift
Yellow Warbler	Yellow-billed Cuckoo			Williamson's Sapsucker
Yellow-bellied Marmot	Yellow-breasted Chat			Willow Flycatcher
Yellow-billed Cuckoo	Yellow-pine Chipmunk			Wilson's Warbler
Yellow-breasted Chat	Yellow-rumped Warbler			Winter Wren
Yellow-pine Chipmunk	Yuma Myotis			Wood Duck
Yellow-rumped Warbler				Woodhouse's Toad
Yuma Myotis				Yellow Warbler
				Yellow-bellied Marmot
				Yellow-billed Cuckoo

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
				Yellow-breasted Chat
				Yellow-pine Chipmunk
				Yellow-rumped Warbler
				Yuma Myotis

Table E-11. Wildlife species occurrence in Agricultural habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Great Blue Heron	Great Blue Heron	Great Blue Heron	Great Blue Heron	Great Blue Heron
Tundra Swan	Tundra Swan	Tundra Swan	Tundra Swan	Tundra Swan
American Wigeon	American Wigeon	Blue-winged Teal	Cinnamon Teal	American Wigeon
Blue-winged Teal	Blue-winged Teal	Cinnamon Teal	Swainson's Hawk	Blue-winged Teal
Cinnamon Teal	Cinnamon Teal	Swainson's Hawk	Red-tailed Hawk	Cinnamon Teal
Swainson's Hawk	Swainson's Hawk	Red-tailed Hawk	Gray Partridge	Swainson's Hawk
Red-tailed Hawk	Red-tailed Hawk	Gray Partridge	Ring-necked Pheasant	Red-tailed Hawk
Gray Partridge	Gray Partridge	Ring-necked Pheasant	Killdeer	Gray Partridge
Ring-necked Pheasant	Ring-necked Pheasant	Killdeer	Solitary Sandpiper	Ring-necked Pheasant
Killdeer	Killdeer	Solitary Sandpiper	Long-billed Dowitcher	Sandhill Crane
Solitary Sandpiper	Solitary Sandpiper	Long-billed Curlew	Rock Dove	Killdeer
Long-billed Curlew	Long-billed Curlew	Long-billed Dowitcher	Mourning Dove	Solitary Sandpiper
Long-billed Dowitcher	Long-billed Dowitcher	Wilson's Snipe	Barn Owl	Long-billed Curlew
Wilson's Snipe	Wilson's Snipe	Rock Dove	Short-eared Owl	Long-billed Dowitcher
Rock Dove	Rock Dove	Mourning Dove	Northern Shrike	Wilson's Snipe
Mourning Dove	Mourning Dove	Barn Owl	Black-billed Magpie	Rock Dove
Barn Owl	Barn Owl	Short-eared Owl	American Crow	Mourning Dove
Short-eared Owl	Short-eared Owl	Northern Shrike	Barn Swallow	Barn Owl
Loggerhead Shrike	Loggerhead Shrike	Black-billed Magpie	European Starling	Short-eared Owl
Northern Shrike	Northern Shrike	American Crow	Vesper Sparrow	Loggerhead Shrike
Black-billed Magpie	Black-billed Magpie	Barn Swallow	Savannah Sparrow	Northern Shrike
American Crow	American Crow	European Starling	Grasshopper Sparrow	Black-billed Magpie
Barn Swallow	Barn Swallow	Vesper Sparrow	Lazuli Bunting	American Crow
European Starling	European Starling	Savannah Sparrow	Western Meadowlark	Barn Swallow
Vesper Sparrow	Vesper Sparrow	Grasshopper Sparrow	Brewer's Blackbird	European Starling
Savannah Sparrow	Savannah Sparrow	Lazuli Bunting	Brown-headed Cowbird	American Pipit
Grasshopper Sparrow	Grasshopper Sparrow	Western Meadowlark	House Finch	Vesper Sparrow
Lazuli Bunting	Lazuli Bunting	Brewer's Blackbird	House Sparrow	Savannah Sparrow
Bobolink	Bobolink	Brown-headed Cowbird	Big Brown Bat	Grasshopper Sparrow
Western Meadowlark	Western Meadowlark	House Finch	Eastern Fox Squirrel	Lazuli Bunting

Palouse Subbasin	Lower Snake Subbasin	Tucannon Subbasin	Asotin Subbasin	Walla Walla Subbasin
Brewer's Blackbird	Brewer's Blackbird	House Sparrow	Northern Pocket Gopher	Bobolink
Brown-headed Cowbird	Brown-headed Cowbird	Big Brown Bat	Deer Mouse	Western Meadowlark
House Finch	House Finch	Eastern Fox Squirrel	Bushy-tailed Woodrat	Brewer's Blackbird
House Sparrow	House Sparrow	Northern Pocket Gopher	Montane Vole	Brown-headed Cowbird
Virginia Opossum	Virginia Opossum	Deer Mouse	House Mouse	House Finch
Big Brown Bat	Big Brown Bat	Bushy-tailed Woodrat	Raccoon	House Sparrow
Eastern Fox Squirrel	Eastern Fox Squirrel	Montane Vole		Virginia Opossum
Northern Pocket Gopher	Northern Pocket Gopher	House Mouse		Big Brown Bat
Deer Mouse	Deer Mouse	Raccoon		Eastern Fox Squirrel
Bushy-tailed Woodrat	Bushy-tailed Woodrat	White-tailed Deer (Eastside)		Northern Pocket Gopher
Montane Vole	Montane Vole			Deer Mouse
House Mouse	House Mouse			Bushy-tailed Woodrat
Raccoon	Raccoon			Montane Vole
				House Mouse
				Raccoon
				White-tailed Deer (Eastside)

Appendix F: Focal Species Accounts

Columbian Sharp-tailed Grouse
(*Tympanuchus phasianellus columbianus*)

Introduction

The Columbian sharp-tailed grouse (CSTG) is 1 of 6 subspecies of sharp-tailed grouse and the only one found in Washington. The range of the Columbian sharp-tailed grouse is the inter-mountain region including western Montana, Idaho, southern British Columbia, eastern Washington, eastern Oregon, northeastern California, northern Utah, western Colorado, and western Wyoming (Aldrich 1963). Relatively stable populations are present in Idaho, Colorado, and British Columbia; remnant populations are found in Washington, Montana, Utah, Wyoming, and northeastern Oregon.

There has been a clear decline in CSTG abundance and distribution within the state of Washington (Yocom 1952; Buss and Dziedzic 1955; Hays *et al.* 1998; Schroeder et al. 2000). The long-term decline in the status of sharp-tailed grouse has been attributed to the dramatic alteration of native habitat from agricultural conversion, degradation from overgrazing, and invasion of noxious weeds (Buss and Dziedzic 1955; McDonald and Reese 1998). Native habitats important for CSTG include grass-dominated nesting habitat and deciduous shrub-dominated wintering habitat, both of which are critical for sharp-tailed grouse (Giesen and Connelly 1993; Connelly *et al.* 1998). In southeast Washington, the last known sighting of a sharp-tailed grouse was in 1947 (P. Fowler, personal communication, 2003). Ancedotal information indicates that several sharp-tailed grouse were observed in the Asoptin subbasin as late as 2000 (M. Schroeder, WDFW, personal communication, 2003).

Life History and Habitat Requirements

Life History

Diet

Food items in the spring and summer include wild sunflower (*Helianthus* spp.), chokecherry (*Prunus virginiana*), sagebrush (*Artemisia* spp.), serviceberry (*Amelanchier* spp.), salsify (*Tragopogon* spp.), dandelion (*Taraxacum* spp.), bluegrass (*Poa* spp.), and brome (*Bromus* spp.) (Marshall and Jensen 1937; Hart *et al.* 1952; Jones 1966; Parker 1970). Although juveniles and adults consume insects, chicks eat the greatest quantity during the first few weeks of life (Parker 1970; Johnsgard 1973). In winter, CSTG commonly forage on persistent fruits and buds of chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier* spp.), hawthorn (*Crataegus* spp.), snowberry (Symphoricarpos spp.), aspen (*Populus tremuloides*), birch (Betula spp.) willow (*Salix* spp.) and wild rose (*Rosa* spp.) (Giesen and Connelly 1993, Schneider 1994).

Reproduction

Breeding Display Grounds (leks)

During spring males congregate on display sites (leks) to breed with females. Leks are usually within 1.2 miles of nesting, brood-rearing, and wintering habitat (Marks and Marks 1988, Giesen and Connelly 1993); distances appear to be larger in degraded habitat. Most leks are located on knolls and ridges with relatively sparse vegetation (Hart *et al.* 1952; Rogers 1969; Oedekoven 1985).

Nesting

Residual grasses and forbs are necessary for concealment and protection of nests and broods during spring and summer (Hart *et al.* 1952, Parker 1970, Oedekoven 1985, Marks and Marks 1988, Meints *et al.* 1991, Giesen and Connelly 1993). Preferred nest sites are on the ground in relatively dense cover provided by clumps of shrubs, grasses, and/or forbs (Hillman and Jackson 1973; Meints *et al*. 1992). Fields enrolled in agricultural set-aside programs are often preferred. After hatching, hens with broods move to areas where succulent vegetation and insects can be found (Hamerstrom 1963; Bernhoft 1967; Sisson 1970; Gregg 1987; Marks and

Marks 1987; Klott and Lindzey 1990). In late summer, riparian areas and mountain shrub communities are preferred (Giesen 1987).

Migration

Suitable winter habitat is critical to the annual survival of all grouse. During a mild winter, Ulliman (1995) observed that CSTG in Idaho used CRP and remnant sagebrush patches, likely because of the proximity of these habitats to leks, availability of forage, and structural cover. Proximity to leks may reduce stress and predation associated with longer migration movements to unfamiliar winter habitat, whereas the availability of forage and cover reduces the need to move between cover types in search of food. In northwestern Colorado, Boisvert (2002) observed that most leks are located within 1 km of suitable winter habitat, but the average movement to a wintering area exceeded 12 km. An explanation for this is lacking, and warrants further investigation.

In severe winters CSTG are generally forced to move to habitats at higher elevations containing "budding" trees and shrubs such as riparian, mountain shrub, and aspen (*Populus tremuloides*) (Schneider 1994). Most literature suggests that grouse generally leave summer and fall ranges in search of denser tree and/or shrub cover when they become more conspicuous due to snow cover (Bergerud 1988b). However, in a severe winter in Idaho, Ulliman (1995) found that 4 radio-marked grouse remained in a valley despite heavy snowfall, subsisting largely on midge galls (*Rhopalomyia* spp.) and Russian olive (*Eleagnus angustifolia*) berries.

Survival

Columbian sharp-tailed grouse are subject to variable mortality rates, depending on season, sex, habitat, and weather. Females are most vulnerable to predation during the nesting and brooding seasons, while males suffer the highest mortality during the lekking period. Differences in severity of winter from year to year can also cause marked differences in over-winter survival (Ulliman 1995).

Annual survival of grouse in mine reclamation and CRP habitats in northwestern Colorado was quite low (20%) (Boisvert 2002). Grouse captured in mine reclamation lands had a relatively higher annual survival rate (28%, n = 73) compared to birds captured in CRP (14%, n = 73). Braun (1975) speculated that 50-70% annual mortality is natural in Colorado. Meints (1991) reported annual survival rates in 2 areas of Idaho to be 66% (n = 28) and 44% (n = 24). Schroeder (1994) observed a 53% annual survival in Washington, while McDonald reported 55% (n = 38) (1998).

A wide array of predators are known to prey upon Columbian sharp-tailed grouse. Some prey mainly on eggs, such as the striped skunk (*Mephitis mephitis*), ground squirrel (*Spermophilus* spp.), badger (Taxidea taxus), American magpie (*Pica hudsonia*), American crow (*Corvus branchyrynchos*), and common raven (*C. corax*). Nest predation is quite common because nests are on the ground (Bergerud 1988a). Various species of snakes likely take eggs or young chicks, but the extent of snake predation is unknown due to difficulty of documentation and a resulting paucity of reporting in the literature.

Other species may prey upon eggs, chicks, and/or adults. These include coyote (*Canis latrans*), weasel (*Mustela* spp.), red fox (*Vulpes vulpes*), red-tailed hawk (*Buteo jamaicensis*), northern goshawk (*Accipiter gentilis*), peregrine falcon (*Falco perigrinus*), gyrfalcon (*Falco rusticolus*), prairie falcon (*Falco mexicanus*), great horned owl (Bubo virginianus), long-eared owl (Asio otus), and northern harrier (*Circus cyaneus*) (Marshall and Jensen 1937, Schiller 1973). Cattle have also been documented stepping on nests of CSTG in southern Idaho (T. Apa, personal communication).

Harvest

Historic

Columbian sharp-tailed grouse hunting ceased in Whitman County in 1919 and statewide between 1933 and 1952. Although restrictive hunting seasons (2 day length, 2-4 bag limit) were eventually re-established between 1953 and 1987 (excluding 1957) in portions of Okanogan, Lincoln, Grant, and Douglas counties, statewide hunting was terminated in 1988 (Washington Department of Fish and Wildlife 1995).

Current

Hunting of sharp-tailed grouse has not occurred in Washington since 1988.

Habitat Requirements

Nesting

Females likely select a nest site before visiting a lek to copulate (Johnsgard 1983; Bergerud and Gratson 1988). Before lek visitation, hens search large areas that are reported to be twice as large as late winter/early spring ranges (Gratson 1988). Large pre-laying ranges may reflect the female sampling a large number of males at different leks, or searching throughout a patchy habitat for suitable nest sites before copulation.

Columbian sharp-tailed grouse select different habitats for nesting throughout their range (Giesen 1997). Previous studies have documented a variety of habitats used for nesting by Columbian sharp-tailed grouse, including native shrubsteppe, mountain shrub, grassland, CRP, agricultural fields, and mine reclamation (Marks and Marks 1987; Meints 1991; Apa 1998; McDonald 1998).

Females prefer nest sites with an overhead canopy of grasses, shrubs, or both (Giesen and Connelly 1993). They are able to tolerate considerable variation in the proportion of grasses and shrubs that comprise suitable nesting habitat, but the most important factor is that a certain height and density of vegetation is required. Canopy coverage and visual obstruction are greater at nest sites than at independent sites (Kobriger 1980; Marks and Marks 1987; Meints 1991). Giesen (1987) reported density of shrubs less than 1 m tall was 5 times higher at nest sites than at random sites or sites 10 m from the nest. Meints (1991) found that mean grass height at successful nests averaged 26.8 cm, while 18.4 cm was the average at unsuccessful nests. Hoffman (2001) recommended that the minimum height for good quality nesting and brood-rearing habitat is 20 cm, with 30 cm being preferred. Bunchgrasses, especially those with a high percentage of leaves to stems like bluebunch wheatgrass (*Agropyron smithii*), are preferred by nesting sharp-tailed grouse over sod-forming grasses such as smooth brome (*Bromus inermis*).

Marks and Marks (1987) reported mean distance moved from lek of capture to nest and renests for radio-marked hens as 0.5 km in Idaho, whereas Meints (1991) reported an average distance of just over 1 km, and Apa (1998) reported 1.4 km. Gratson (1988) found that nests averaged 998+ 329 m from the nearest lek in Wisconsin, and hypothesized that hens nest relatively far away from leks to avoid increased predation pressures caused by displaying males. Apa's work in Idaho supports this theory.

Once a specific nest site is selected, the hen scrapes out a rudimentary nest bowl on the ground and lines it with grass, herbaceous plant materials, and breast feathers. There is an average of 1-3 days between copulation and laying of the first egg (Schiller 1973), with subsequent eggs laid every 1-2 days. For first nests only, Meints (1991) found the mean clutch size in Idaho to be 11.9 eggs (range 10-13, n=18), Hart *et al.* (1952) reported 10.9 in Utah (range 3-17, n=127), McDonald reported 12.2 in Washington (range 11-14, n=17), and Giesen (1987) reported 10.8

in Colorado (range 8- 14). Hens may re-nest if the first nest is unsuccessful, with adult hens showing a tendency to re-nest more often than yearlings.

Native habitats would be expected to contribute to higher nest success than non-native habitats, however Meints (1991) found that hens nesting in non-native habitats in southeastern Idaho had a significantly higher success rate than hens nesting in native uplands. Svedarsky (1988) also found this to be the case for greater prairie chickens (*T. cupido pinatus*); 86% versus 53%. Boisvert (2002), found nest success in mine reclamation to be 81% compared to 22% for native shrub-steppe in Colorado. These results are contrary to the findings of Hart et al. (1952) in Utah, who found nest success in alfalfa and wheat stubble to be 47% and 18% respectively, compared to 70% in native rangeland, Apa (1998) in Idaho who observed 40% nest success in non-native sites and 36% in native sites, and McDonald (1998) in Washington who observed 39% and 100% nest success in two native sites and 0% and 18% in two CRP sites.

Nest success varies widely throughout the range of the CSTG, and may also vary in the same location from year to year. Overall nest success was reported as 46% (n=65) (Boisvert 2002) and 61% (n=13) (Giesen 1987) in Colorado, 51% (n=47) (Apa 1998), 72% (n=25) (Meints 1991), and 56% (n=9) (Marks and Marks 1987) in Idaho, and 41% in Washington (n=37) (McDonald 1998).

The incubation period ranges from 21-23 days and only the female incubates the eggs. She leaves the eggs to forage in the morning and evening (Hart *et al.* 1952, Schiller 1973). The chicks hatch precocious and nidifugious, and are usually brooded near the nest for 1-2 days.

Brooding

Columbian sharp-tailed grouse broods are known to use a variety of habitats typically described as shrub-steppe vegetation dominated by sagebrush and other shrubs including rabbitbrush (*Chrysothamnus* spp.), antelope bitterbrush (*Purshia tridentata*), and common chokecherry (*Prunus virginiana*), with a diversity of forbs and bunchgrasses (Marks and Marks 1987). These areas often contain an abundance of insects necessary for the chicks' robust protein requirements (Connelly *et al.* 1998), as well as a high interspersion of cover types (Klott and Lindzey 1990). In the first 2 weeks after hatching, chicks require microhabitats with warm temperatures to offset an inability to thermo-regulate, and a plant structure that provides concealment but does not hinder movement (Bergerud 1988). Brood use sites are generally located within 1.6 km of the lek where the hen bred (Parker 1970; Bredehoft 1981; Oedekoven 1985).

Klott and Lindzey (1990) found that CSTG broods used mountain shrub and sagebrush-snowberry (*Artemisia/Symphoricarpos* spp.) habitats more often than expected based on their availability in Wyoming. Total shrub cover at brood use sites was higher than expected based on availability. Apa (1998) found that CSTG broods in Idaho used sites with more vertical cover, higher visual obstruction, and taller forbs than at independent sites. Meints (1991) also found that greater cover occurred at brood use sites than at random sites. In general, CSTG brood use sites have a higher diversity of forbs and more grass cover than random sites (Klott 1987; Klott and Lindzey 1990). Chicks can fly short distances at 7-10 days (Hart *et al.* 1950; Pepper 1972), reach half of adult body mass at 8 weeks, and become fully independent by 12 weeks of age, when brood breakup occurs (Gratson 1988).

Non-Breeding

Fall

After brood breakup occurs, young males may be recruited to the breeding population by joining adult males in displaying at leks (Hamerstrom and Hamerstrom 1951; Moyles and Boag 1981). Not all leks are thought to be active in the fall, and no breeding takes place at this time as

virtually no females attend leks, but juvenile males may attempt to establish a peripheral territory on a lek, an advantage the following spring when seniority at the lek is important. The sooner a young male begins to display at the lek, the sooner he may become a central territory holder. Moyles and Boag (1981) found that most (68%) new territories at spring leks were actually established the previous fall. In autumn, juvenile females join flocks of other adult and yearling females, and non-lekking males.

Winter

Suitable winter habitat is critical to the annual survival of all grouse. During a mild winter, Ulliman (1995) observed that CSTG in Idaho used CRP and remnant sagebrush patches, likely because of the proximity of these habitats to leks, availability of forage, and structural cover. Proximity to leks may reduce stress and predation associated with longer migration movements to unfamiliar winter habitat, whereas the availability of forage and cover reduces the need to move between cover types in search of food. In northwestern Colorado, Boisvert (2002) observed that most leks are located within 1 km of suitable winter habitat, but the average movement to a wintering area exceeded 12 km. An explanation for this is lacking, and warrants further investigation.

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In winter, CSTG commonly forage on persistent fruits and buds of chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier* spp.), hawthorn (*Crataegus* spp.), snowberry, aspen, birch (*Betula* spp.) willow (*Salix* spp.) and wild rose (*Rosa* spp.) (Giesen and Connelly 1993; Schneider 1994). Like other species of grouse, CSTG may use snow burrows during day and night in winter to conserve heat and avoid predators (Marks and Marks 1987). In Washington, CSTG were found to require at least 28 cm of soft snow for burrowing (McDonald 1998).

Population and Distribution

Population

Historic

The Palouse prairie underwent major declines of CSTG between the late 1800s and the 1920s (Buss and Dziedzic 1955). Other portions of Washington underwent steady declines throughout most of the 1900's (McClanahan 1940; Yocom 1952; Aldrich 1963; Miller and Graul 1980).

Current

The 2003 population estimate for Washington was 598. Results for the analysis of annual changes in attendance at lek complexes indicate that the population declined an average of 4.2% (SE = 3.5%) per year between 1970 and 2003. These annual changes were used to "back-estimate" the population; the estimated population in 1970 was 5,067. The overall population declined almost continually between 1970 and 2003, particularly during the 1970s, when the estimated population declined from about 5,000 to about 3,000 birds. The overall estimated decline was 88.2% between 1970 and 2003 (Shroeder 2003).

Captive Breeding Programs, Transplants, Introductions

Historic

No data are available.

Current

Recent transplants near Enterprise, Oregon and Jackpot, Nevada have reestablished small populations in those areas (Snyder *et al.* 1999). CSTG in the Scotch Creek population of northcentral Washington benefited from a 3-year translocation of 43 birds starting in 1998. The population went from 2 known birds to 52 in 2003 (Schroeder 2003). Washington State is currently planning to translocate additional CSTG from British Columbia into the state.

Distribution

Historic

Sharp-tailed grouse were historically found in great abundance throughout the shrubsteppe, meadow-steppe, and steppe communities of eastern Washington (Yocum 1952).

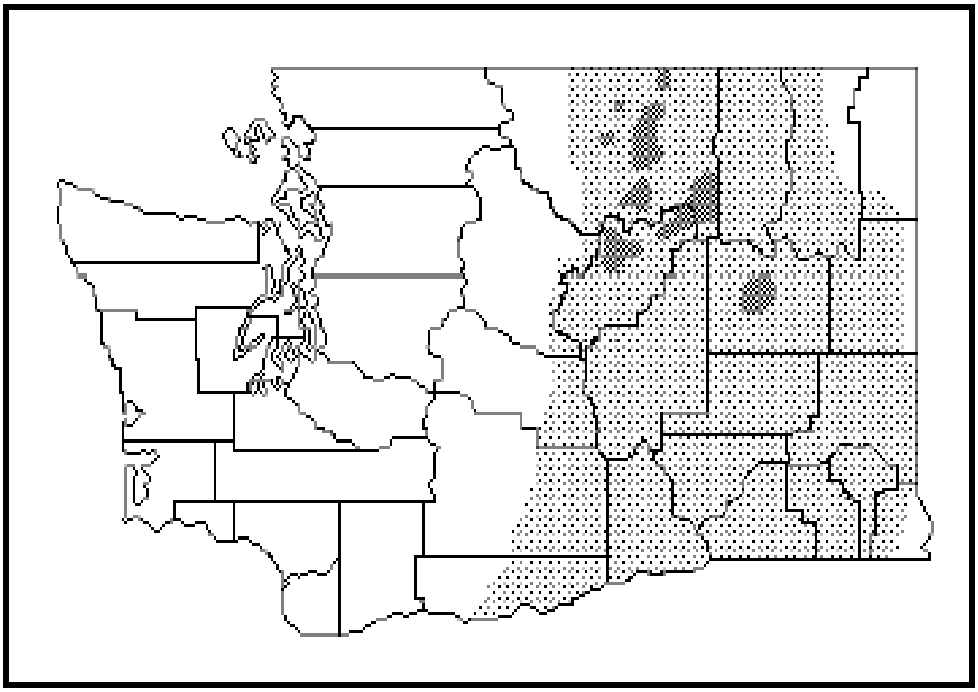

Figure 1. Historic and current distribution of Columbian sharp-tailed grouse in Washington (WDFW 1988).

Current

CSTG range is currently restricted to small, isolated populations in north-central Washington (Hofmann and Dobler 1989; WDFW 1995). The most stable populations of birds are found in the Nespelem, Tunk Valley, Chesaw, and Scotch Creek areas of Okanogan County; the Dyre Hill area of Douglas County; and the Swanson Lakes area of Lincoln County (Figure 1).

Breeding

Breeding range occurs in the same area as described above.

Non-Breeding

Occurs in the same area described above, minimal migration appears to occur.

Status and Abundance Trends

Status

Within the Asotin, Tucannon, Palouse, Walla Walla, and Lower Snake subbasins, no known populations of CSTG exist. Reports of CSTG sightings have trickled in for the Asotin subbasin during the past 10 years, but this is likely a result of birds migrating across the Snake River from

an Idaho Department of Fish and Game release site (P. Fowler, WDFW, personal communication, 2003). The remaining populations of CSTG in Washington have continued to decline over the last 30 years. In 1998, this decline lead to the state listing of the Columbian sharp-tailed grouse as a threatened species in Washington (Hays *et al.* 1998). Efforts are being made to bolster the available habitat and productivity of these populations.

Trends

The 2003 population estimate for Washington was 598, with a 4.2% (SE = 3.5%) average annual decline from 1970 throush 2003 (Schroeder 2003). The overall decline from 1970 through 2003 is estimated to be 88.2%. In 2003, populations appeared to continue the decline, at least slightly. Analysis of CSTG genetic samples are currently being analyzed from Washington and other states.

Out-of-Subbasin Effects and Assumptions

If CSTG can become reestablished in one or all of these subbasins, habitat manipulations will need to continually occur. Noxious weeds have already become established in most areas that were historically used by CSTG, but new species of weeds are continually being found.

Healthy populations of any species usually require some (although minimal) amount of gene flow. The establishment or maintenance of CSTG populations in adjacent subbasins would increase the possibility of interpopulation movements and reduce the risks associated with small isolated populations (genetically or extirpation).

Factors Affecting Sharp-tailed Grouse Population Status

Key Factors Inhibiting Populations and Ecological Processes

Columbian sharp-tailed grouse have suffered dramatic declines as a result of the conversion of native shrub-steppe habitat for agrigultural purposes, flooding of habitat resulting from hydropower facilities, fragmentation of existing habitats, degredation of existing habitats from overgrazing, and tree/shrub removal in riparian areas (Yokum 1952; Ziegler 1979). Noxious weeds such as cheatgrass (*Bromus tectorum*), yellow starthistle (*Centaurea solstitialis*), Scotch thistle (*Onopordum acanthium*), Canada thistle (*Cirsium arvense*), jointed goatgrass (*Aegilops cylindrical*), and spotted knapweed (*Centaurea biebersteinii*) continue to be factors negatively affecting the quality of habitat in southeastern Washington. Addressing each of these issues at some scale is necessary within the subbasins in order to reestablish CSTG.

Currently no populations of CSTG exist within or near the Asotin, Touchet , Tucannon, or Walla Walla subbasins. Restoration of sufficient quantity and quality native habitat will be necessary to reestablish viable populations of CSTG within the Asotin, Tucannon, Touchet, or Walla Walla subbasins. Reestablishment would require restoring agricultural land to permanent cover for nesting and brood rearing near sites with sufficient winter range (shrubs desireable as food plants).

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Grasshopper Sparrow
(*Ammodramus savannarum perpallidus*)

Introduction

Grassland ecosystems that were prominent in the Columbia Basin have suffered the greatest losses of any habitats in the Columbia Plateau (Kagan *et al*.1999). The Palouse Prairie has been identified as the most endangered ecosystem in the United States (Noss *et al.* 1995). Land conversion and livestock grazing coupled with the rapid spread of cheatgrass (*Bromus tectorum*) and a resulting change in the natural fire regime has effectively altered much of the grassland habitats to the effect that it is difficult to find stands which are still in relatively natural condition (Altman and Holmes 2000).

As a result, many of these steppe, grassland, species are declining in our area. BBS data (Robbins *et al*. 1986) have shown a decreasing long term trend for the grasshopper sparrow (1966-1998) (Sauer *et al.* 1999). Throughout the U.S., this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992; Brewer *et al.* 1991; Garrett and Dunn 1981). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s. In Washington, the grasshopper sparrow is considered a State Candidate species. In Oregon it is considered as a naturally rare, vulnerable species, and a state Heritage program status as imperiled.

Life History and Habitat Requirements

Life History

Diet

Grasshopper sparrows are active ground or low shrub searchers. Vickery (1996) states that exposed bare ground is the critical microhabitat type for effective foraging. Bent (1968) observed that grasshopper sparrows search for prey on the ground, in low foliage within relatively dense grasslands, and sometimes scratch in the litter.

Grasshopper sparrows eat mostly insects, primarily grasshoppers, but also other invertebrates and seeds. In one study, grasshoppers formed 23% of the grasshopper sparrows' diet during 8 months of the year; 60% of their diet in Jan., and 37% from May to August. From February to October, 63% of food taken was animals, 37% vegetable. Insects comprised 57% total food; spiders, myriapods, snails and earthworms made up 6%. Of the insects, "harmful" beetles (click beetles (*Clateridae*), weevils and smaller leaf beetles (*Systens* spp.) made up 8%, caterpillars (cutworms) made up 14%. Vegetable matter eaten included waste grain, grass, weed and sedge seeds (Smith 1968; Terres 1980).

Grasshopper sparrow diet varies by season. Spring diet consists of 60% invertebrates and 40% seeds (n=28). Summer diet is comprised of 61% invertebrates, 39% seeds (n=100). The fall diet is made up of 29% invertebrates and 71% seeds (n=17), and there are no data for winter (Martin *et al.* 1951 in Vickery 1996).

Reproduction

Grasshopper sparrows are monogamous throughout the breeding season (Ehrlich 1988). Grasshopper sparrows nest in semi-colonial groups of 3-12 pairs (Ehrlich 1988). Smith (1963) recorded breeding densities that ranged from 0.12 to 0.74 males per hectare in Pennsylvania and Collier (1994) observed breeding densities of 0.55 males per hectare in California. Clutch size ranges from 2 to 6, with 4 most frequently (Smith 1963). The female alone has a brood patch and incubates eggs (Smith 1963; Ehrlich 1988; Harrison 1975). During incubation, the male defends the pair's territory (Smith 1963).

Incubation period is from 11 to 13 days (Smith 1963, Ehrlich 1988, Harrison 1975), with a nestling period of 6 to 9 days after hatching (Harrison 1975; Hill 1976; Kaspari and O'Leary 1988). Hatchlings are blind and covered with grayish-brown down (Smith 1968).

Throughout most of their range, grasshopper sparrows can produce two broods, one in late May and a second in early July (George 1952; Smith 1968; Vickery 1996). However, in the northern part of its range, one brood is probably most common (Vickery *et al*. 1992; Wiens 1969). Grasshopper sparrows frequently renest after nest failure, and if unsuccessful in previous attempts, may renest 3-4 times during the breeding season (Vickery 1996).

After the young hatch, both parents share the responsibilities of tending the hatchlings and seem more concerned over human intrusion into their territory than before (Smith 1963). Kaspari and O'Leary (1988) observed cooperative breeding by non-parental attendants, birds bringing food to the nest. Unrelated juveniles and adults from adjacent territories made 9-50% of the provisioning visits to four of twenty-three nests. Parents facilitated visits from non-parental attendants by moving off the nest yet unrelated birds that did not bring food to the nest were vigorously chased away. Kaspari and O'Leary (1988) suggested that non-parental attendants, rare among the population observed, are likely cases of "misdirected parental care".

Nesting

Grasshopper sparrows arrive on the breeding grounds in mid-April and depart for the wintering grounds in mid-September (George 1952; Bent 1968; Smith 1968; Harrison 1975; Stewart 1975; Laubach 1984; Vickery 1996). In Saskatchewan and Manitoba, they arrive later (mid-May) and leave earlier (August) (Knapton 1979). Grasshopper sparrows may be site faithful (Skipper 1998).

With few exceptions, nests are built on the ground, near a clump of grass or base of a shrub, "domed" with overhanging vegetation (Vickery 1996). Female grasshopper sparrows build a cup nest in two or three days time. Domed with overhanging grasses and accessed from one side, the rim of the nest is flush with the ground; the slight depression inside fashioned such that the female's back is nearly flush with the ground while brooding (Dixon 1916; Pemberton 1917; Harrison 1975; Ehrlich 1988; and Vickery 1996).

Male grasshopper sparrows establish territories promptly upon arrival to the breeding grounds and rigidly maintain them until the young hatch. Territorial defense then declines and considerable movement across territory boundaries may occur. It appears that fledglings frequently flutter into adjoining territories and the parent birds follow in answer to the feeding call. A sharp increase in territorial behavior is exhibited during the two or three days prior to re-nesting (Smith 1963). Collier (1994 in Vickery 1996) observed grasshopper sparrow territory sizes of 0.37 - 0.16 (SD) ha (n=41) in southern California. In other states, territories have been observed to range in size from 1.4 ha (n=6) in Michigan (Kendeigh 1941) to 0.19 0.13 (SD) ha (n=20: Piehler 1987) in western Pennsylvania.

Although average territory size for grasshopper sparrows is small (<2 ha) (George 1952; Wiens 1969,1970; Ducey and Miller 1980; Laubach 1984; Delisle 1995), grasshopper sparrows are area sensitive, preferring large grassland areas over small areas (Herkert 1994a,b; Vickery *et al*. 1994; Helzer 1996). In Illinois, the minimum area on which grasshopper sparrows were found was 10-30 ha (Herkert 1991), and the minimum area needed to support a breeding population may be less than 30 ha (Herkert 1994b). In Nebraska, the minimum area in which grasshopper sparrows were found was 8-12 ha, with a perimeter-area ratio of 0.018 (Helzer 1996; Helzer and Jelinski 1999). Occurrence of grasshopper sparrows was positively correlated with patch area and inversely correlated with perimeter-area ratio (Helzer and Jelinski 1999).

Migration

In spring, the grasshopper sparrow is a notably late migrant, arriving in southern B.C. in early to late May (Vickery 1996). Grasshopper sparrows arrive in Colorado in mid May and remain through September. They initiate nesting in early June, and most young fledge by the end of July. They winter across the southern tier of states, south into Central America.

This species generally migrates at night, sometimes continuing into morning. Mechanisms surrounding migration are not known but probably involve similar mechanisms as in savannah Sparrow, which include magnetic, stellar, and solar compasses (Moore 1980; Able and Able 1990a, b). While in migration the grasshopper sparrow does not form large conspecific flocks; individuals are found in mixed-species flocks with other sparrows and appear to migrate in small numbers, travelling more as individuals (Vickery 1996).

Data regarding the movements of grasshopper sparrows outside of the breeding season is scarce due to their normally secretive nature (Zeiner *et al*.1990). Although diurnally active, grasshopper sparrows are easily overlooked as "they seldom fly, preferring to run along the ground between and beneath tufts of grass" (Pemberton 1917). Because of their secretive nature the northern limits of their winter range is poorly known. Migratory individuals have been recorded casually south to w. Panama (Ridgely and Gwynne 1989) and (in winter) north to Maine (PDV), New Brunswick, Minnesota (Eckert 1990), and Oregon (Vickery 1996).

Mortality

Nest predators cited include: raccoons (*Procyon lotor*), red fox (*Vulpes vulpes*), northern black racers (*Coluber constrictor constrictor*), blue jays (*Cyanocitta cristata*), and common crows (*Corvus brachyrhynchos*) (Johnson and Temple 1990; Wray *et al.* 1982). Loggerhead shrikes (*Lanius ludovicianus*) commonly take grasshopper sparrows as prey in Oklahoma and Florida (Stewart 1990; Vickery 1996). Many other species, especially those not dependent upon sight to find nests, are likely to be predators. Seasonal flooding in some areas may be a source of mortality during the nesting season (Vickery 1996).

Mowing and haying operations be the source of mortality for grasshopper sparrows directly and indirectly. Haying may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger *et al.* 1990).

Habitat Requirements

Grasshopper sparrows prefer grasslands of intermediate height and are often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968; Blankespoor 1980; Vickery 1996). Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl *et al*. 1985; Arnold and Higgins 1986). In east central Oregon grasshopper sparrows occupied relatively undisturbed native bunchgrass communities dominated by *Agropyron spicatum* and/or *Festuca idahoensis*, particularly north-facing slopes on the Boardman Bombing Range, Columbia Basin (Holmes and Geupel 1998). Vander Haegen *et al.* (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but did find one with the percent cover perennial grass.

In portions of Colorado, Kansas, Montana, Nebraska, Oklahoma, South Dakota, Texas, Wisconsin, and Wyoming, abundance of grasshopper sparrows was positively correlated with percent grass cover, percent litter cover, total number of vertical vegetation hits, effective vegetation height, and litter depth; abundance was negatively correlated with percent bare ground, amount of variation in litter depth, amount of variation in forb or shrub height, and the amount of variation in forb and shrub heights (Rotenberry and Wiens 1980).

Grasshopper sparrows have also been found breeding in Conservation Reserve Program (CRP) fields, pasture, hayland, airports, and reclaimed surface mines (Wiens 1970, 1973; Harrison 1974; Ducey and Miller 1980; Whitmore 1980; Kantrud 1981; Renken 1983; Laubach 1984; Renken and Dinsmore 1987; Bollinger 1988; Frawley and Best 1991; Johnson and Schwartz 1993; Klute 1994; Berthelsen and Smith 1995; Hull et al. 1996; Patterson and Best 1996; Delisle and Savidge 1997; Prescott 1997; Koford 1999; Jensen 1999; Horn and Koford 2000). In Alberta, Manitoba, and Saskatchewan, grasshopper sparrows are more common in grasslands enrolled in the Permanent Cover Program (PCP) than in cropland (McMaster and Davis 1998). PCP was a Canadian program that paid farmers to seed highly erodible land to perennial cover; it differed from CRP in that haying and grazing were allowed annually in PCP.

Grasshopper sparrows occasionally inhabit cropland, such as corn and oats, but at a fraction of the densities found in grassland habitats (Smith 1963; Smith 1968; Ducey and Miller 1980; Basore *et al*. 1986; Faanes and Lingle 1995; Best *et al.* 1997).

Grasshopper sparrows are also included as members of shrubsteppe communities, occupying the steppe habitats having the habitat features shown in Table 1 (Altman and Holmes 2000).

Table 1. Key habitat relationships required for breeding grasshopper sparrows (Altman and Holmes 2000).

Conservation Focus	Key Habitat Relationships			
	Vegetative Composition	Vegetation Structure	Landscape/ Patch Size	Special Considerations
native bunchgrass cover	native bunchgrasses	bunchgrass cover >15% and >60% total grass cover; bunchgrass >25 cm tall; shrub cover <10%	>40 ha (100 ac)	larger tracts better; exotic grass detrimental; vulnerable in agricultural habitats from mowing, spraying, etc.

Population and Distribution

Population

Historic

According to the ICBEMP terrestrial vertebrate habitat analyses, historical source habitats for grasshopper sparrow within our planning unit occurred primarily along the eastern portions of the Columbia Plateau Ecological Reporting Unit (ERU) and the northern portion of the Owyhee Uplands ERU with a small amount in the northern portion of the Great Basin (Wisdom *et al.* 2000). Within this core of historical habitat, the current amount of source habitat has been reduced dramatically from historical levels by 91% in the Columbia Plateau and 85% in the Owyhee Uplands. Within the entire Interior Columbia Basin, overall decline in source habitats for this species (71%) was third greatest among 91 species of vertebrates analyzed (Wisdom *et al.* 2000).

Wing (1941) described the grasshopper sparrow as occupies the edge between the *Agropyron-Poa* type and the *Festuca-Agropyron* type. Jewett *et al.* (1953) gave its distribution in summer as north to Sprague, east to Pullman, south to Anatone and Prescott, and west to Toppenish.

Current

No data are available

Distribution

Grasshopper sparrows are found from North to South America, Ecuador, and in the West Indies (Vickery 1996, AOU 1957). They are common breeders throughout much of the continental United States, ranging from southern Canada south to Florida, Texas, and California. Additional populations are locally distributed from Mexico to Colombia and in the West Indies (Delany *et al.* 1985; Delany 1996a; Vickery 1996) (Figure 1).

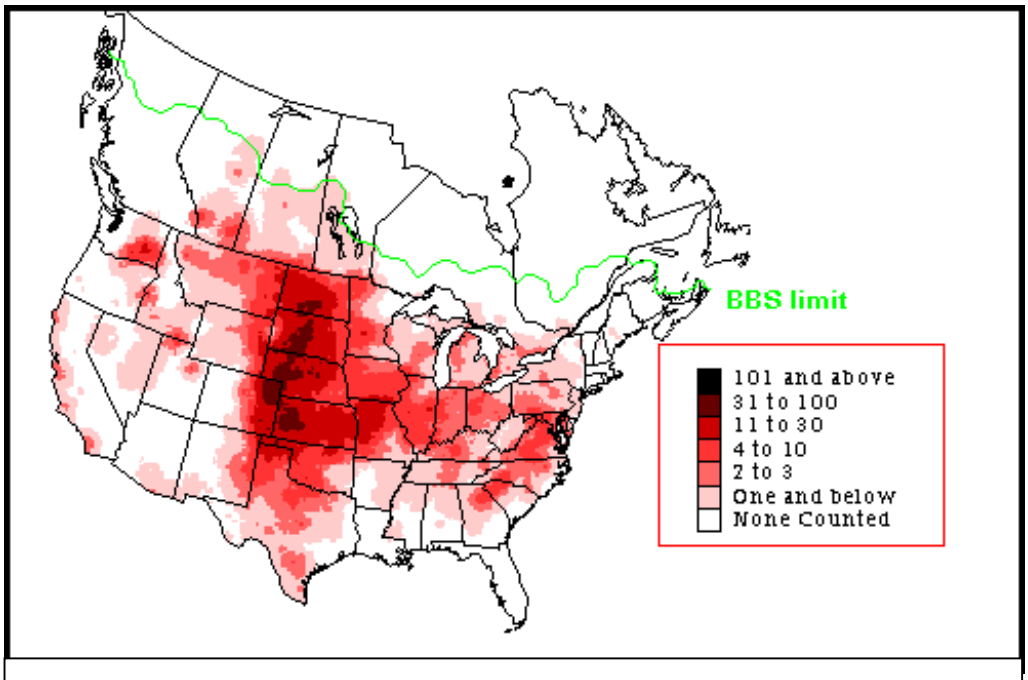

Figure 1. Breeding Range and Abudance of grasshopper sparrow in the U.S. based on Breeding Bird Survey data 1985-2001. Scale represents average number of individuals detected per route per year (Sauer 2003).

The subspecies breeding in eastern Washington is *Ammodramus savannarum perpallidus* (Coues) which breeds from northwest California, where it is uncommon, into eastern Washington, northeast and southwest Oregon, where it is rare and local, into southeast B.C., where it is considered endangered, east into Nevada, Utah, Colorado, Oklahoma, Texas, and possibly to Illinois and Indiana (Vickery 1996).

Historic

Larrison (1981) called it a local irregular summer resident and/or migrant mostly through the arid interior of the Northwest and rare west of the Cascades in southwestern B.C. and Oregon. In Idaho, it was considered an uncommon irregular summer resident and migrant in the northern portion (Larrison 1981).

Jewett *et al.* (1953) classified the grasshopper sparrow as a rare summer resident between May and probably August or September locally in the bunch-grass associations of the lower Transition Zone of eastern Washington, occurring locally in the Upper Sonoran also.

Current

Grasshopper sparrows have a spotty distribution at best across eastern Washington. Over the years they have been found in various locales including CRP. They appear to utilize CRP on a consistent basis in southeast Washington (Mike Denny pers. Comm). See Figure 2 for current distribution map.

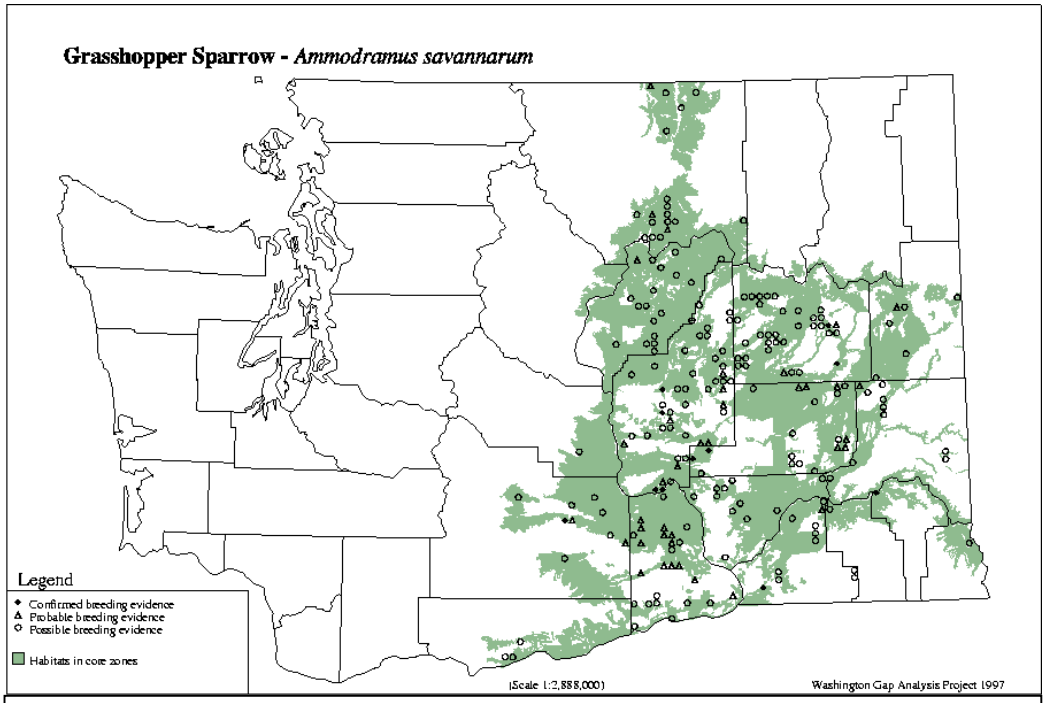

Figure 2. Current distribution of grasshopper sparrow in Washington from GAP analysis (Smith et al. 1997).

Status and Abundance Trends

Status

No data are available.

Trends

Throughout the U.S., this sparrow has experienced population declines throughout most of its breeding range (Brauning 1992; Brewer *et al.* 1991; Garrett and Dunn 1981). In 1996, Vickery (1996) reported that grasshopper sparrow populations have declined by 69% across the U.S. since the late 1960s.

Approximately 6 million hectares of shrubsteppe have been converted to wheat fields, row crops, and orchards in the interior Columbia Basin (Quigley and Arbelbide 1997). In Washington over 50% of historic shrubsteppe has been converted to agriculture (Dobler *et al*. 1996).

Accordingly, BBS data show long term declines from 1980 through 2002 of –3.0, -1.6 and –10.7 for Washington, Oregon and Idaho, respectively (Table 2). The entire Intermountain Grassland area shows large decrease of –12.4 over this same time period.

Washington, Oregon and the entire Intermountain Grassland area show an increasing negative trend when looking at the more recent time period 1996-2002 time period indicating the populations have increase even more over this time period (Sauer *et al.* 2003).

Table 2. Trends for grasshpper sparrow from BBS data (1980-2002) (Sauer *et al.* 2003).

State	1996- 2002	1980-2002
Washington	-4.9	-3.0
Idaho	-7.4	-10.7
Oregon	-4.4	-1.6
Intermountain Grassland	-13.0	-12.4

Factors Affecting Focal Species Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss and Fragmentation

The principal post-settlement conservation issues affecting bird populations include: habitat loss and fragmentation resulting from conversion to agriculture; and habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes. Conversion of shrub-steppe lands to agriculture adversely affects landbirds in two ways: 1) native habitat is in most instances permanently lost, and 2) remaining shrub-steppe is isolated and embedded in a highly fragmented landscape of multiple land uses, particularly agriculture. Fragmentation resulting from agricultural development or large fires fueled by cheatgrass can have several negative effects on landbirds. These include: insufficient patch size for area-dependent species, and increases in edges and adjacent hostile landscapes, which can result in reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Additionally, fragmentation of shrub-steppe has likely altered the dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale. In a recent analysis of neotropical migratory birds within the Interior Columbia Basin, most species identified as being of "high management concern" were shrub-steppe species (Saab and Rich 1997) which includes the grasshopper sparrow.

Approximately 6 million hectares of shrub-steppe have been converted to wheat fields, row crops, and orchards in the interior Columbia Basin (Quigley and Arbelbide 1997). In Washington over 50% of historic shrubsteppe has been converted to agriculture (Dobler *et al*. 1996).

Large scale reduction and fragmentation of sagebrush habitats have occurred due to a number of activities, including land conversion to tilled agriculture, urban and suburban development, and road and power-line rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Making this loss of habitat even more severe is that the grasshopper sparrow like other grassland species shows a sensitivity to the grassland patch size (Herkert 1994; Samson 1980; Vickery 1994a, b; Bock *et al.* 1999). Herkert (1991) in Illinois, found that grasshopper sparrows were not present in grassland patches smaller than 30 ha despite the fact that their published average territory size is only about 0.3 ha. Vickery *et al.* (1994) found the minimum requirement to be 100 hectares and Samson (1980) found the minimum to be 20 ha. in Missouri. Differences in minimum area requirements may be explained by the effect of relative population level on the selectivity of individuals, as has been shown for many species of birds (Vickery *et al*. 1994). Minimum requirement size in the Northwest is unknown.

Grazing

Grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1 percent of sagebrush steppe habitats remain untouched by livestock; 20 percent is lightly grazed, 30 percent moderately grazed with native understory remaining, and 30 percent heavily grazed with

understory replaced by invasive annuals. The effects of grazing in sagebrush habitats is complex, depending on intensity, season, duration and extent of alteration to native vegetation. Extensive and intensive grazing in North America has had negative impacts on this species (Bock and Webb 1984).

The legacy of livestock grazing in the Columbia Plateau has had widespread and severe impacts on vegetation structure and composition. One of the most severe impacts in shrub-steppe has been the increased spread of exotic plants (Altman and Holmes 2000; Weddell 2001)

For instance, the grasshopper sparrow has been found to respond positively to light or moderate grazing in tallgrass prairie (Risser *et al.* 1981). However, it responds negatively to grazing in shortgrass, semidesert, and mixed grass areas (Bock *et al*. 1984).

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrub-steppe, altering shrubland habitats.

The degree of degradation of terrestrial ecosystems is often diagnosed by the presence and extent of alien plant species (Andreas and Lichvar 1995); frequently their presence is related to soil disturbance and overgrazing. Increasingly, however, aggressive aliens are becoming established even in ostensibly undisturbed bunchgrass vegetation, wherever their seed can reach. The most notorious alien species in the Palouse region are upland species that can dominate and exclude perennial grasses over a wide range of elevations and substrate types (Weddell 2001).

Fire

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

The historical role of fire in the steppe and meadow steppe vegetation of the Palouse region is less clear (Weddell 2001). Daubenmire (1970) dismissed it as relatively unimportant, whereas others conclude that fires were probably more prevalent in the recent past than at present (Morgan *et al*. 1996). The lack of information about the presettlement fire frequency of steppe and meadow steppe ecosystems makes it difficult to emulate the natural fire regime in restored communities.

Studies on the effects of burns on grassland birds in North American grasslands have shown similar results as grazing studies: namely, bird response is highly variable. Confounding factors include timing of burn, intensity of burn, previous land history, type of pre-burn vegetation, presence of fire-tolerant exotic vegetation (that may take advantage of the post-burn circumstances and spread even more quickly) and grassland bird species present in the area. It should be emphasized that much of the variation in response to grassland fires lies at the level of species, but that even at this level results are often difficult to generalize. For instance, Mourning Doves have been found to experience positive (Bock and Bock 1992; Johnson 1997) and negative (Zimmerman 1997) effects by fire in different studies. Similarly, grasshopper sparrow have been found to experience positive (Johnson 1997), negative (Bock and Bock 1992; Zimmerman 1997; Vickery *et al.* 1999), and no significant (Rohrbaugh 1999) effects of

fire. Species associated with short and/or open grass areas will most likely experience short-term benefits from fires. Species that prefer taller and denser grasslands most likely will demonstrate a negative response to fire. (CPIF 2000).

Avoid burning during breeding season. Encroachment of woody vegetation in grassland areas wll be detrimental to most grassland species. For instance, grasshopper sparrows have been found to be absent from areas with greater than 30% shrub cover. In areas of good grassland bird diversity and productivity, efforts should be made to keep woody vegetation from reducing open grassland habitat. (CPIF 2000).

Mowing/Haying

Mowing and haying affects grassland birds directly and indirectly. It may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger *et al*. 1990). Studies on grasshopper sparrow have indicated higher densities and nest success in areas not mowed until after July 15 (Shugaart and James 1973; Warner 1992). Grasshopper sparrows are vulnerable to early mowing of fields, while light grazing, infrequent and post-season burning or mowing can be beneficial (Vickery 1996).

Brood Parasitism

Grasshopper sparrows may be multiply-parasitized (Elliott 1976; 1978; Davis and Sealy 2000). In Kansas, cowbird parasitism cost grasshopper sparrows about 2 young/parasitized nest, and there was a low likelihood of nest abandonment occurring due to cowbird parasitism (Elliott 1976, 1978). In Manitoba, mean number of host young fledged from successful, unparasitized nests was significantly higher than from successful, parasitized nests; cowbird parasitism cost Grasshopper Sparrows about 1.3 young/successful nest (Davis and Sealy 2000).

Predators

Predators of the grasshopper sparrow are hawks, loggerhead shrikes, mammals and snakes (Vickery 1996).

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Sage Sparrow
(*Amphispiza belli*)

Introduction

Sage sparrow (*Amphispiza belli*) is a species of concern in the West due to population decline in some regions and the degradation and loss of breeding and wintering habitats. Vulnerable to loss and fragmentation of sagebrush habitat, sage sparrows may require large patches for breeding. Sage sparrow can likely persist with moderate grazing and other land management activities that maintain sagebrush cover and the integrity of native vegetation. Sagebrush habitats may be very difficult to restore where non-native grasses and other invasive species are pervasive, leading to an escalation of fire cycles that permanently convert sagebrush habitats to annual grassland.

Sage sparrows are still common throughout much of sagebrush country and have a high probability of being sustained wherever large areas (e.g., 130 hectares observed in Washington, Vander Haegen, pers. comm.) of sagebrush and other preferred native shrubs exist for breeding. Sage sparrows are likely to return to areas where sagebrush and other native vegetation have been restored. However, sagebrush habitats can be very difficult to reclaim once invaded by cheatgrass and other noxious non-native vegetation, leading to an escalation of fire frequency and fire intensity that permanently converts shrubsteppe to annual grassland.

Life History and Habitat Requirements

Life History

Diet

Sage sparrows eat insects, spiders, seeds, small fruits, and succulent vegetation. They forage on the ground, usually under or near shrubs. They may occasionally be observed gleaning prey items from main stems and leaves. Consumed vegetation and insect prey provide most water requirements (Martin and Carlson 1998).

Reproduction

Sage sparrow clutch size usually is three to four, sometimes five. Incubation lasts about 13 days. Nestlings are altricial. Individual females produce one to three broods annually. Reproductive success is greater in wetter years (Rotenberry and Wiens 1991).

In eastern Washington, 70 percent (n = 53) of clutches examined had 3 eggs (Rotenberry and Wiens 1989). Annual reproductive success in Idaho was 1.3 fledglings/nest and probability of nest success was 40 percent (Reynolds 1981). Estimate of nest success in eastern Washington is 32 percent (M. Vander Haegen, unpub. data in Altman and Holmes 2000).

Nesting

Sage sparrows form monogamous pair bonds in early spring; nesting behavior occurs from March to July. Nests are constructed by females in or under sagebrush shrubs and pairs raise 1-2 broods a season (Martin and Carlson 1998).

Brown-headed cowbirds will parasitize sage sparrow nests; parasitized nests are often abandoned (Rich 1978).

Chicks are altricial and fledge when 9-10 days of age. Both parents feed young for more than two weeks after fledging. Fledglings often sit low in shrubs or on the ground under shrubs (Martin and Carlson 1998).

Migration

Sage sparrow populations in Washington are migratory. Sage sparrows are present only during the breeding season, arriving in late February-early March. Birds winter in shrubsteppe habitats of the southwestern United States and northwestern Mexico.

Mortality

Little information is available on estimates of annual survival rates (Martin and Carlson 1998). Typical nest predators include, common raven (*Corvus corax*), Townsend's ground squirrel (*Spermophilus townsendi*), and gopher snakes (*Pituophis catenifer*) (Martin and Carlson 1998, Rotenberry and Wiens 1989). Predators of juvenile and adult birds include loggerhead shrike (*Lanius ludovicianus*) and raptors (Martin and Carlson 1998).

Habitat Requirements

Similar to other shrubsteppe obligate species, sage sparrows are associated with habitats dominated by big sagebrush (*Artemisia tridentata*) and perennial bunchgrasses (Paige and Ritter 1999). In shrubsteppe habitat in southwestern Idaho, habitat occupancy by sage sparrows increased with increasing spatial similarity of sites, shrub patch size, and sagebrush cover; landscape features were more important in predicting presence of sage sparrows than cover values of shrub species and presence of sagebrush was more important than shadscale (Knick and Rotenberry 1995).

Nesting

Habitat in the vicinity of sage sparrow nests in southwestern Idaho was characterized by lower sagebrush cover (23 percent), greater shrub dispersion (clumped vs. uniform), and taller shrub height (18 in.) than surrounding areas. Sage sparrows preferred nesting in large, live sagebrush plants; birds frequently nested in shrubs 16-39 in. tall, shrubs less than 6 in. or greater than 39 in. were rarely used (Petersen and Best 1985). In eastern Washington, height of sagebrush nest shrubs averaged 35 inches (Vander Haegen 2003). In Idaho, nests were constructed an average distance of 13 inches above ground, 11 inches from the top, and 8 inches from the shrub perimeter (Petersen and Best 1985). Although sage sparrows generally place nests in sagebrush shrubs they frequently nest on the ground (Vander Haegen 2003).

Breeding

Washington breeders represent the northern subspecies *A. b. nevadensis.*. In the northern Great Basin, sage sparrow is associated with low and tall sagebrush/bunchgrass, juniper/sagebrush, mountain mahogany/shrub, and aspen/sagebrush/bunchgrass communities for breeding and foraging (Maser *et al.* 1984). In Idaho, sage sparrows are found in sagebrush of 11 to 14 percent cover (Rich 1980). Martin and Carlson (1998) report a preference for evenly spaced shrubs; other authors (Rotenberry and Wiens 1980; Peterson and Best 1985) report association where sagebrush is clumped or patchy. Sage sparrows prefer semi-open habitats, shrubs 1-2 meters tall (Martin and Carlson 1998). Habitat structure (vertical structure, shrub density, and habitat patchiness) is important to habitat selection (Martin and Carlson 1998). Sage sparrow is positively correlated with big sagebrush (A*rtemisia tridentata*), shrub cover, bare ground, above-average shrub height, and horizontal patchiness; it is negatively correlated with grass cover (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981; Larson and Bock 1984).

The subspecies *nevadensis* breeds in brushland dominated by big sagebrush or sagebrush-saltbush (Johnson and Marten 1992). Sage sparrows nest on the ground or in a shrub, up to about one meter above ground (Terres 1980). In the Great Basin, nests are located in living sagebrush where cover is sparse but shrubs are clumped (Petersen and Best 1985). Nest placement may be related to the density of vegetative cover over the nest, and will nest higher in a taller shrub (Rich 1980).

Breeding territory size in eastern Washington averages 1.5-3.9 acres but may vary among sites and years (Wiens *et al.* 1985). Territories are located in relatively large tracts of continuous sagebrush-dominated habitats. Territory size can vary with plant community composition and structure, increasing with horizontal patchiness (see Wiens *et al.* 1985). Sage sparrows are absent on sagebrush patches less than 325 acres (Vander Haegen *et al.* 2000; M. Vander Haegen unpub. data in Altman and Holmes 2000).

Non-Breeding

In migration and winter, sage sparrows are found in arid plains with sparse bushes, grasslands and open areas with scattered brush, mesquite, and riparian scrub, preferring to feed near woody cover (Martin and Carlson 1998; Meents *et al.* 1982; Repasky and Schluter 1994). Flocks of sage sparrows in the Mojave Desert appear to follow water courses (Eichinger and Moriarty 1985). Wintering birds in honey mesquite of lower Colorado River select areas of higher inkweed (S*uaeda torreyana*) density (Meents *et al.* 1982).

Population and Distribution

Population

Historic

No data are available.

Current

Sage sparrow populations are most abundant in areas of deep loamy soil and continuous sagebrush cover 3.3-6.6 feet high (Vander Haegen *et al.* 2000). In south-central Washington sage sparrows are one of the most common shrubsteppe birds (Vander Haegen *et al.* 2001). Sage sparrow breeding density was estimated at 121-207 individuals/km^2 over a two-year study at the Arid Lands Ecology Reservation in southern Washington (Wiens *et al.* 1987). Density estimates ranged from 33-90 birds/km^2 in sagebrush habitat on the Yakima Training Center (Shapiro and Associates 1996), whereas Schuler *et al.* (1993) on Hanford Reservation, reported density from 0.23-21.03 birds/km^2.

The sedentary subspecies *belli* is found in the foothills of the Coast Ranges (northern California to northwestern Baja California) and the western slope of the central Sierra Nevada in California (Johnson and Marten 1992).

The subspecies *canescens* breeds in the San Joaquin Valley and northern Mohave Desert in California and extreme western Nevada, winters in the southwestern U.S. (Johnson and Marten 1992).

The subspecies *nevadensis* breeds from central interior Washington eastward to southwestern Wyoming and northwestern Colorado, south to east-central California, central Nevada, northeastern Arizona, and northwestern New Mexico. *Nevadensis* winters in the southwestern U.S. and northern Mexico (Johnson and Marten 1992).

Distribution

Historic

Jewett *et al.* (1953) described the distribution of the sage sparrow as a common summer resident probably at least from March to September in portions of the sagebrush of the Upper Sonoran Zone and of the neighboring bunchgrass areas of the Transition zone in eastern Washington. They describe its summer range as north to Wilbur and Waterville, Grand Coulee; east to Connell and Wilbur; south to Kiona, Kennewick, and Lower Flat, Walla Walla County; and west to Waterville, Moxee City, Sunnyside, Yakima, and Soap Lake. Jewett *et al.* (1953) also note that the sage sparrow was found practically throughout the sagebrush of eastern Washington, and in a few places, notably in the vicinity of Wilbur, Waterville, Prescott, and

Horse Heaven, it ranges into the bunch grass as well. Jewett *et al.* (1953) report that Snodgrass found it the predominant sparrow in the sagebrush west of Connell. Hudson and Yocom (1954) described the sage sparrow as a summer resident and migrant in sagebrush areas of Adams, Franklin, and Grant counties. They report that Snodgrass reported it as common in western Walla Walla County.

Current

Data are not available.

Breeding

During the breeding season, sage sparrows are found in central Washington, eastern Oregon, southern Idaho, southwestern Wyoming, and northwestern Colorado south to southern California, central Baja California, southern Nevada, southwestern Utah, northeastern Arizona, and northwestern New Mexico (AOU 1983; Martin and Carlson 1998) (Figure 1).

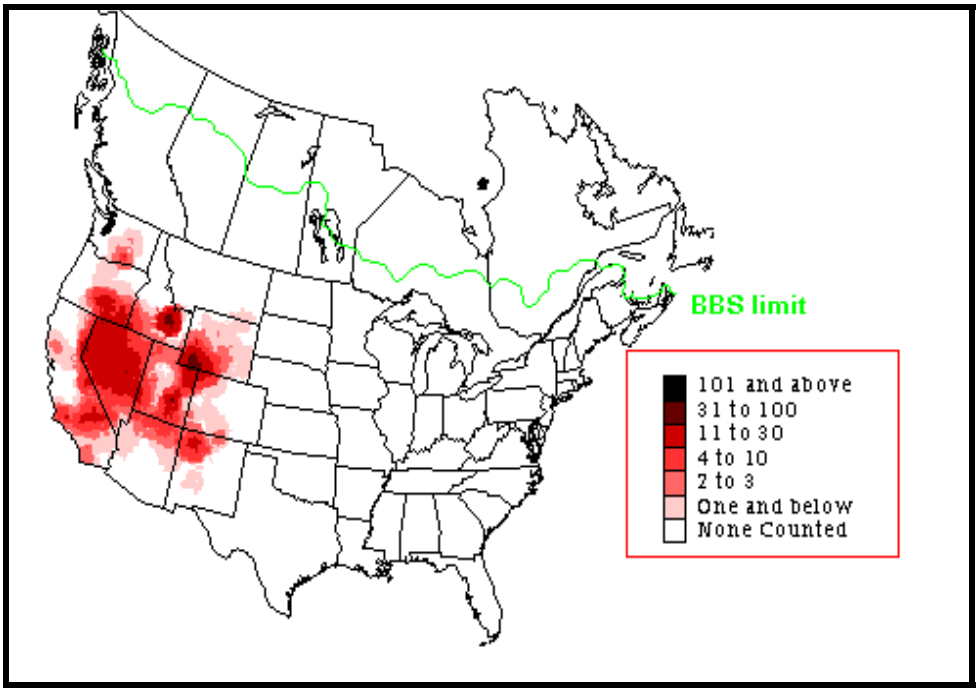

Figure 1. Sage sparrow breeding season abundance from BBS data (Sauer *et al.* 2003).

Non-Breeding

Sage sparrows are found in central California, central Nevada, southwestern Utah, northern Arizona, and central New Mexico south to central Baja California, northwestern mainland of Mexico, and western Texas (AOU 1983; Martin and Carlson 1998) (Figure 2).

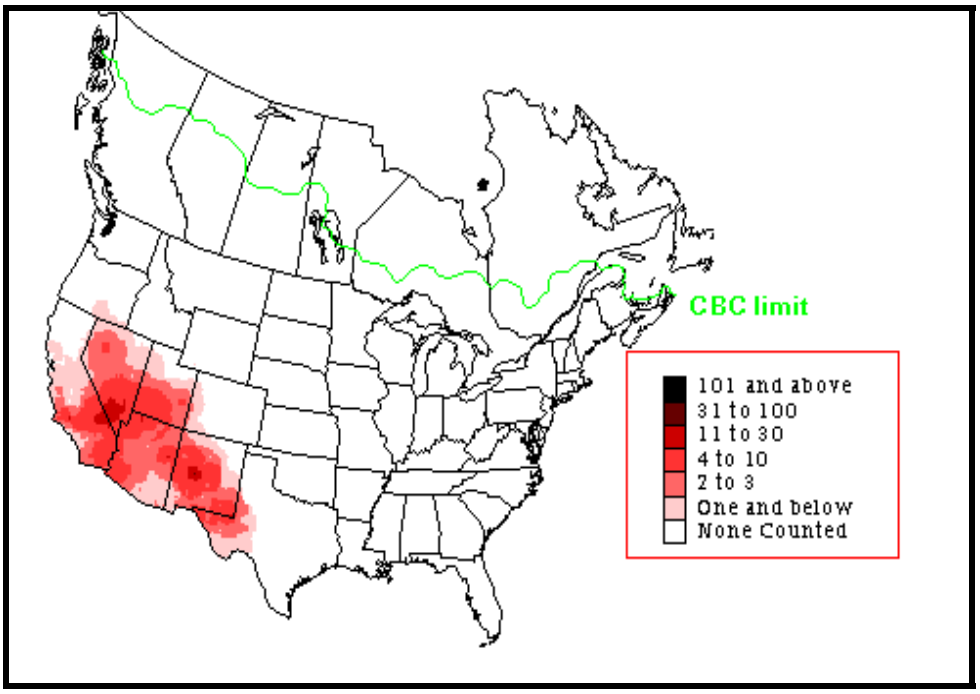

Figure 2. Sage sparrow winter season abundance from CBC data (Sauer *et al.* 2003).

Status and Abundance Trends

Status

North American BBS data indicate that sage sparrows have declined 1.0-2.3 percent in recent decades (1966-1991); greatest declines have occurred in Arizona, Idaho, and Washington (Martin and Carlson 1998). Sage sparrows are listed as a 'candidate' species (potentially threatened or endangered) by the Washington Department of Fish and Wildlife and are listed by the Oregon-Washington chapter of Partners in Flight as a priority species, and on the National Audubon Society Watch List. Based on genetic and morphometric differences, the subspecies *A. b. nevadensis* (currently found in east-central Washington) may be reclassified as a distinct species. Such an action would likely prompt increased conservation interest at the federal level.

Trends

The BBS data (1966-1996) for Washington State show a non-significant 0.3 percent average annual increase in sage sparrow survey-wide (n = 187 survey routes) (Figure 3). There has been a significant decline of -4.8 percent average per year for 1966-1979 (n = 73), and a recent significant increase of 2.0 percent average per year, 1980-1996 (n = 154; Sauer *et al.* 1997). BBS data indicate recent non-significant declines in California and Wyoming, 1980-1995. Generally, low sample sizes make trend estimates unreliable for most states and physiographic regions. Highest sage sparrow summer densities occur in the Great Basin, particularly Nevada, southeastern Oregon, southern Idaho, and Wyoming (Sauer *et al.* 1997). The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure 4.

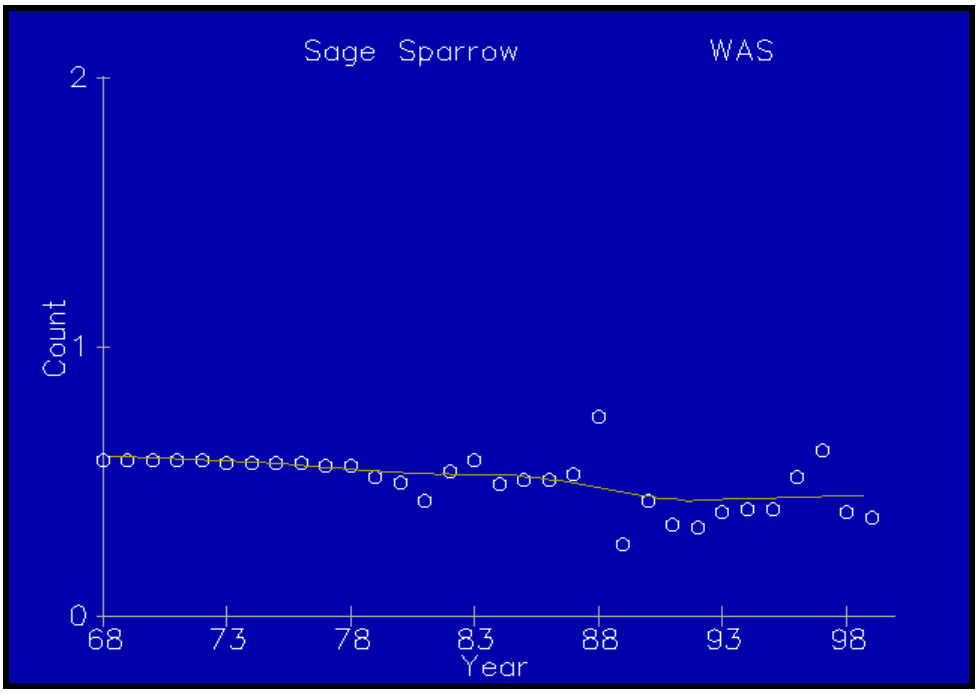

Figure 3. Sage sparrow population trend data from BBS, Washington (Sauer *et al.* 2003).

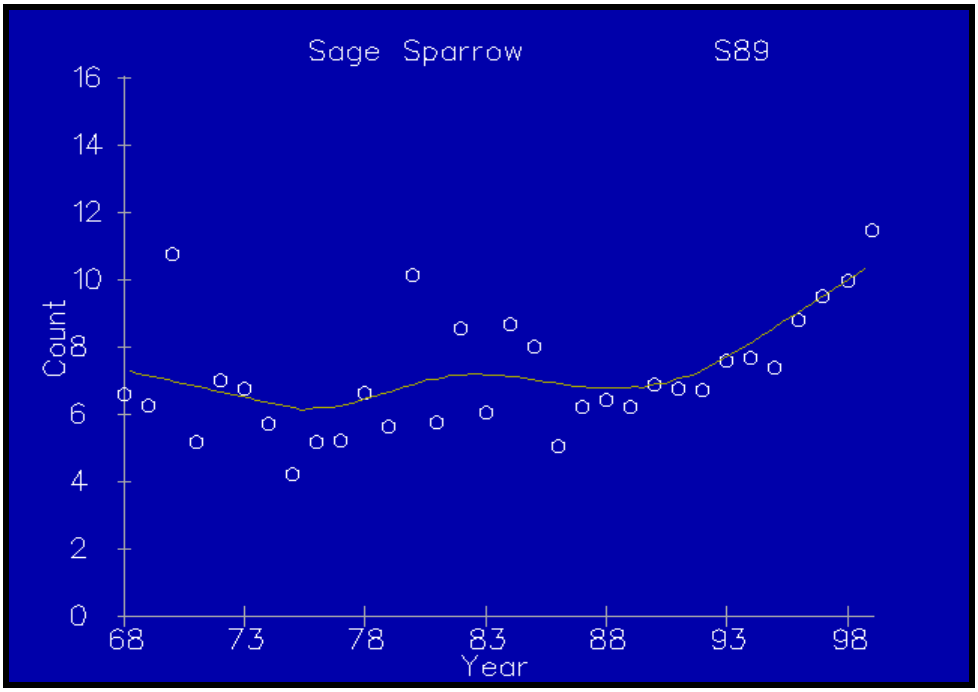

Figure 4. Sage sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

Christmas Bird Count (CBC) data show a significant decline in sage sparrows (-2.1 percent average per year; n = 160 survey circles) survey-wide for the period from 1959-1988. Sage sparrow trend estimates show declines in Arizona, New Mexico, and a significant decline in Texas (-2.2 percent average per year; n = 16). The highest sage sparrow winter counts occur in southern Nevada, southern California, Arizona, New Mexico, and west Texas (Sauer *et al.* 1996).

According to the ICBEMP terrestrial vertebrate habitat analysis, historical source habitats for sage sparrow occurred throughout most of the three ERUs within our planning unit (Wisdom *et al.* in press). Declines in source habitats were moderately high in the Columbia Plateau (40 percent), but relatively low in the Owyhee Uplands (13 percent) and Northern Great Basin (7 percent). However, declines in big sagebrush (e.g., 50 percent in Columbia Plateau ERU), which is likely higher quality habitat, are masked by an increase in juniper sagebrush (>50 percent in Columbia Plateau ERU), which is likely reduced quality habitat. Within the entire Interior Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom *et al.* in press) (from Altman and Holmes 2000).

Factors Affecting Sage Sparrow Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss

Because sage sparrows are shrubsteppe obligates. Sagebrush shrublands are vulnerable to a number of activities that reduce or fragment sagebrush habitat, including land conversion to tilled agriculture, urban and suburban development, and road and powerline rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Agricultural set-aside programs such as the Conservation Reserve Program (CRP) may eventually increase the quantity of potential breeding habitat for sage sparrows but it is not clear how long this will take. Habitat objectives recommended for sage sparrows include; dominant sagebrush canopy with 10 - 25 percent sagebrush cover, mean sagebrush height greater than 50 cm, high foliage density, mean native grass cover greater than 10 percent, mean exotic annual grass cover less than 10 percent, mean open ground cover greater than 10 percent, and where appropriate provide suitable habitat conditions in patches greater than 400 acres (Altman and Holmes 2000).

Fragmentation

The presence of relatively large tracts of sagebrush-dominated habitats is important as research in Washington indicates a negative relationship between sage sparrow occurrence and habitat fragmentation (Vander Haegen *et al.* 2000). Additionally, fragmentation of shrubsteppe habitat may increase vulnerability of sage sparrows to nest predation by generalist predators such as the common raven (*Corvus corax*) and black-billed magpie (*Pica hudsonia*) (Vander Haegen *et al.* 2002).

Livestock Management

Response to variation in grazing intensity is mixed. Sage sparrows respond negatively to heavy grazing of greasewood/Great Basin wild rye and shadscale/Indian ricegrass communities. They respond positively to heavy grazing of Nevada bluegrass/sedge communities, moderate grazing of big sage/bluebunch wheatgrass community, and to unspecified grazing intensity of big sage communities (see review by Saab *et al.* 1995). Because sage sparrows nest on the ground in early spring, and forage on the ground, maintenance of >50 percent of annual vegetative herbaceous growth of perennial bunchgrasses through the following season is recommended (Altman and Holmes 2000).

Pesticides/Herbicides

Large scale (16 km^2) aerial spraying of sagebrush habitat with the herbicide 2,4-D resulted in a significant decline in sage sparrow abundance 2 years post treatment. Because sage sparrows display high site fidelity to breeding areas birds may occupy areas that have been rendered unsuitable (Wiens and Rotenberry 1985).

Fire

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing habitat for sage sparrow (Paige and Ritter 1998).

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe.

Brood Parasitism

Sage sparrow is an occasional host for brown-headed cowbird (*Molothrus ater*), and may abandon the nest (e.g., see Reynolds 1981). Prior to European-American settlement, sage sparrow was probably largely isolated from cowbird brood parasitism, but is now vulnerable where the presence of livestock, land conversion to agriculture, and fragmentation of shrublands creates a contact zone between the species (Rich 1978).

Predation

In Oregon, predation by Townsend ground squirrel (*Spermophilus townsendi*) affected sage sparrow reproductive success when squirrel densities were high. Sage sparrow populations in southeastern Washington and northern Nevada incurred high rates of nest predation, probably mainly by gopher snakes (*Pituophis melanoleucus*) (Rotenberry and Wiens 1989). Loggerhead shrikes (*Lanius ludovicianus*) prey on both adults and altricial young in nest, and can significantly reduce nest production (Reynolds 1979). Feral cats near human habitations may increase predation (Martin and Carlson 1998).

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the sage sparrow. It is a short distance migrant, wintering in the southwestern U.S. and northern Mexico, and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, personal communication, 2003). Management requires the protection shrub, shrubsteppe, desert scrub habitats, and the elimination or control of noxious weeds. Migration routes, corridors, and wintering grounds need to be identified and protected just as its breeding areas.

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Sage Thrasher
(*Oreoscoptes montanus*)

Introduction

Sage thrasher (*Oreoscoptes montanus*) appears to be stable or increasing in much of its range. Sage thrashers can likely persist with moderate grazing and other land management activities that maintain sagebrush cover, tall vigorous shrubs, and the quality and integrity of native vegetation. Sage thrashers are vulnerable where sagebrush habitats are severely degraded or converted to annual grasslands or to other land uses.

There is a high probability of sustaining sage thrashers wherever native sagebrush habitats are maintained with high shrub vigor, tall shrubs, horizontal shrub patchiness, and an open understory of bare ground and native bunchgrasses and forbs.

Life History and Habitat Requirements

Life History

Diet

Sage thrashers forage on the ground for a variety of insect prey, especially ants, ground beetles, and grasshoppers (Vander Haegen 2003). Birds may also eat other arthropods, berries, and plant material (Reynolds *et al.* 1999). All foraging activity occurs during the day. Little information is available on the importance of access to free water (Reynolds *et al.* 1999). Sage thrashers may occasionally predate nests of other shrubsteppe bird species (Vander Haegen *et al.* 2002).

Reproduction

Sage thrasher clutch size is four to seven (usually three to five). The incubation period is about 15 days, by both sexes. Sage thrasher nestlings are altricial and downy. Sage thrashers can probably raise two broods per season, but probably only one brood per year in British Columbia (Cannings 1992). In Oregon, reproductive parameters were not associated with climatic variation (Rotenberry and Wiens 1989).

Chicks fledge when 10 - 11 days of age (Howe 1992; Reynolds 1999). Both parents brood and feed the young. Juveniles continue to be fed by parents for about a week after fledging, during which time they remain close to the nest (Reynolds *et al.* 1999).

Nesting

In Idaho, nest success (number of nests producing 1 fledgling) averaged 46 percent. The mean number of young fledged per successful nest varied from an average of 2.2 - 3.5 (Reynolds and Rich 1978; Reynolds 1981; Howe 1992). In eastern Washington, nest success is 38 percent (Altman and Holmes 2000).

Females usually lay one clutch per breeding season but will lay a replacement clutch if the first nest is predated (Reynolds and Rich 1978). In Washington, egg laying commences in early April (Reynolds *et al.* 1999). A five-year study of sage thrashers in central Oregon found significant differences in clutch size among years (Rotenberry and Wiens 1989).

Migration

Sage thrasher populations in Washington are migratory. Birds arrive in late March to establish breeding territories and leave in August - September. Territory size averaged 0.96 ha (2.4 ac) and ranged from 0.6 to 1.6 ha (1.5 - 4.0 ac) in south central Idaho (Reynolds and Rich 1978).

Mortality

Little information is available regarding sage thrasher survivorship or longevity. Snakes, particularly gopher snakes (*Pituophis melanoleucus*) and Townsend's ground squirrels (*Spermophilus townsendi*) are known nest predators (Rotenberry and Wiens 1989). Presumed nest predators include common ravens (*Corvus corax*), loggerhead shrike (*Lanius ludovicianus*), and long-tailed weasels (*Mustela frenata*) (Rotenberry and Wiens 1989; Reynolds *et al.* 1999).

Habitat Requirements

Sage thrashers are considered a shrubsteppe obligate species and are dependent upon areas of tall, dense sagebrush (*Artemisia tridentata*) within large tracts of shrubsteppe habitat (Knock and Rotenberry 1995; Paige and Ritter 1999; Vander Haegen 2003). In shrubsteppe communities in eastern Washington, sage thrashers are more abundant on loamy and shallow soils than areas of sandy soils, and on rangelands in good and fair condition than those of poor condition (Vander Haegen *et al.* 2000; Vander Haegen 2003). The presence of sage thrashers is positively associated with percent shrub cover and negatively associated with increased annual grass cover (Dobler *et al.* 1996). Total shrub cover and abundance of shrub species, especially sage brush are important habitat features for sage thrashers. Occurrence of sage thrashers in sagebrush habitat has been correlated with increasing sagebrush, shrub cover, shrub patch size, and decreasing disturbance (Knick and Rotenberry 1995).

Nesting

Sage thrasher nests are constructed either in or under sagebrush shrubs. Twenty-one of 34 (62 percent) nests located in south central Idaho were constructed on the ground. Elevated nests were constructed 4-16 in. above ground in sagebrush 30-45 in. tall while ground nests were constructed under sagebrush 22-35 in. tall (Reynolds and Rich 1978). Sagebrush shrubs selected for nesting are usually taller, and have greater crown height and width than random (Reynolds *et al.* 1999). In Washington, nests are usually located in tall sagebrush shrubs, average height 40 inches. (Vander Haegen 2003).

Breeding

Sage thrashers breed in sagebrush plains, primarily in arid or semi-arid situations, rarely around towns (AOU 1998). The birds usually breed between 1,300 and 2,000 meters above sea level (Reynolds and Rich 1978). In eastern Washington, sage thrashers showed the strongest correlation to the amount of sagebrush cover of all shrubsteppe birds and were most abundant where sagebrush percent cover was 11 percent, which is similar to estimated historic sagebrush cover (Dobler 1992, Dobler *et al.* 1996). In northern Great Basin, the sage thrasher breeds and forages in tall sagebrush/bunchgrass, juniper/sagebrush/bunchgrass, mountain mahogany/shrub, and aspen/sagebrush/bunchgrass communities (Maser *et al.* 1984).

Sage thrashers are positively correlated with shrub cover, shrub height, bare ground, and horizontal heterogeneity (patchiness). They are negatively correlated with spiny hopsage, budsage, and grass cover (Rotenberry and Wiens 1980, Wiens and Rotenberry 1981). In Idaho, sage thrashers are more likely to occur in sites with higher sagebrush cover and greater spatial similarity within a one-kilometer radius (Knick and Rotenberry 1995). In Nevada, sage thrashers are found most often on plots with taller, denser sagebrush (Medin 1992).

Sage thrashers usually nests within 1 meter of the ground in a fork of shrub (almost always sagebrush) and sometimes nest on the ground (Harrison 1978; Reynolds 1981; Rich 1980). In southeastern Idaho, sage thrashers nested in clumps of tall big sagebrush, with dense foliage overhead, invariably a depth of 0.5 meter from nest to shrub crown, and nests tending to be on the southeast side of the shrub (Petersen and Best 1991). Reynolds (1981) recorded a mean nest shrub height of 89 cm, a mean nest height 18 cm, and a mean distance between nest and shrub crown of 58 cm. For nests placed within shrubs, Rich (1980) observed a mean nest shrub

height of 83 cm, a mean nest height of 23 cm, and a mean distance between nest and shrub crown of 60 cm (n = 114 nests). The distance between nest and shrub crown is nearly always the same (58 to 60 cm) whether the nest is placed on the ground or within a shrub, presumably for optimum shading and shelter (Reynolds 1981; Rich 1980).

Non-Breeding

In winter, sage thrashers use arid and semi-arid scrub, brush and thickets.

Population and Distribution

Population

Historic

The only historic population estimate found was Jewett *et al.* (1953) given by Kennedy (1914: 252) who estimated there were 5 pairs/mi^2 through the Yakima Valley.

Current

Breeding density rarely exceeds 30 per km^2 (Rotenberry and Wiens 1989). In eastern Washington sagebrush shrubsteppe, mean breeding densities were reported at 0.09-0.2 individuals/ha (Dobler *et a.l* 1996). Medin (1990) reported breeding densities of 0.05 individuals/ha or less in shadscale habitat in eastern Nevada. Territory size in eastern Idaho averaged 8 territories/1.86 ha in one year, and 11 territories/1.14 ha the following year (Reynolds 1981).

On the Yakima Training Center density estimates ranged from 17-31 birds/km^2 in sagebrush habitat (Shapiro and Associates 1996), whereas Schuler *et al.* (1993) on Hanford Reservation, reported density from 0.17-0.23 birds/km^2.

The relative abundance of sage thrashers is significantly positively correlated with the following species in the western U.S., based on North American Breeding Bird Survey data (T.D. Rich, unpubl. data): Brewer's sparrow (*Spizella breweri*) ($r = 0.87$, $P < 0.001$), sage sparrow (*Amphispiza belli*) ($r = 0.73$, $P < 0.001$), gray flycatcher (E*mpidonax wrightii*) ($r = 0.73$, $P < 0.001$), sage grouse (*Centrocercus urophasianus*) ($r = 0.71$, $P < 0.001$), rock wren (*Salpinctes obsoletus*) ($r = 0.61$, $P < 0.001$), vesper sparrow (*Pooecetes gramineus*) ($r = 0.53$, $P < 0.001$), prairie falcon (*Falco mexicanus*) ($r = 0.53$, $P < 0.001$), and green-tailed towhee (*Pipilo chlorurus*) ($r = 0.51$, $P < 0.001$).

Distribution

Historic

Jewett *et al.* (1953) described the distribution of the sage thrasher as a summer resident at least from March to August irregularly through the sagebrush of the Upper Sonoran Zone in eastern Washington. They describe its summer range as north to Soap Lake, Almira, St. Andrews and Withrow; east to Sprague and Spokane; south to Bickleton, Wallula, Horse Heaven, and Kiona; and west to Ellensburg and Yakima Valley. Jewett *et al.* (1953) also note that Snodgrass observed none in the desert of Franklin and western Walla Walla counties, but found it rather numerous on the west side of the Columbia River between White Bluffs and Yakima, a few inhabiting tree-covered area along the Yakima River, and abundant in the arid Horse Heaven country. They note that the species has been reported as far east as Sprague and Riverside. Hudson and Yocom (1954) described the sage thrasher as uncommon and locally distributed summer resident in sagebrush areas. They note it presence was recorded by Taylor around Spokane and also that one record exits near Pullman.

Sage thrashers inhabited large, lowland areas of southeast Washington when it consisted of shrubsteppe habitat. Conversion of shrub-step to agricultural use has greatly reduced the

habitat available to the sage thrasher, resulting in localized populations associated with existing sagebrush habitat in eastern Walla Walla and northeast Asotin counties (Smith *et al.* 1997).

Current

Sage thrashers are a migratory species in the state of Washington; birds are present only during the breeding season. Confirmed breeding evidence has been recorded in Douglas, Grant, Lincoln, Adams, Yakima, and Kittitas counties. Core habitats also occur in Okanogan, Chelan, Whitman, Franklin, Walla Walla, Benton, Klickitat, and Asotin counties (Smith *et al.* 1997).

Estimates of sage thrasher density in eastern Washington during 1988-89 was 0.5 birds/ac (Dobler *et al.* 1996).

Breeding

During the breeding season, sage thrashers are found in southern British Columbia, central Idaho, and south-central Montana south through the Great Basin to eastern California, northeastern Arizona, and west-central and northern New Mexico (AOU 1983; Reynolds *et al.* 1999). Sage thrashers breed at least irregularly in southern Alberta and southern Saskatchewan (Cannings 1992) (Figure 1).

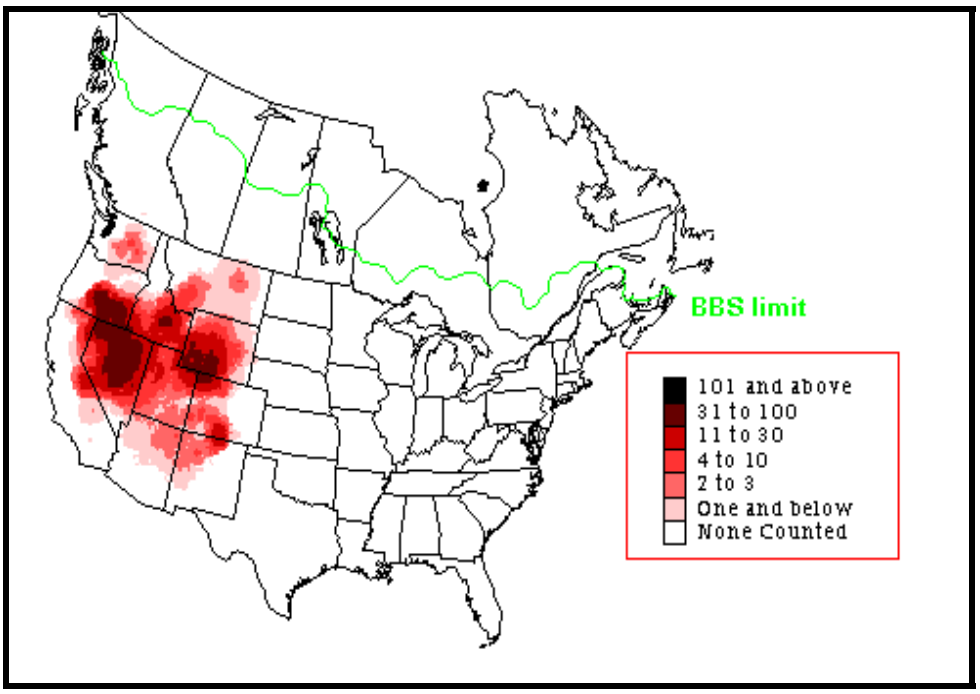

Figure 1. Sage thrasher breeding season abundance from BBS data (Sauer *et al*. 2003).

Non-Breeding

Sage thrashers are found in central California, southern Nevada, northern Arizona, central New Mexico, and central Texas south to southern Baja California, northern Sonora, Chihuahua, Durango, Guanajuato, northern Nuevo Leon, and northern Tamaulipas (AOU 1983; Reynolds *et al.* 1999) (Figure 2).

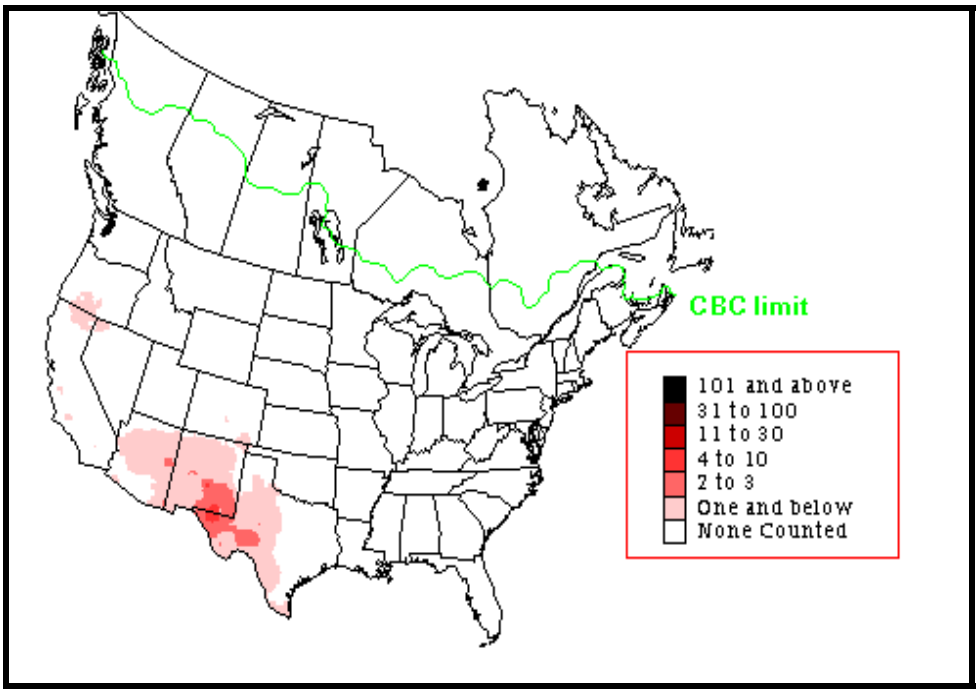

Figure 2. Sage thrasher winter season abundance from CBC data (Sauer *et al*. 2003).

Status and Abundance Trends

Status

The sage thrasher is considered a 'state candidate' species by the Washington Department of Fish and Wildlife. In Canada, sage thrashers are on the British Columbia Environment Red List (review for endangered and threatened status). They are considered a priority species by the Oregon-Washington Chapter of Partners in Flight and are on the Audubon Society Watch List for Washington State. Sage thrashers are listed as a species of high management concern by the Interior Columbia River Basin Ecosystem Management Project (Saab and Rich 1997).

Trends

North American Breeding Bird Survey (BBS) data (1966-1996) show a non-significant sage thrasher survey-wide increase (n = 268 survey routes) (Figure 3). There have been increasing trends in all areas except Idaho (-1.0 average decline per year, non-significant, n = 29) and the Intermountain Grassland physiographic region (-4.0 average decline per year, significant, n = 26) for 1966-1996. BBS data indicate a significant decline in Intermountain Grassland for 1980-1996 (-8.8 average per year decrease, n = 22). Significant long-term increases in sage thrashers are evident in Colorado (4.4 percent average per year, n = 24) and Oregon (2.6 percent average per year, n = 28), 1966-1996. The sample sizes are small or trends are not significant in other states. The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure 4.

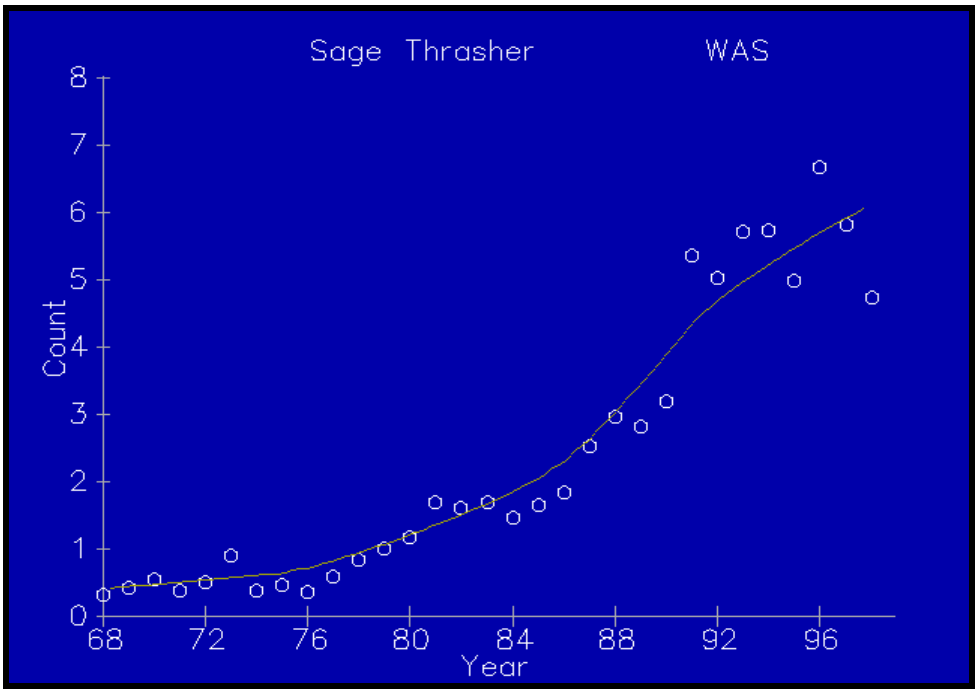

Figure 3. Sage thrasher trend results from BBS data, Washington (Sauer *et al.* 2003).

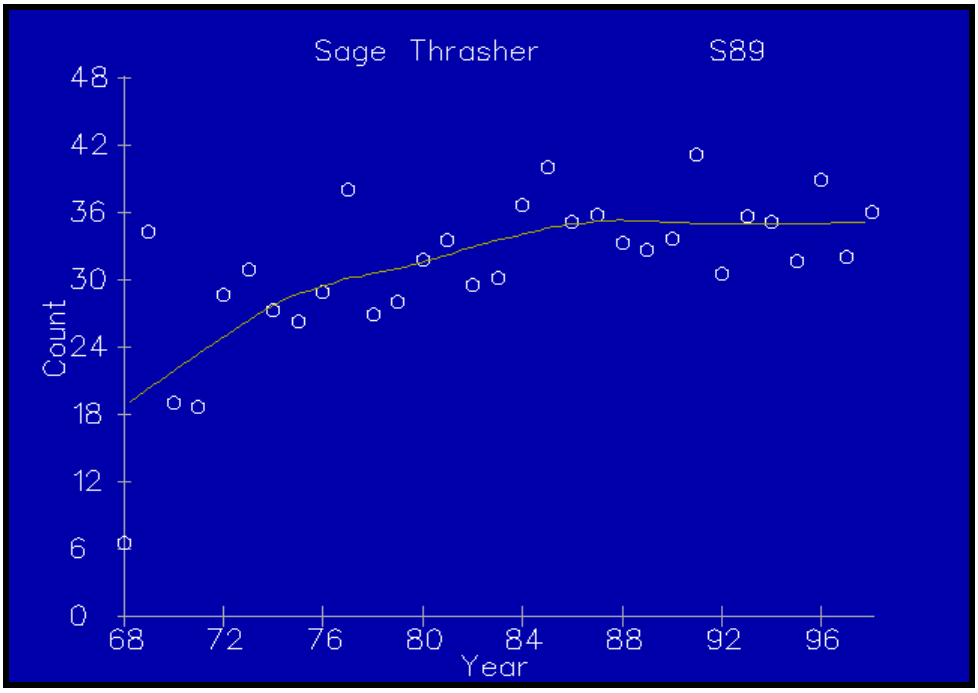

Figure 4. Sage thrasher trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

Christmas Bird Count (CBC) show stable trends for the period 1959-1988 (0.0 percent average annual change, n = 161 survey circles) survey-wide, but a significant decline in Texas (-2.8 percent average annual decline, n = 59) and a significant increase in New Mexico (2.4 percent average per year, n = 19). Sage thrasher winter abundance is highest in west Texas and southeastern New Mexico (Sauer *et al.* 1996).

Sage thrasher is positively correlated with the presence of Brewer's sparrow, probably due to similarities in habitat relations (Wiens and Rotenberry 1981), and does not exhibit the steep and widespread declines evident from BBS data for Brewer's sparrow (see Sauer *et al.* 1997).

Factors Affecting Sage Thrasher Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss and Fragmentation

Removal of sagebrush and conversion to other land uses is detrimental (Castrale 1982). Large-scale reduction and fragmentation of sagebrush habitats is occurring in many areas due to land conversion to tilled agriculture, urban and suburban development, and road and powerline right-of-ways. Range management practices such as mowing, burning, herbicide treatments, and residential and agricultural development have reduced the quantity and quality of sagebrush habitat (Braun *et al.* 1976, Cannings 1992, Reynolds *et al.* 1999). Range improvement programs remove sagebrush (particularly once grazed sagebrush becomes overly dense) by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock. Burning can result in longer-lasting sagebrush control than chaining (Castrale 1982).

In Washington, the conversion of native shrubsteppe to agriculture has resulted in a 50 percent loss in historic breeding habitat. Concomitant with habitat loss has been fragmentation of remaining shrubsteppe. Research in Washington suggests that sage thrashers may be less sensitive to habitat fragmentation than other shrubsteppe obligates as birds were found to nest in shrubsteppe patches <10 ha (24 ac) (Vander Haegen *et al.* 2000). However, birds nesting in small habitat fragments may experience higher rates of nest predation than birds nesting in larger areas of contiguous habitat (Vander Haegen 2003).

Recommended habitat conditions for sage thrashers include areas of shrubsteppe >16 ha (40 ac) where average sagebrush cover is 5-20 percent and height is >80 cm (31 in), sagebrush should be patchily distributed rather than dispersed, and mean herbaceous cover 5-20 percent with <10 percent cover of non-native annuals (Altman and Holmes 2000).

According to the ICBEMP terrestrial vertebrate habitat analyses, historical source habitats for sage thrasher occurred throughout most of the three ERUs within our planning unit (Wisdom *et al.* in press). Declines in source habitats were moderately high in the Columbia Plateau (40 percent), but relatively low in the Owyhee Uplands (15 percent) and Northern Great Basin (5 percent). However, declines in big sagebrush (e.g., 50 percent in Columbia Plateau ERU), which is likely higher quality habitat, are masked by an increase in juniper sagebrush (>50 percent in Columbia Plateau ERU), which is likely reduced quality habitat. Within the entire Interior Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom *et al.* in press) (from Altman and Holmes 2000).

Grazing

Although sage thrashers are found on grazed range land, the effects of long-term grazing by livestock are not known. The response by sage thrashers to grazing is mixed as studies have reported both positive and negative population responses to moderate grazing of big sage/bluebunch wheatgrass communities (Saab *et al.* 1995). There is some evidence that sage thrasher density may be lower in grazed habitats as the average distance between neighboring nests was found to be significantly lower in ungrazed vs. grazed shrubsteppe habitats in south-central Idaho, 64 m (209 ft) and 84 m (276 ft) respectively (Reynolds and Rich 1978). Altman and Holmes (2000) suggest maintaining >50 percent of annual vegetative growth of perennial bunchgrasses through the following growing season.

Grazing can increase sagebrush density, positively affecting thrasher abundance. Dense stands of sagebrush, however, are considered degraded range for livestock and may be treated to reduce or remove sagebrush. Grazing may also encourage the invasion of non-native grasses, which escalates the fire cycle and converts shrublands to annual grasslands. West (1988, 1996) estimates less than 1 percent of sagebrush steppe habitats remain untouched by livestock; 20 percent is lightly grazed, 30 percent moderately grazed with native understory remaining, and 30 percent heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, and depend on intensity, season, duration and extent of alteration to native vegetation.

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Cheatgrass can create a more continuous grass understory than native bunchgrasses. Dense cheatgrass cover can possibly affect foraging ability for ground foragers, and more readily carries fire than native bunchgrasses. Crested wheatgrass and other non-native annuals have also altered the grass-forb community in many areas of sagebrush shrubsteppe.

Fire

Cheatgrass has altered the natural fire regime on millions of acres in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates (Paige and Ritter 1998).

Predation

Sage thrashers are preyed upon by loggerhead shrikes (*Lanius ludovicianus*); predation can be a major factor in breeding success of sagebrush birds (Reynolds 1979).

Brood Parasitism

Sage thrashers coexist with brown-headed cowbirds (*Molothrus ater*) at various points throughout their range and have been observed to reject cowbird eggs by ejecting eggs from the nest (Rich and Rothstein 1985).

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the sage thrasher. It is a short distance migrant, wintering in the southwestern U.S. and northern Mexico, and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm., 2003). Management requires the protection shrub, shrubsteppe, desert scrub habitats, and the elimination or control of noxious weeds. Migration routes, corridors, and wintering grounds need to be identified and protected just as its breeding areas.

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Brewer's Sparrow
(*Spizella breweri*)

Introduction

Although not currently listed, Brewer's sparrows have significantly declined across their breeding range in the last 25 years, a cause for concern because this species is one of the most widespread and ubiquitous birds in shrubsteppe ecosystems (Saab *et al.* 1995). Brewer's sparrow is a sagebrush obligate where sagebrush cover is abundant (Altman and Holmes 2000). However, in recent decades many of the shrubsteppe habitats in Washington have changed as a result of invasion by exotic annuals, especially cheatgrass. Cheatgrass-dominated areas have an accelerated fire regime that effectively eliminates the sagebrush shrub component of the habitat, a necessary feature for Brewer's sparrows (Vander Haegen *et al.* 2000).

Conservation practices that retain deep-soil shrubsteppe communities, reduce further fragmentation of native shrubsteppe, and restore annual grasslands and low-productivity agricultural lands are all important (Vander Haegen *et al.* 2000). A patchy distribution of sagebrush clumps is more desirable than dense uniform stands. Removal of sagebrush cover to <10 percent has a negative impact on populations (Altman and Holmes 2000). Recommended habitat objectives include the following: patches of sagebrush cover 10-30 percent, mean sagebrush height > 64cm (24 in), high foliage density of sagebrush, average cover of native herbaceous plants > 10 percent, bare ground >20 percent (Altman and Holmes 2000).

Life History and Habitat Requirements

Life History

Diet

Brewer's sparrows forage by gleaning a wide variety of small insects from the foliage and bark of shrubs. Occasionally, seeds are taken from the ground. They will drink free-standing water when available but are physiologically able to derive adequate water from food and oxidative metabolism (Rotenberry *et al.* 1999). Lepidopterans (butterflies and moths, 90 percent larvae), araneans (spiders), hemipterans (bugs), and homopterans (hoppers, aphids, etc.) make up 72 percent of the nestling diet (Petersen and Best 1986).

Reproduction

Breeding begins in mid-April in the south to May or early June in the north. Clutch size is usually three to four. Nestlings are altricial. Brewer's sparrow reproductive success is correlated with climatic variation and with clutch size; success increasing in wetter years (Rotenberry and Wiens 1989, 1991).

Brewer's sparrows are able to breed the first year following hatch and may produce two broods a year. In southeastern Idaho, the probability of nest success was estimated at 9 percent (n = 7; Reynolds 1981). In eastern Washington 31 of 59 (53 percent) pairs were unsuccessful, 25 (42 percent) fledged one brood, 3 (5 percent) fledged two broods (Mahony *et al.* 2001). The probability of nest success was an estimated 39 percent for 495 nests monitored in eastern Washington; reproductive success was lower in fragmented landscapes (M. Vander Haegen unpubl. data in Altman and Holmes 2000). The number of fledglings produced/nest varies geographically and temporally. The average number of fledglings/nest range from 0.5-3.4 but may be zero in years with high nest predation (Rotenberry *et al.* 1999).

Nesting

Brewer's sparrow pair bonds are established soon after females arrive on breeding areas, usually in late March but pair formation may be delayed by colder than average spring weather. Not all males successfully acquire mates. In Washington, 51 percent of 55 males monitored in

the breeding season were observed incubating eggs, especially during inclement weather (Mahony *et al.* 2001). Pairs may start a second clutch within 10 days after fledging the young from their first brood (Rotenberry *et al.* 1999).

Brown-headed cowbirds (*Molothrus ater*) are known to lay eggs in Brewer's sparrow nests; parasitized nests are usually abandoned (Rich 1978, Biermann *et al.* 1987, Rotenberry *et al.* 1999). Parasitism of Brewer's sparrows nest by cowbirds is only about 5 percent in eastern Washington (Altman and Holmes 2000).

Both parents feed the nestlings, 90 percent of foraging trips are less than 164 feet from the nest site. Fledglings are unable to fly for several days after leaving the nest and continue to be dependent upon the parents. During this period they remain perched in the center of a shrub often less than33 feet from the nest and quietly wait to be fed (Rotenberry *et al.* 1999).

Migration

Brewer's sparrow is a neotropical migrant. Birds breed primarily in the Great Basin region and winter in the southwestern U.S., Baja, and central Mexico. North-south oriented migration routes are through the Intermountain West. Brewer's sparrows are an early spring migrant. Birds arrive in southeastern Oregon by mid-late March. The timing of spring arrival may vary among years due to weather conditions. Birds generally depart breeding areas for winter range in mid-August through October (Rotenberry *et al.* 1999).

Mortality

Nest predators include gopher snake (*Pituophis catenifer*), western rattlesnake (*Crotalus viridis*), common raven (*Corvus corax*), black-billed magpie (*Pica pica*), loggerhead shrike (*Lanius ludovicianus*), long-tailed weasel (*Mustela frenata*), Townsend's ground squirrel (*Spermophilus townsendii*), and least chipmunk (*Tamias minimus*). Predators of juvenile and adult birds include loggerhead shrike, American kestrel (*Falco sparverius*), sharp-shinned (*Accipiter striatus*) and Cooper's (*A. cooperi*) hawks (Rotenberry 1999).

Habitat Requirements

In eastern Washington, abundance of Brewer's sparrows (based on transect surveys) was negatively associated with increasing annual grass cover; higher densities occurred in areas where annual grass cover was <20 percent (Dobler 1994). Vander Haegen *et al.* (2000) determined that Brewer's sparrows were more abundant in areas of loamy soil than areas of sandy or shallow soil, and on rangelands in good or fair condition than those in poor condition. Additionally, abundance of Brewer's sparrows was positively associated with increasing shrub cover. In southwestern Idaho, the probability of habitat occupancy by Brewer's sparrows increased with increasing percent shrub cover and shrub patch size; shrub cover was the most important determinant of occupancy (Knick and Rotenberry 1995).

Nesting

Brewer's sparrows construct an open cup shaped nest generally in a live big sagebrush shrub (Petersen and Best 1985, Rotenberry *et al.* 1999). In southeastern Idaho, mean sagebrush height (54 cm, 21 in) and density (29 percent cover) were significantly higher near Brewer's sparrow nest sites than the habitat in general while herbaceous cover (8 percent) and bare ground (46 percent) were significantly lower (Petersen and Best 1985). The average height of nest shrubs in southeastern Idaho was 69 cm (27 in). Ninety percent (n = 58) of Brewer's sparrows nests were constructed at a height of 20-50 cm (8-20 in) above the ground (Petersen and Best 1985).

Breeding

Brewer's sparrow is strongly associated with sagebrush over most of its range, in areas with scattered shrubs and short grass. They can also be found to a lesser extent in mountain mahogany, rabbit brush, bunchgrass grasslands with shrubs, bitterbrush, ceonothus, manzanita and large openings in pinyon-juniper (Knopf *et al.* 1990; Rising 1996; Sedgwick 1987; USDA Forest Service 1994). In Canada, the subspecies *taverneri* is found in balsam-willow habitat and mountain meadows.

The average canopy height is usually < 1.5 meter (Rotenberry *et al.* 1999). Brewer's sparrow is positively correlated with shrub cover, above-average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness). They are negatively correlated with grass cover, spiny hopsage, and budsage (Larson and Bock 1984; Rotenberry and Wiens 1980; Wiens 1985; Wiens and Rotenberry 1981). Brewer's sparrows prefer areas dominated by shrubs rather than grass. They prefer sites with high shrub cover and large patch size, but thresholds for these values are not quantified (Knick and Rotenberry 1995). In Montana, preferred sagebrush sites average 13 percent sagebrush cover (Bock and Bock 1987). In eastern Washington, Brewer's sparrow abundance significantly increased on sites as sagebrush cover approached historic 10 percent level (Dobler *et al.* 1996). Brewer's sparrows are strongly associated throughout their range with high sagebrush vigor (Knopf *et al.* 1990).

Adults are territorial during the breeding season. Territory size is highly variable among sites and years. In central Oregon and northern Nevada, territory size was not correlated with 17 habitat variables but was negatively associated with increasing Brewer's sparrow density. The average size of territories ranges from 0.5-2.4 ha (1.2-5.9 ac, n = 183) in central Oregon. The reported territory size in central Washington is much lower, 0.1 ha (0.2 ac) (Rotenberry *et al.* 1999).

Non-Breeding

In migration and winter, Brewer's sparrows use low, arid vegetation, desert scrub, sagebrush, creosote bush (Rotenberry *et al.* 1999).

Population and Distribution

Population

Historic

No data are available.

Current

Brewer's sparrows can be abundant in sagebrush habitat and will breed in high densities (Great Basin and Pacific slopes), but densities may vary greatly from year to year (Rotenberry *et al.* 1999). Dobler *et al.* (1996) reported densities of 50-80 individuals/km^2 in eastern Washington. In the Great Basin, density usually ranged from 150-300/km^2, sometimes exceeding 500/km^2 (Rotenberry and Wiens 1989). Brewer's sparrow breeding density ranges from 0.08 to 0.10 individuals/ha in shadscale habitat in eastern Nevada (Medin 1990). Breeding territory usually averages between 0.6-1.25 hectares and will contract as densities of breeding birds increase (Wiens *et al.* 1985).

In southeastern Oregon, densities have ranged from 390 to 780/mi^2 but can exceed 500/km^2 (1,295/mi^2) (Weins and Rotenberry 1981, Rotenberry and Weins 1989).

Distribution

Historic

Jewett *et al.* (1953) described the distribution of the Brewer's sparrow as a fairly common migrant and summer resident at least from March 29 to August 20, chiefly in the sagebrush of

the Upper Sonoran Zone in eastern Washington. They describe its summer range as north to Brewster and Concully; east to Spokane and Pullman; south to Walla Walla, Kiona, and Lyle; and west to Wenatchee and Yakima. Jewett *et al.* (1953) also noted that Snodgrass (1904: 230) pointed out its rarity in Franklin and Yakima counties. Snodgrass also reported that where the vesper sparrow was common, as in Lincoln and Douglas counties, the Brewer's sparrow was also common (Jewett *et al.* 1953). Hudson and Yocom (1954) described the Brewer's sparrow as an uncommon summer resident and migrant in open grassland and sagebrush.

Undoubtedly, the Brewer's sparrow was widely distributed throughout the lowlands of southeast Washington when it consisted of vast expanses of shrubsteppe habitat. Large scale conversion of shrubsteppe habitat to agriculture has resulted in populations becoming localized in the last vestiges of available habitat (Smith *et al.* 1997). A localized population existed in small patches of habitat in northeast Asotin County. Brewer's sparrow may also occur in western Walla Walla County, where limited sagebrush habitat still exists.

Current

Washington is near the northwestern limit of breeding range for Brewer's sparrows. Birds occur primarily in Okanogan, Douglas, Grant, Lincoln, Kittitas, and Adams counties (Smith *et al.* 1997).

There is high annual variation in breeding season density estimates. A site may be unoccupied one year and have densities of up to 150 birds/km^2 the next. Because of this variation, short-term and/or small scale studies of Brewer's sparrow habitat associations must be viewed with caution (Rotenberry *et al.* 1999).

Breeding

The subspecies *breweri* is found in southeast Alberta, southwestern Saskatchewan, Montana, and southwestern North Dakota, south to southern California (northern Mojave Desert), southern Nevada, central Arizona, northwestern New Mexico, central Colorado, southwestern Kansas, northwestern Nebraska, and southwestern South Dakota (AOU 1983, Rotenberry *et al.* 1999) (Figure 1). The subspecies *taverneri* is found in southwest Alberta, northwest British Columbia, southwest Yukon, and southeast Alaska (Rotenberry *et al.* 1999).

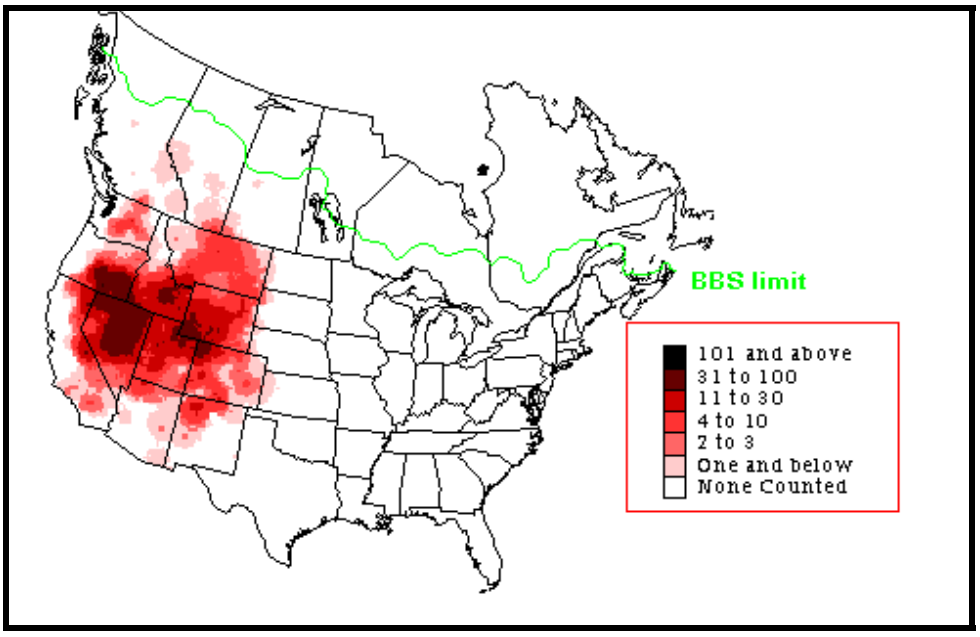

Figure 1. Brewer's sparrow breeding season abundance from BBS data (Sauer *et al.* 2003).

Non-Breeding

During the non-breeding season, Brewer's sparrows are found in southern California, southern Nevada, central Arizona, southern New Mexico, and west Texas, south to southern Baja California, Sonora, and in highlands from Chihuahua, Coahuila, and Nuevo Leon south to northern Jalisco and Guanajuato (Terres 1980, AOU 1983, Rotenberry *et al.* 1999).

Status and Abundance Trends

Status

Brewer's sparrow is often the most abundant bird species in appropriate sagebrush habitats. However, widespread long-term declines and threats to shrubsteppe breeding habitats have placed it on the Partners in Flight Watch List of conservation priority species (Muehter 1998). Saab and Rich (1997) categorize it as a species of high management concern in the Columbia River Basin.

Considered a shrubsteppe obligate, the Brewer's sparrow is one of several species closely associated with landscapes dominated by big sagebrush (*Artemisia tridentate*) (Rotenberry 1999, Paige and Ritter 1999). Historically, the Brewer's sparrow may have been the most abundant bird in the Intermountain West (Paige and Ritter 1999) but Breeding Bird Survey trend estimates indicate a range-wide population decline during the last twenty-five years (Peterjohn *et al.* 1995). Brewer's sparrows are not currently listed as threatened or endangered on any state or federal list. Oregon-Washington Partners in Flight consider the Brewer's sparrow a focal species for conservation strategies for the Columbia Plateau (Altman and Holmes 2000).

Trends

Breeding Bird Survey (BBS) data for 1966-1996 show significant and strong survey-wide declines averaging -3.7 percent per year (n = 397 survey routes) (Figure 2). The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure 3. Significant declines in Brewer's sparrow are evident in California, Colorado, Montana, Nevada, Oregon, and Wyoming, with the steepest significant decline evident in Idaho (-6.0 percent average per year; n = 39). These negative trends appear to be consistent throughout the 30-year survey period. Only Utah shows an apparently stable population. Sample sizes for Washington are too small for an accurate estimate. Mapped BBS data show centers of summer abundance in the Great Basin and Wyoming Basin (Sauer *et al.* 1997).

Christmas Bird Count (CBC) data for the U.S. for the period 1959-1988 indicate a stable survey-wide trend (0.2 percent average annual increase; n = 116 survey circles), and a significantly positive trend in Texas (6.7 percent average annual increase; n = 33). Arizona shows a non-significant decline (-1.4 percent average annual decline; n = 34). Mapped CBC data show highest wintering abundances in the U.S. in the borderlands of southern Arizona, southern New Mexico, and west Texas (Sauer *et al.* 1996).

Note that although positively correlated with presence of sage thrashers (*Oreoscoptes montanus*), probably due to similarities in habitat relations (Wiens and Rotenberry 1981), thrashers are not exhibiting the same steep and widespread declines evident in BBS data (see Sauer *et al.* 1997).

According to the ICBEMP terrestrial vertebrate habitat analyses, historical source habitats for Brewer's sparrow occurred throughout most of the three ERUs within our planning unit (Wisdom *et al.* in press). Declines in source habitats were moderately high in the Columbia Plateau (39 percent), but relatively low in the Owyhee Uplands (14 percent) and Northern Great Basin (5 percent). However, declines in big sagebrush (e.g., 50 percent in Columbia Plateau ERU), which is likely higher quality habitat, are masked by an increase in juniper sagebrush (>50 percent in Columbia Plateau ERU), which is likely reduced quality habitat. Within the entire

Interior Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom *et al.* in press) (from Altman and Holmes 2000).

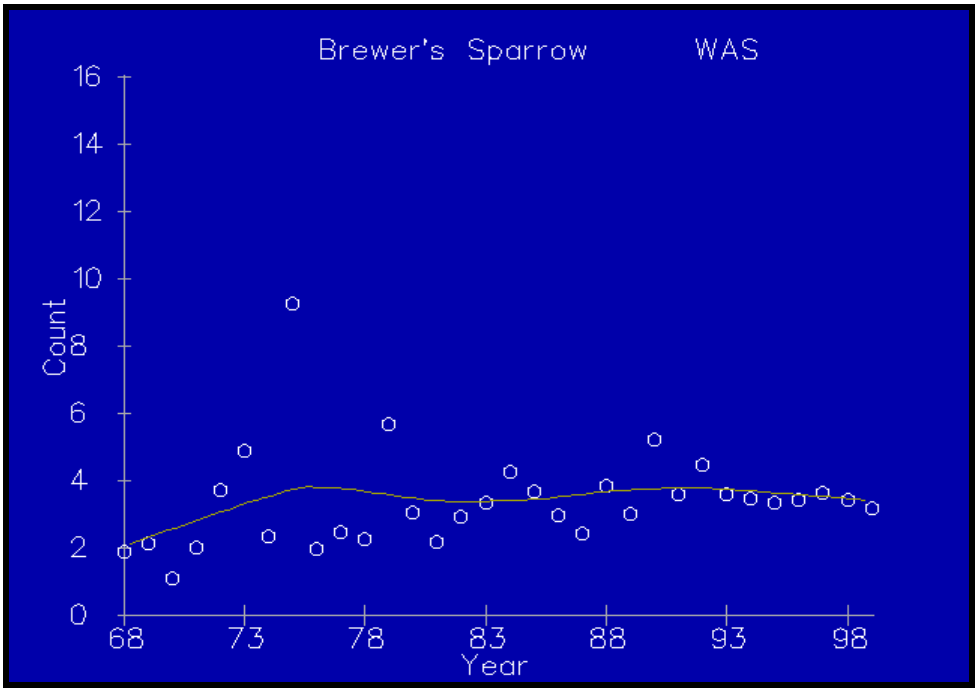

Figure 2. Brewer's sparrow trend results from BBS data, Washington (Sauer *et al.* 2003).

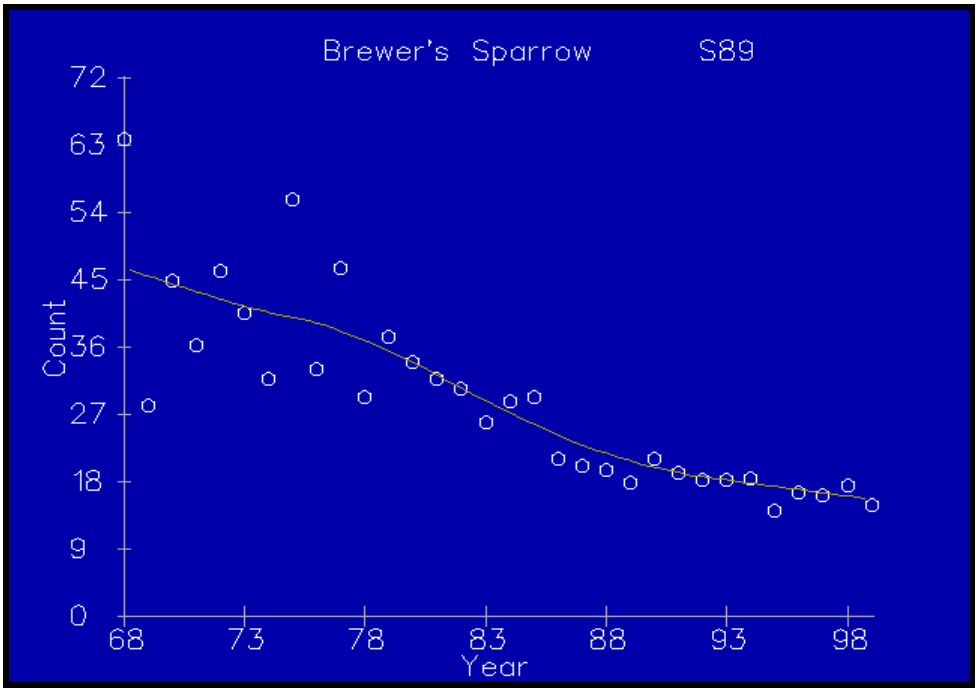

Figure 3. Brewer's sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003)..

Factors Affecting Brewer's Sparrow Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat Loss and Fragmentation

Large scale reduction and fragmentation of sagebrush habitats occurring due to a number of activities, including land conversion to tilled agriculture, urban and suburban development, and road and power-line rights of way. Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Grazing

Rangeland in poor condition is less likely to support Brewer's sparrows than rangeland in good and fair condition. Grazing practices that prevent overgrazing, reduce or eliminate invasion of exotic annuals, and restore degraded range are encouraged (Vander Haegen *et al.* 2000). Brewer's sparrow response to various levels of grazing intensity is mixed. Brewer's sparrows respond negatively to heavy grazing of greasewood/great basin wild rye and low sage/Idaho fescue communities; they respond positively to heavy grazing of shadscale/Indian ricegrass, big sage/bluebunch wheatgrass, and Nevada bluegrass/sedge communities; they respond negatively to moderate grazing of big sage/bluebunch wheatgrass community; and they respond negatively to unspecified grazing intensity of big sage community (see review by Saab *et al.* 1995).

Grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1 percent of sagebrush steppe habitats remain untouched by livestock; 20 percent is lightly grazed, 30 percent moderately grazed with native understory remaining, and 30 percent heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, depending on intensity, season, duration and extent of alteration to native vegetation.

Invasive Grasses

Cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe, altering shrubland habitats.

Fire

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

Brood Parasitism

Brewer's sparrow nests are an occasional host for brown-headed cowbird (*Molothrus ater*); nests usually abandoned, resulting in loss of clutch (Rotenberry *et al.* 1999). Prior to European-American settlement, Brewer's sparrows were probably largely isolated from cowbird parasitism, but are now vulnerable as cowbird populations increase throughout the West and where the presence of livestock and pastures, land conversion to agriculture, and fragmentation of shrublands creates a contact zone between the species (Rich 1978, Rothstein 1994). Frequency of parasitism varies geographically; the extent of impact on productivity unknown (Rotenberry *et al.* 1999). In Alberta, in patchy sagebrush habitat interspersed with pastures and riparian habitats, a high rate of brood parasitism reported. Usually abandoned parasitized nests

and cowbird productivity was lower than Brewer's (Biermann *et al.* 1987). Rich (1978) also observed cowbird parasitism on two nests in Idaho, both of which were abandoned.

Predators

Documented nest predators (of eggs and nestlings) include gopher snake (*Pituophis melanoleucus*), Townsend's ground squirrel (*Spermohpilus townsendii*); other suspected predators include loggerhead shrike (*Lanius ludovicianus*), common raven (*Corvus corax*), black-billed magpie (*Pica pica*), long-tailed weasel (*Mustela frenata*), least chipmunk (*Eutamias minimus*), western rattlesnake (*Crotalus viridis*), and other snake species. Nest predation significant cause of nest failure. American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), coachwhip (*Masticophis flagellum*) reported preying on adults (Rotenberry *et al.* 1999). Wiens and Rotenberry (1981) observed significant negative correlation between loggerhead shrike and Brewer's sparrow density.

Pesticides/Herbicides

Aerial spraying of the herbicide 2,4-D did not affect nest success of Brewer's sparrows during the year of application. However, bird densities were 67 percent lower one year, and 99 percent lower two years, after treatment. Birds observed on sprayed plots were near sagebrush plants that had survived the spray. No nests were located in sprayed areas one and two years post application (Schroeder and Sturges 1975).

Out-of-Subbasin Effects and Assumptions

No data could be found on the migration and wintering grounds of the Brewer's sparrow. It is a short-distance migrant, wintering in the southwestern U.S. and northern Mexico, and as a result faces a complex set of potential effects during it annual cycle. Habitat loss or conversions is likely happening along its entire migration route (H. Ferguson, WDFW, pers. comm., 2003). Management requires the protection shrub, shrubsteppe, desert scrub habitats, and the elimination or control of noxious weeds. Wintering grounds need to be identified and protected just as its breeding areas. Migration routes and corridors need to be identified and protected.

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