Southeast Washington

Subbasin Planning Ecoregion

Wildlife Assessment

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1.0 Wildlife Assessment Framework

This section briefly describes the framework used to develop subbasin wildlife assessments for subbasin plans in southeast Washington. Where subbasins extend into Idaho and Oregon, appropriate federal, state, tribal, and local wildlife and land management entities were consulted and/or have partnered with the Washington Department of Fish and Wildlife (WDFW) to complete Ecoprovince/subbasin plans. As the lead wildlife agency in Washington State, WDFW is responsible for compiling wildlife assessment, inventory, and management information for the Palouse, Lower Snake, Tucannon, Asotin, and Walla Walla subbasins. These contiguous subbasins occupy the southeast corner of Washington State and extend into Idaho and Oregon (Figure_1).

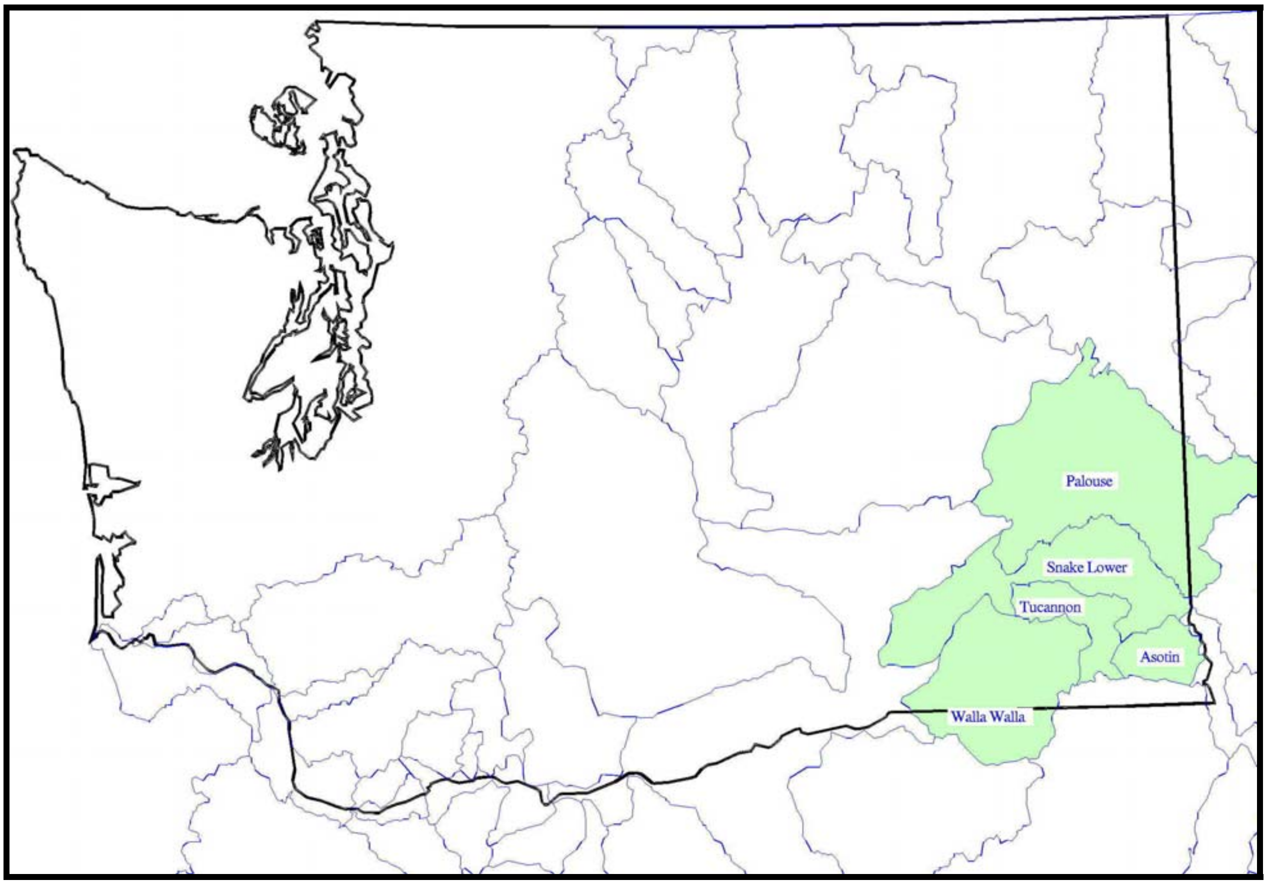

Figure 1. The Palouse, Lower Snake, Tucannon, Asotin, and Walla Walla subbasins.

The Asotin subbasin is the northern most subbasin in the Blue Mountain Ecoprovince (Figure_2), while the Palouse, Lower Snake, Tucannon, and Walla Walla subbasins lie within the Columbia Plateau Ecoprovince (Figure_3). To avoid confusion between the two Ecoprovinces, the term "*Southeast Washington Subbasin Planning Ecoregion*," or simply, "*Ecoregion*," refers collectively to the Palouse, Lower Snake, Tucannon, Asotin, and Walla Walla subbasins (Figure_4) and will be used for the remainder of the wildlife assessment.

Ecoregion subbasins share similar habitats, soils, wildlife populations, limiting factors, land uses, physiographic, and hydrologic features. Furthermore, water from streams and rivers within the Ecoregion eventually converge with the Snake River further tying the subbasins together at the landscape level.

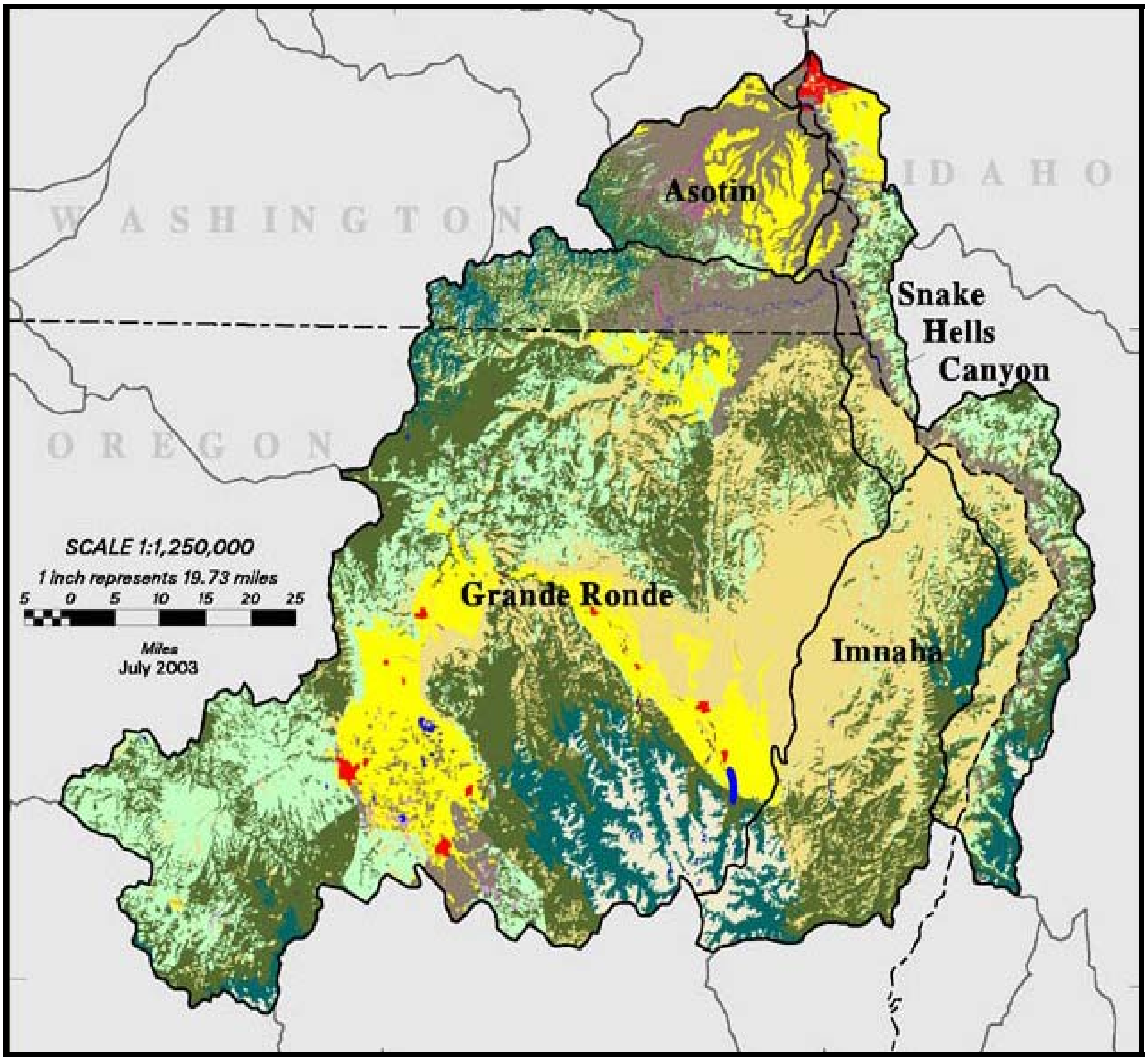

Figure 2. The Blue Mountains Ecoprovince (NHI 2003).

Wildlife conservation activities are usually conducted in a partial, fragmented way that emphasizes only a single species or habitat type in a small geographic area. Advances in conservation biology reveal a need for a holistic approach – protecting the full range of biological diversity at a landscape scale with attention to size and condition of core areas (or refugia), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient quantity and quality to ensure long-term viability of wildlife species. Ecoregion planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

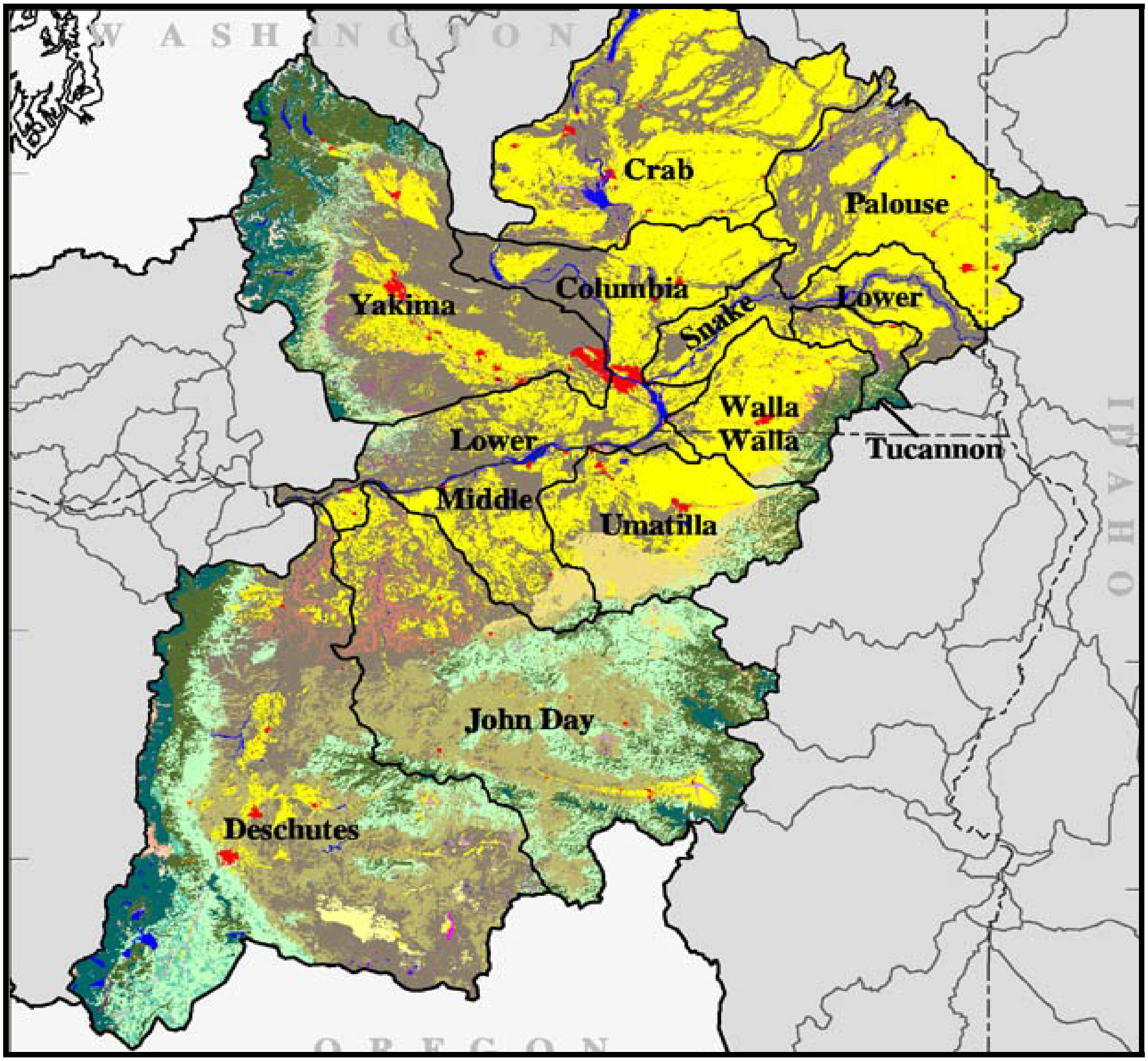

Figure 3. The Columbia Plateau Ecoprovince (NHI 2003).

In response to this need, Ecoregion planners created an approach to subbasin planning at two scales. The ecoregional scale emphasizes focal macro habitats and related strategies, goals, and objectives. The subbasin scale highlights species guilds, individual focal species, important micro habitats, habitat linkages, and subbasin-specific strategies, goals, and objectives that are not addressed at the Ecoregion level. To facilitate this multi-faceted approach, Ecoregion planners organized two interactive wildlife planning teams consisting of Ecoregion level planners and subbasin level planners (Figure_5). Washington Department of Fish and Wildlife is the lead planning entity for the wildlife assessment at the Ecoregion level. Subbasin lead entities are shown in Table_1. Subbasin planners provided information to the Ecoregion planners on both the subbasin and landscape scale.

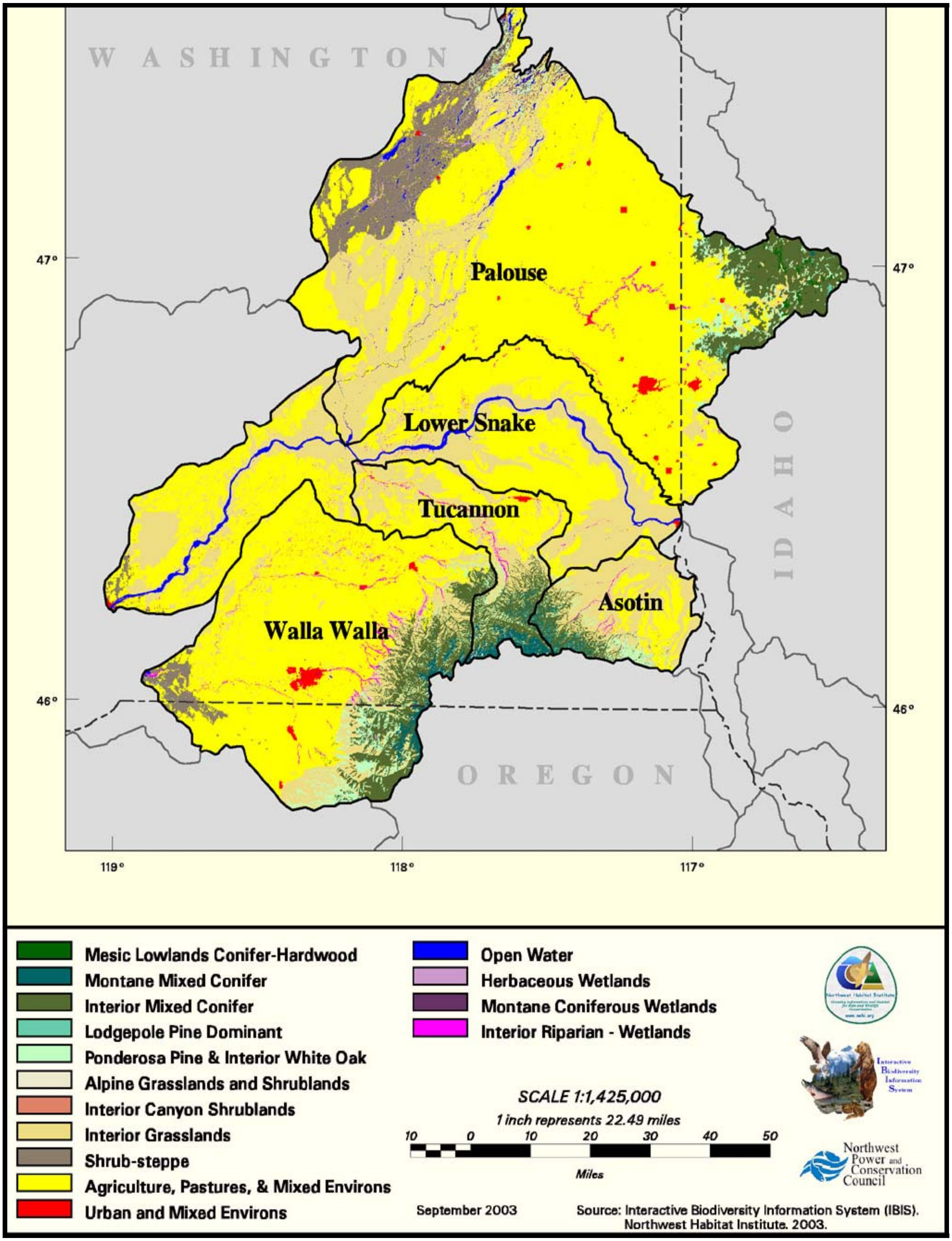

Figure 4. The Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

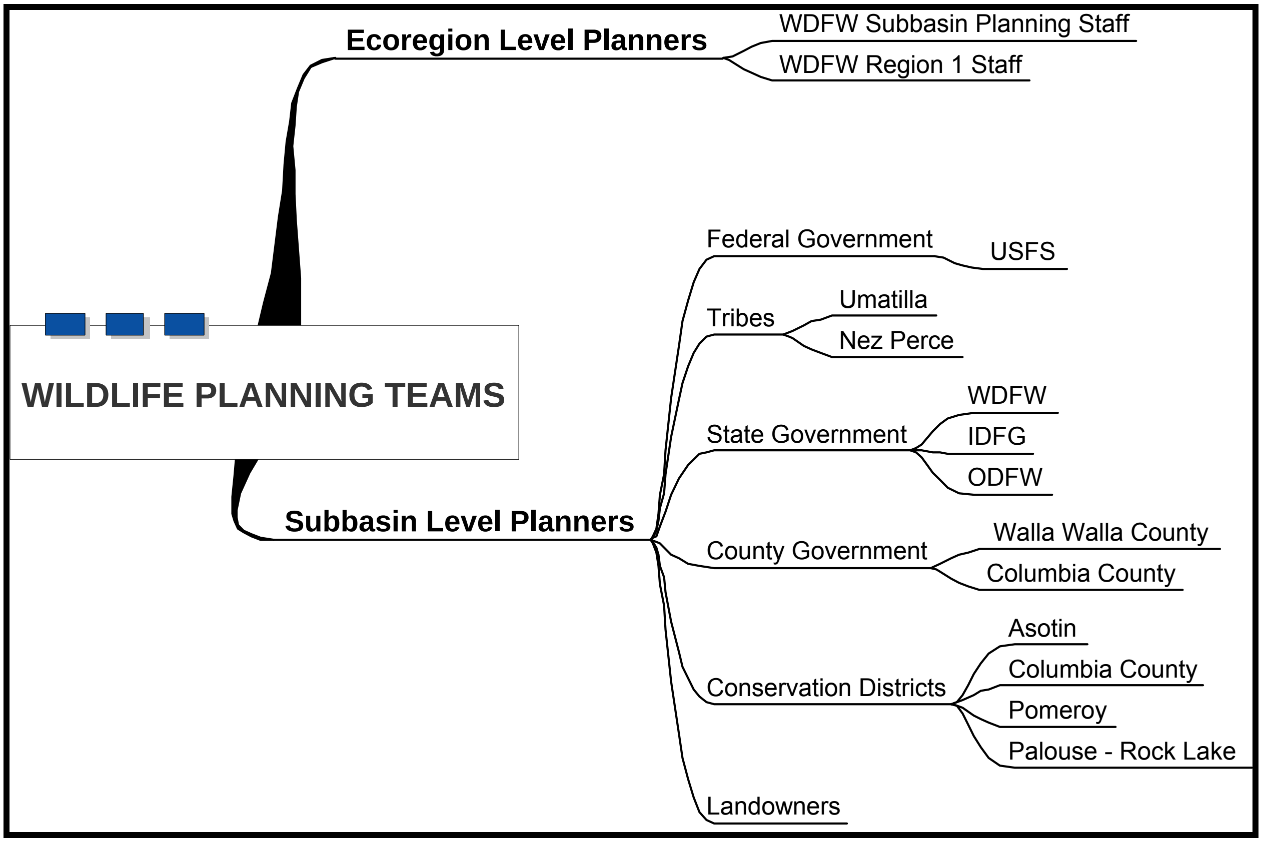

Figure 5. Wildlife planning teams for the Southeast Washington Subbasin Planning Ecoregion.

Table 1. Subbasin lead entities for the Southeast Washington Subbasin Planning Ecoregion.

Subbasin	Lead Entity
Palouse	Palouse-Rock Lake Conservation District
Lower Snake	Pomeroy Conservation District
Tucannon	Columbia County Conservation District
Asotin	Asotin Conservation District
Walla Walla	Walla Walla County

1.1 Assessment Tools

The wildlife assessment was developed from a variety of "tools" including subbasin summaries, the Interactive Biodiversity Information System (IBIS), the WDFW Priority Habitats and Species (PHS) database, the Washington GAP Analysis database, Partners in Flight (PIF) information, National Wetland Inventory maps, Ecoregional Conservation Assessment (ECA) analyses, and input from local, state, federal, and tribal wildlife managers. Specific information about these data sources is located in Appendix_A.

Although IBIS is a useful assessment tool, it should be noted that IBIS-generated historic habitat maps have a minimum polygon size of 1 km^2 while current IBIS habitat type maps have a minimum polygon size of 250 acres (T. O'Neil, NHI, personal communication, 2003). In either case, linear aquatic, riparian, wetland, subalpine, and alpine habitats are under represented as are small patchy habitats that occur at or near the canopy edge of forested habitats. It is also likely that micro habitats located in small patches or narrow corridors were not mapped at all.

Another limitation of IBIS data is that they do not specifically rate habitat quality nor do they associate habitat elements (key environmental correlates [KECs]) with specific areas. As a result, a given habitat type may be accurately depicted on NHI maps, but may be lacking functionality and quality. For example, NHI data do not distinguish between shrubsteppe habitat dominated by introduced weed species and pristine shrubsteppe habitat.
Washington State GAP data were also used extensively throughout the wildlife assessment. The GAP-generated acreage figures may differ from NHI acreage figures as an artifact of using two different data sources. The differences, however, are relatively small (less than five percent) and will not impact planning or management decisions.

The ECA spatial analysis is a relatively new terrestrial habitat assessment tool developed by The Nature Conservancy (TNC). The ECA has not been completed in all areas within the greater Columbia River Basin; however, wherever possible, WDFW integrated ECA data into Ecoregion and subbasin plans. The major contribution of ECA is the spatial identification of priority areas where conservation strategies should be implemented. Ecoregional Conservation Assessment products were reviewed and modified by local wildlife area managers and subbasin planners.

2.0 Physical Features

2.1 Land Area

The Ecoregion covers approximately 11.5 percent of Washington State and, at an estimated 7,631 mi^2 (4,884,153 acres), is just slightly smaller than the state of New Hampshire. Of the five subbasins in the Ecoregion, the Palouse subbasin is the largest, consisting of 2,125,841 acres (3,322 mi^2) and comprising 44 percent of the entire Ecoregion (Table 2). The Asotin is the smallest subbasin, making up only 5 percent of the Ecoregion.

Table 2. Subbasin size relative to the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Subbasin	Size		Percent of Ecoregion
	Acres	Mi^2	
Palouse	2,125,841	3,322	44
Lower Snake	1,059,935	1,656	22
Tucannon	326,185	510	7
Asotin	246,001	384	5
Walla Walla	1,126,198	1,760	22
Total (Ecoregion)	**4,884,160**	**7,632**	**100**

2.2 Physiography

The Ecoregion is within the Columbia Plateau, a vast area of arid and semi-arid landscape that begins in the rainshadow of the Cascade Mountains and extends east to cover most of the non-forested portions of eastern Oregon and Washington. The Columbia Plateau is characterized by a relatively uniform underlying geology dominated by thick flows of basalt lava that are punctuated in localized areas by volcanic ashflows and deposits of volcanic tuffs and rhyolite. The uniform bedrock of the Columbia Plateau has been faulted and uplifted, cut by rivers and eroded by wind, water, and glaciers to produce a diverse landscape that contains considerable topographic relief. Present within the landscape are desert mountain ranges, low rolling hills, riverine valleys, broad basins containing permanent lakes and seasonal playas, sand dunes, plateaus, and expansive plains. Many of the current features present in the region date only from the Pleistocene epoch or one million years before present. This is a relatively new landscape that continues to change and be altered by natural processes.

The Palouse bioregion (Bailey 1995) covers 3,953,600 mi^2 in west central Idaho, southeastern Washington, and northeastern Oregon between the western edge of the Rocky Mountains and the Columbia River Basin. The region is characterized by a moderate climate and loess soils deposited on plateaus dissected by rivers deeply incised through layers of bedded basalt. The Palouse Prairie lies at the eastern edge of the Palouse bioregion, north of the Clearwater River. Here, where the loess hills are most developed, soils are often more than 39 inches deep. The depth and fertility of the soils make the region one of the world's most productive grain-growing areas (Williams 1991).

The highly productive loess dunes which characterize the region are Pleistocene in origin (Alt and Hyndman 1989). Having been deposited by southwest winds, the steepest slopes (up to 50 percent) face the northeast. The dune-like topography and northeastern orientation are important ecological features; the lee slopes are moist and cool, and level areas tend to be in the bottom lands. Due to their ontogeny, low-lying areas are often disconnected from stream systems and are thus seasonally saturated.

Geology on the west side of the Ecoregion is a result of massive meltwater flooding during the last ice age, which radically altered the geology and vegetation patterns over the entire Columbia Basin. The most spectacular meltwater floods were the Spokane Floods, also known as the Missoula floods for the glacial lake of their origin, or as Bretz floods, after J. Harlan Bretz, their discoverer. Bretz (1959) first discerned that the geology of Washington’s aptly named channeled scablands must have been due to flooding, the origin of which was due to periodic failures of ice dams holding back 772 mi^2 of water in glacial Lake Missoula (Waitt 1985).

The effect of the Spokane floods was profound. A network of meltwater channels was cut through bedrock hundreds of feet deep and as many miles long, reaching from the Idaho Panhandle to the mouth of the Columbia River and even into Oregon. The floods moved huge walls of rock and mud across the State of Washington, leaving behind a landscape of scoured bedrock, dry waterfalls, alluvial gravels the size of trucks, anomalous rock deposits left by rafted ice blocks, and ripple bars with 100-foot crests. Over the last 10,000 years, these flooded landscapes developed into unique plant communities, possibly even producing new species, such as *Hackelia hispida* var. *disjuncta* (Hitchcock *et al.* 1969; Gentry and Carr 1976), which only occurs in large meltwater coulees.

In some areas, the flood sediments have been locally reworked by wind to form sand dunes or loess deposits (Reidel *et al.* 1992). Another prominent soil feature which covers hundreds of square miles of central Washington and occurs in the northwest corner of the Ecoregion is the regularly spaced low mounds of fine soil atop a matrix of scoured basalt, known as biscuit-swale topography. This type of patterned ground has many competing hypotheses to explain its origin; chief among them is intensive frost action associated with a periglacial climate (Kaatz 1959).

Soils are a conspicuous component of shrubsteppe ecosystems and influence the composition of the vegetation community. The composition, texture, and depth of soils affect drainage, nutrient availability, and rooting depth and result in a variety of edaphic climax communities (Daubenmire 1970). Much of the interior Columbia Basin in eastern Washington is underlain by basaltic flows, and the soils vary from deep accumulations of loess-derived loams to shallow lithosols in areas where glacial floods scoured the loess from underlying basalt. Sandy soils cover extensive areas in the west-central and southern parts of the Basin, the result of glacial outwash and alluvial and wind-blown deposition (Daubenmire 1970; Wildung and Garland).

Results of a previous census of shrubsteppe birds in eastern Washington suggested that the abundance of some species might vary with soil type of the vegetation community (Dobler *et al.* 1996). If it exists, this relationship might prove a valuable asset to management, because soils are a mapable component of the landscape and could be incorporated into spatially explicit models of resource use and availability.

In this landscape, riparian and wetland habitats have special importance and provide significant distinction to the region. The Ecoregion contains two very different types of river systems: one which has direct connections to the Pacific Ocean and in many instances still supports anadromous fish populations, and one that contains only internally drained streams and is one of the defining characteristics of the hydrographic Great Basin.

The natural history of the Columbia River Basin led to the development of many, diverse communities typically dominated by shrubs or grasses that are specialized for living in harsh, dry climates on a variety of soils. Many other species have adapted to these conditions, including invasive species, which have fundamentally altered the function of the ecosystem. Arno and Hammerly (1984) identified a number of factors that help maintain the treeless character of these areas: wind speed and duration; soils and geology; temperature; snow; precipitation; soil moisture; frozen ground; light intensity and biotic factors such as the lack of thermal protection from tree cover, and the lack of a seed bank for new tree establishment. Of these, the authors postulated the strongest determinants of tree exclusion to be precipitation, insolation (excessive heating), and cold.

3.0 Socio-Political Features

3.1 Land Ownership

Ecoregional land ownership is illustrated in Figure_6. Approximately 10 percent of the Ecoregion is in federal, state, tribal and local government ownership, while the remaining 90 percent is privately owned or owned by non-government organizations (NGOs) (Table_3). The Palouse subbasin contains the highest percentage of privately held lands (92 percent), while the Asotin subbasin contains the least amount (63 percent). In contrast, the Asotin subbasin is comprised of the highest percentage of federal land (26 percent), while the Lower Snake contains the least amount (2 percent). Similarly, the Asotin subbasin has the highest percentage of state lands (10 percent), whereas the Walla Walla subbasin has the smallest percentage of lands owned by state governments (1.4 percent).

3.2 Land Use

This section is meant to describe broad changes in land use throughout the Ecoregion from circa 1850 to 1999. A more detailed discussion of changes in vegetation, wildlife habitats and factors limiting wildlife populations and abundance resulting from changes in land use can be found in section 4.

It is well known that the Ecoregion has undergone extensive change over the past 125 years. European settlement and land use patterns differed dramatically from Native American practices. Native Americans lived in the river valleys, while European-Americans lived on the prairies. Native Americans were hunter-gatherers or low-impact agriculturists of native species; the European-Americans were high-impact agriculturists of introduced species.

Both biophysical and human changes have been closely associated with advances in agricultural technology. The conversion from perennial native grass, shrub, and forest vegetation to agriculture and the interactions between human cultures and environment

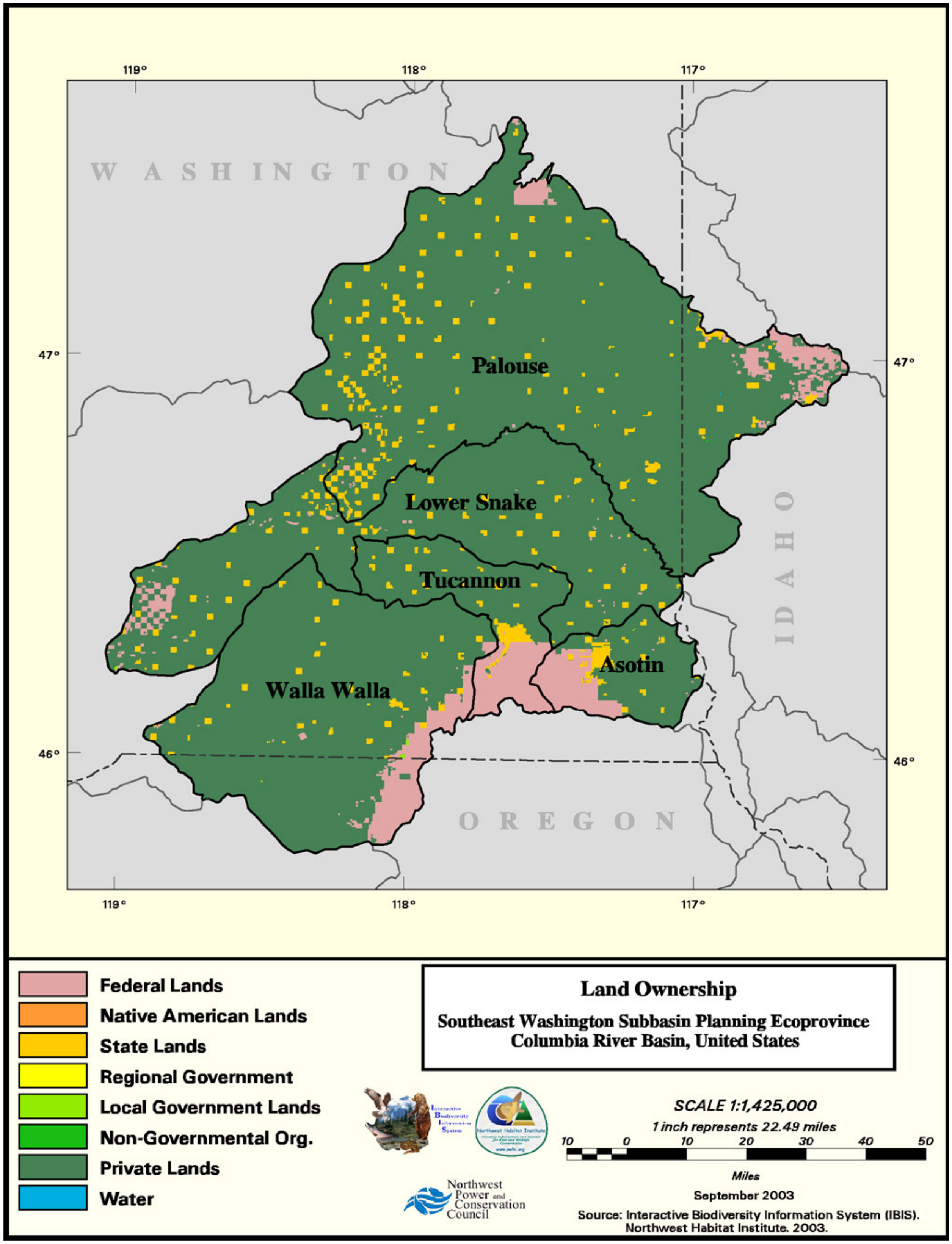

Figure 6. Land ownership of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 3. Land ownership of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Land Ownership	Subbasin					
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	Total
Federal Lands[1]	68,778	24,542	78,417	64,684	102,100	**338,521**
Native American Lands	0	0	0	0	8,500	**8,500**
State Lands[2]	79,890	35,432	19,111	16,742	16,634	**167,809**
Local Government Lands	0	139	0	31	595	**765**
NGO Lands	49	0	0	0	0	**49**
Private Lands	1,977,093	999,816	228,657	164,544	998,369	**4,368,479**
Water	31	6	0	0	0	**37**
Total	**2,125,841**	**1,059,935**	**326,185**	**246,001**	**1,126,198**	**4,884,160**

[1] Includes lands owned by the U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, and the U.S. Army Corps of Engineers.
[2] Includes lands owned by WDFW, Washington State Parks, and the Washington Department of Natural Resources.

influenced the extent and spatial pattern of landscape change, and therefore influenced wildlife population dynamics and viability. Major changes in land use between 1901 and 1930 resulted from the intensification and commercialization of agriculture. Farming remained labor-intensive and still relied heavily on human and horse power. An organized harvesting/threshing team in the 1920s required 120 men and 320 mules and horses (Williams 1991). The quest for a less labor-intensive bushel of wheat continued, but combine use lagged behind other farming areas in the United States (Williams 1991). It was only when the Idaho Harvester Company in Moscow began to manufacture a smaller machine that widespread combine harvesting became feasible (Sisk 1998). Such improvements enabled farmers to use lands previously left for grazing and as "waste," but the steepest hills and hilltops were still left as pasture for cattle and horses.

The era between 1931 and 1970 was one of continued mechanization, and especially industrialization. With the development of each new technology, farming became less labor intensive, allowing fewer people to farm larger areas. Petroleum-based technology replaced horse and most human labor early in the era. By 1970, most farm workers used motorized equipment, which removed the need for pasture lands and provided equipment that could till even the steepest slopes. Fertilizers, introduced after World War II, increased crop production by 200-400 percent (Sisk 1998). Federal agricultural programs encouraged farmers to drain seasonally wet areas, allowing farming in flood plains and seasonally saturated soils. With the advent of industrial agriculture, the last significant refugia for native communities were plowed.

Since 1970, major changes have occurred in the composition of the rural population and land use. Rural populations began to rise as more town and city residents sought rural suburban homesites. Some lands with highly erodible soils have been temporarily removed from crop production under the Conservation Reserve Program (CRP).

Instead of living in the river canyons and foraging on the prairies, people now live on the prairies, cultivate the former wild meadows, and recreate in the river canyons. Local economies are based on extraction rather than subsistence. With each advance in agricultural technology, crop production has increased and more native vegetation has been converted to field or pasture. First the draining of wetlands, then equipment that enabled farming of steep slopes, then the introduction of chemicals; each effectively shrank remaining refugia for native flora and fauna. Grazing and farming introduced new species and imposed a different set of disturbance regimes on the landscape.

A broad-scale analysis lacks the spatial resolution necessary to detect changes in the number and composition of small patches, connectivity, and other fine-grained landscape patterns. Ecoregion planners believe that the past abundance of riparian areas and the small patches of wetlands and shrubs once common in the Ecoregion are vastly underestimated. The fine-scale topography of the Ecoregion would have harbored wetlands of a size too small to be captured at the current scale. In addition, such changes were captured only over the last 90 years, 40 years after European-Americans began to settle the area.

Planners also believe small areas of brush, grass, and riparian vegetation were converted to agriculture from open shrublands and riparian areas. Most forest lands were logged, creating open forests with shrubs. Significant conversions of riparian areas to fields and pastures probably occurred between 1880 and 1940. Stringers of riparian vegetation shrank to thin, broken tendrils, and shrub vegetation virtually disappeared. The cumulative effects of such changes are enormous. Alteration in the size, quality, and connectivity of habitats may have important consequences for wildlife species (Forman and Godron 1986; Soule 1986).

Many once-intermittent streams are now farmed, many perennial streams with large wet meadows adjacent to them are now intermittent or deeply incised, and the adjacent meadows are seeded to annual crops. Clean farming practices such as field burning, herbicide use, and roadbed-to-roadbed farming leave few fences and fewer fencerows, negatively impacting even those edge species that can flourish in agricultural areas (Ratti and Scott 1991).

With the virtual elimination of native habitats, species dependent on these habitats have declined or disappeared as well. Formerly abundant sharp-tailed grouse (*Tympanchus phasianellus*) occur only in highly fragmented, marginal, and disjunct populations (Kaiser 1961; Burleigh 1972; Ratti and Scott 1991). Breeding populations of white-tailed jack rabbit (*Lepus townsendii*) and ferruginous hawk (*Buteo regalis*) have been nearly extirpated.

At the same time, new land uses offer habitats for a different suite of species (Table_4). Humans have intentionally introduced the gray partridge (*Perdix perdix*), ring-necked pheasant (*Phasianus colchicus*), and chukar (*Alectoris chukar*), species which generally fare well in agricultural landscapes. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed" (Table_5).

Conversion of agricultural lands to suburban homesites invites a second new suite of biodiversity into the Ecoregion. Suburbanization of agricultural lands does not necessarily favor native species. Rapid colonization by exotic bullfrogs (*Rana catesbeiana*) may compete with and/or eat native amphibians, including the sensitive spotted frog (*Rana pretiosa*). The brown-headed cowbird (*Molothrus ater*) and European starling (*Sturnus vulgaris*) have taken advantage of new habitats and moved into the area. The black-tailed jack rabbit (*Lepus californicus*) has largely displaced the white-tailed jack rabbit (Tisdale 1961; Johnson and Cassidy 1997).

Changes in biodiversity in the canyonlands follow a parallel track, though from slightly different causes. Due to steep slopes and infertile soils, the canyonlands have been used for grazing instead of farming (Tisdale 1986). Intense grazing and other disturbances have resulted in irreversible changes, with the native grasses being largely replaced by non-native annual brome

Table 4. Examples of changes in species composition: increasing and decreasing species since European-American settlement.

Decreasing		Increasing	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Sharp-tailed grouse	*Pedioecetes phasianellus*	Ring-necked pheasant	*Phasianus colchicus*
Black-tailed jack rabbit	*Lepus californicus*	White-tailed jack rabbit	*L. townsendii*
Mule deer	*Odocoileus hemionus*	White-tailed deer	*O. virginianus*
Ferruginous hawk	*Buteo regalis*	European starling	*Sturnus vulgaris*
Spotted frog	*Rana pretiosa*	Bullfrog	*R. catesbeiana*

Table 5. Noxious weeds in the Southeast Washington Subbasin Planning Ecoregion (Callihan and Miller 1994).

Common Name	Scientific Name	Origin
Field bindweed	*Convolvulus arvensis*	Eurasia
Buffalobur nightshade	*Solanum rostratum*	Native to the Great Plains of the U.S
Pepperweed whitetop	*Cardaria draba*	Europe
Common crupina	*Crupina vulgaris*	Eastern Mediterranean region
Jointed goatgrass	*Aegilops cylindrical*	Southern Europe and western Asia
Meadow hawkweed	*Hieracium caespitosum*	Europe
Orange hawkweed	*Hieracium aurantiacum*	Europe
Poison hemlock	*Conium maculatum*	Europe
Johnsongrass	*Sorghum halepense*	Mediterranean
White knapweed	*Centaurea diffusa*	Eurasia
Russian knapweed	*Acroptilon repens*	Southern Russia and Asia
Spotted knapweed	*Centaurea bibersteinii*	Europe
Purple loosestrife	*Lythrum salicaria*	Europe
Mat nardusgrass	*Nardus stricta*	Eastern Europe
Silverleaf nightshade	*Solanum elaeagnifolium*	Central United States
Puncturevine	*Tribulus terrestris*	Europe
Tansy ragwort	*Senecio jacobaea*	Eurasia
Rush skeletonweed	*Chondrilla juncea*	Eurasia
Wolf's milk	*Euphorbia esula*	Eurasia
Yellow starthistle	*Centaurea solstitialis*	Mediterranean and Asia
Canadian thistle	*Cirsium arvense*	Eurasia
Musk thistle	*Carduus nutans*	Eurasia
Scotch cottonthistle	*Onopordum acanthium*	Europe
Dalmatian toadflax	*Linaria dalmatica*	Mediterranean
Yellow toadflax	*Linaria vulgaris*	Europe

grasses and noxious weeds.

Breaking of the original perennial grass cover left the soil vulnerable to erosion by wind and water. Commercial farming practices exacerbated these problems. Summer fallow leaves the soils with poor surface protection during the winter; burning crop residues leaves the soil with less organic binding material; and heavier, more powerful farming equipment pulverizes the soil, leaving it more vulnerable to wind and water erosion (Kaiser 1961).

Erosion measurements and control efforts began in the early 1930s. The U.S. Department of Agriculture (USDA) (1978) estimates that 360 tons of soil have been lost from every cropland acre in the Palouse subbasin since 1939. Soil loss by water erosion in the Ecoregion was most severe in the heavily farmed areas of Whitman County (Palouse subbasin), where soil losses continue to average 14 tons/acre/year (USDA 1978).

Intensification of agriculture has affected both water quantity and quality as well. Replacing perennial grasses with annual crops resulted in more overland flow and less infiltration, which translates at a watershed level to higher peak flows that subside more quickly than in the past. The result is more intense erosion and loss of perennial prairie streams.

Changes in vegetation and settlement patterns have changed the frequency, size, and pattern of the Ecoregion’s two major disturbances: fires and floods. European-American settlers used fire to clear land for settlement and grazing. Since then, forest fires have become less common because of fire suppression, human settlement, the presence of roads which act as fire breaks, and the conversion of grass and forests to cropland (Morgan *et al.* 1996). One result of the lower fire frequency has been increased tree density on forested lands and encroachment of shrubs and trees into previously open areas. Consequently, when fires occur in forests they are more likely to result in mixed severity or stand-replacing events instead of the low severity fires of the past. Fires are still frequent in canyons, though today, fires give exotic annual grasses an edge over native species in burned areas.

Flooding on the major rivers has been curtailed in the region by large hydroelectric projects on the Columbia River. In addition to altering stream flow and channel scouring, the dams are major barriers to anadromous fish. Drain tiles placed in seasonally wet areas, removal of riparian vegetation, stream channelization, and floodplain development contribute to more severe localized flood events during winter and spring.

3.3 Protection Status

The Northwest Habitat Institute (NHI) relied on Washington State GAP Analysis data to determine how concentrations of species overlap with the occurrence of protected areas. Locations where species concentrations lie outside protected areas constitute a “gap” in the conservation protection scheme of the area. One limitation of the GAP Analysis approach is the need for accurate information on the geographic distribution of each component species. The “GAP status" is the classification scheme that describes the relative degree of management or protection of specific geographic areas for the purpose of maintaining biodiversity. The goal is to assign each mapped land unit with categories of management or protection status, ranging from 1 (highest protection for maintenance of biodiversity) to 4 (no or unknown amount of protection). Protection status categories (Scott *et al.* 1993; Crist *et al.* 1995; Edwards *et al.* 1995) are further defined below.

<u>Status 1 (High Protection)</u>: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which natural disturbance events are allowed to proceed without interference or are mimicked through management. Wilderness areas garner this status. Approximately 0.6 percent of the Ecoregion is within this category.

<u>Status 2 (Medium Protection)</u>: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of the existing natural state. An estimated 0.8 percent of the lands within the Ecoregion are in this category.

<u>Status 3 (Low Protection)</u>: An area having permanent protection from conversion of natural land cover for the majority of the area, but subjected to uses of either a broad, low intensity type or

localized intense type. It also confers protection to federally listed endangered and threatened species throughout the area. Lands owned by WDFW fall within medium and low protection status categories. Ten percent of the lands within the Ecoregion are in this category.

Status 4 (No or Unknown Protection): Lack of irrevocable easement or mandate to prevent conversion of natural habitat types to anthropogenic habitat types and allow for intensive use throughout the tract, or existence of such activity is unknown. This category includes the majority (88 percent) of the land base within the Ecoregion.

The protection status and amount of land within each subbasin are described in Table 6 and illustrated in Figure 7. Protection status by ownership at the 6th level hydrologic unit code (HUC) is shown in Figure 8.

Table 6. Protection status of lands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Subbasin	Palouse (Acres)	Lower Snake (Acres)	Tucannon (Acres)	Asotin (Acres)	Walla Walla (Acres)	Total (Ecoregion)
Status 1: High Protection	49	7,383	13,793	0	8,211	**29,436**
Status 2: Medium Protection	15,014	8,443	10,298	4,976	8,500	**47,231**
Status 3: Low Protection	159,032	61,194	77,157	80,690	124,645	**502,718**
Status 4: No Protection	1,951,648	982,905	224,938	160,334	993,342	**4,313,167**
Total(Subbasin)	**2,125,841**	**1,059,935**	**326,185**	**246,001**	**1,126,198**	**4,892,552**

3.4 Ecoregion Conservation Assessment Priorities and Public Land Ownership

Together with TNC, WDFW identified and prioritized critical wildlife habitats throughout eastern Washington using the ECA process. The primary distinction between ECA classes in the wildlife assessment is the amount of risk potential associated with wildlife habitats. Ecoregion and subbasin planners used this relatively new "tool," in conjunction with EDT, and NHI data, to identify critical fish and wildlife habitats and needs throughout the Ecoregion and to develop strategies to address Ecoregion/subbasin limiting factors and management goals (for further information on ECA, see Appendix A). Ecoregional Conservation Assessment classifications include:

- Class 1: Key habitats in private ownership (high risk potential)
- Class 2: Key habitats on public lands (low to medium risk, depending on ownership)
- Class 3: Unclassified/unspecified land elements (agricultural lands)

An integral part of any land protection or prioritization process is to identify those lands already under public ownership and, thus, likely afforded some protection. The ECA land classes and publicly owned lands are illustrated in Figure 9. When compared with the GAP management-protection status of lands within the Ecoregion (Figure 7), most overlap occurs in the Blue Mountains region (Asotin, Tucannon, and Walla Walla subbasins) and in the area of the Turnbull Wildlife Refuge at the northern edge of the Palouse subbasin. Ecoregional Conservation Assessment Class 1 lands have also been identified along the Snake River and in the Palouse subbasin.

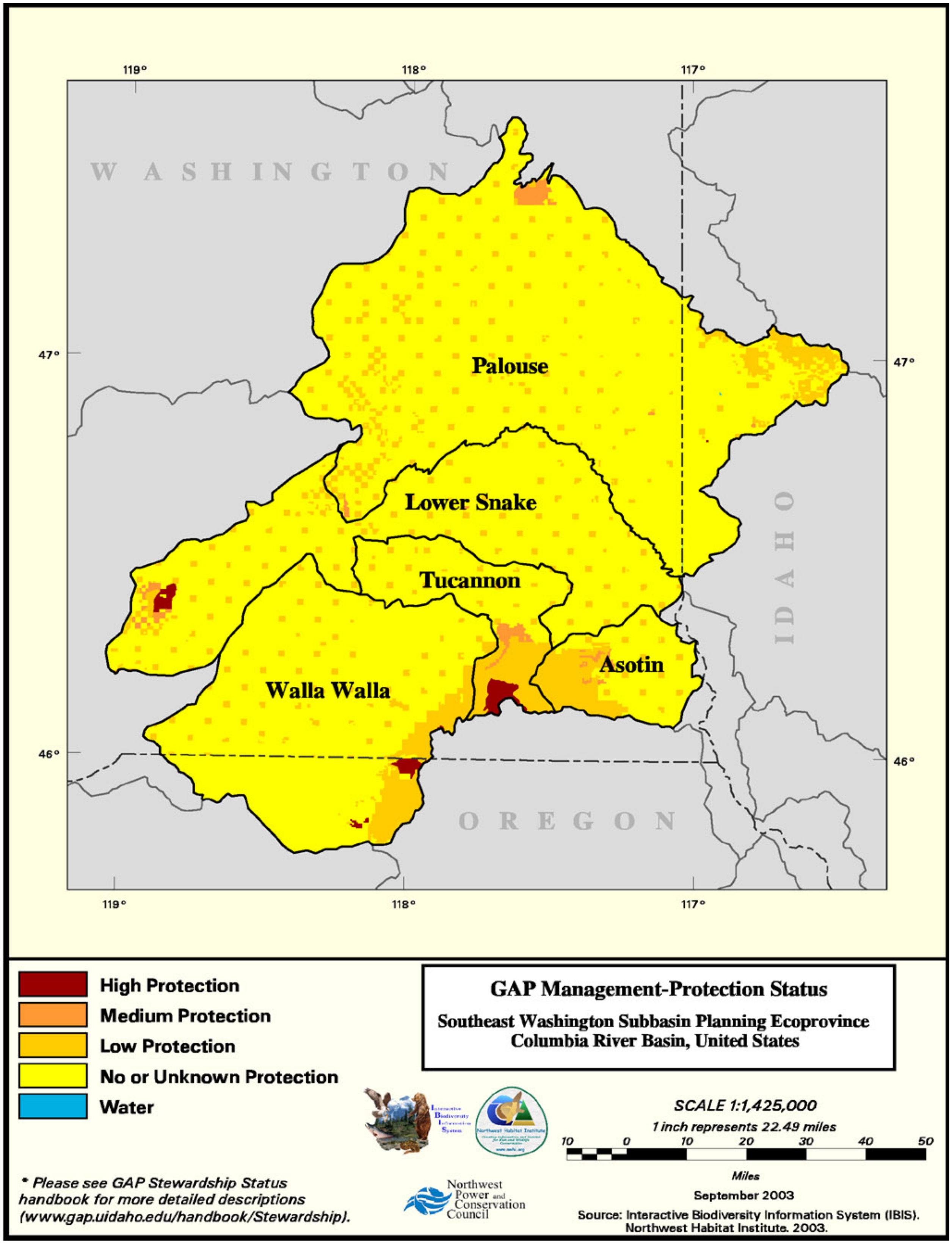

Figure 7. GAP management-protection status of lands within the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

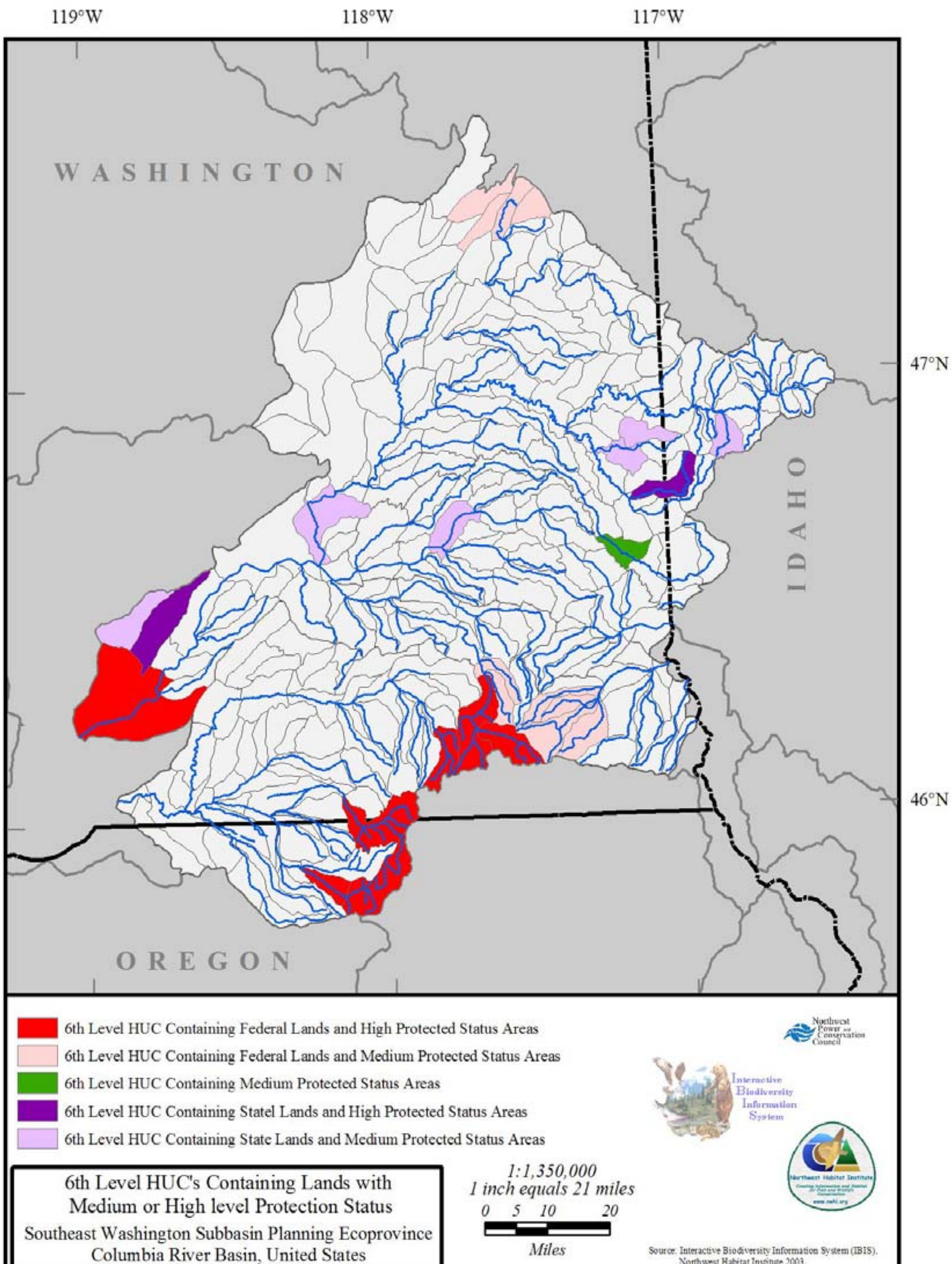

Figure 8. Protection status of lands at the 6th - level HUC within the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

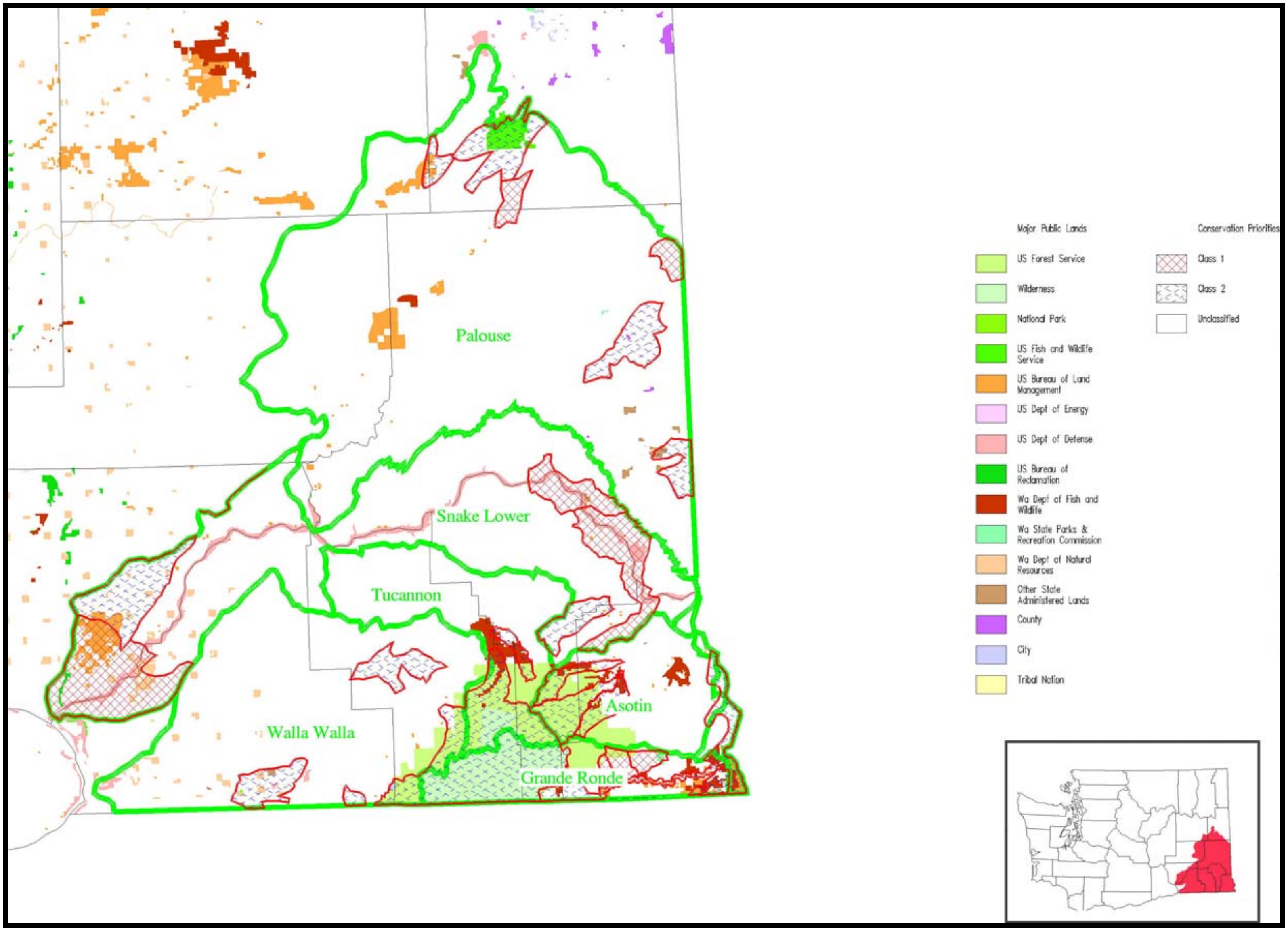

Figure 9. ECA and publicly owned lands in the Southeast Washington Subbasin Planning Ecoregion (WDFW 2004).

4.0 Ecological Features

4.1 Vegetation

Ecoregion rare plant information, wildlife habitat descriptions, and changes in habitat distribution, abundance and condition are summarized in the following sections. Landscape level vegetation information is derived from the Washington GAP Analysis Project (Cassidy 1997) and NHI data (2003).

4.1.1 Rare Plant Communities

The Ecoregion contains several rare plant communities and ecosystems, the approximate locations of which are illustrated in Figure_10.

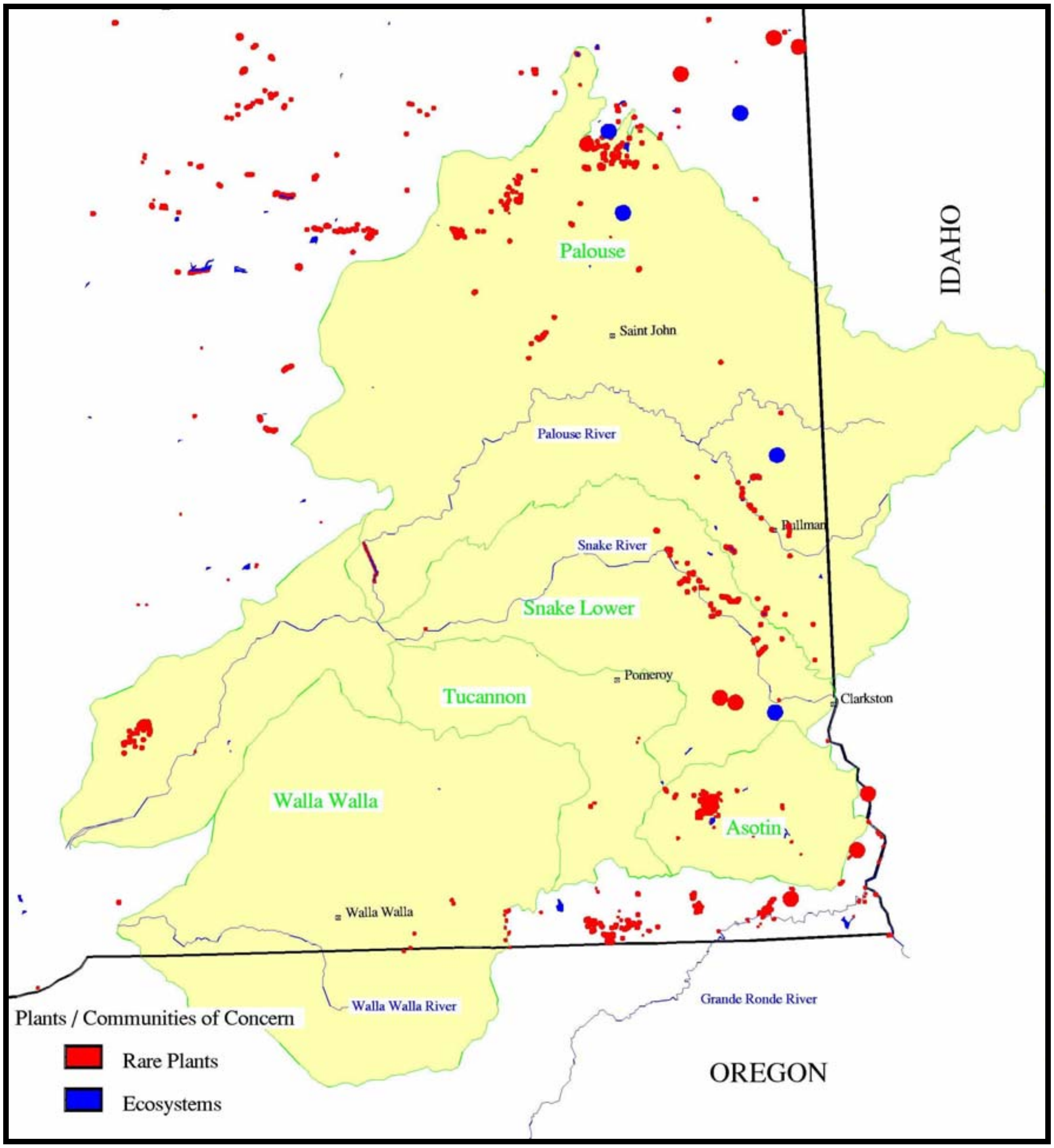

Figure 10. Rare plant/community occurrence in the Southeast Washington Subbasin Planning Ecoregion (WNHP 2003).

Approximately 29 percent of the rare plant communities are associated with grassland habitat, 19 percent with shrubsteppe habitat, 23 percent with upland forest habitat, and 29 percent with riparian wetland habitat. See Table D-1 for a detailed list of known rare plant occurrences and Table D-2 for a list of rare plant communities in the Ecoregion.

4.1.2 Wildlife Habitats

The Ecoregion consists of sixteen wildlife habitat types, which are briefly described in Table 7. Detailed descriptions of these habitat types can be found in Appendix B. Historic and current wildlife habitat distribution are illustrated in Figure 11 and Figure 12.

Table 7. Wildlife habitat types within the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack; several species of conifer; understory typically shrub-
Eastside (Interior) Mixed Conifer Forest	Coniferous forests and woodlands; Douglas-fir commonly present, up to 8 other conifer species present; understory shrub and grass/forb
Lodgepole Pine Forest and Woodlands	Lodgepole pine dominated woodlands and forests; understory various; mid- to high elevations.
Ponderosa Pine and Interior White Oak Forest and	Ponderosa pine dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass understory; lower elevation forest
Upland Aspen Forest	Quaking aspen (Populus tremuloides) is the characteristic and dominant tree in this habitat.
Subalpine Parkland	Whitebark pine (P. albicaulis) is found primarily in the eastern Cascade mountains Okanogan Highlands, and Blue Mountains.
Alpine Grasslands and Shrubland	Grassland, dwarf-shrubland, or forb dominated, occasionally with patches of dwarfed trees.
Interior Canyon Shrublands	Chokecherry, oceanspray, and Rocky Mtn. maple with shrubs and grasses dominated the understory.
Eastside (Interior) Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogam crust.
Shrubsteppe	Sagebrush and/or bitterbrush dominated; bunchgrass understory with forbs, cryptogam crust.
Agriculture, Pasture, and Mixed Environs	Cropland, orchards, vineyards, nurseries, pastures, and grasslands modified by heavy grazing; associated structures.
Urban and Mixed Environs	High, medium, and low (10-29 percent impervious ground) density development.
Lakes, Rivers, Ponds, and Reservoirs	Natural and human-made open water habitats.
Herbaceous Wetlands	Emergent herbaceous wetlands with grasses, sedges, bulrushes, or forbs; aquatic beds with pondweeds, pond lily, other aquatic plants
Montane Coniferous Wetlands	Forest or woodland dominated by evergreen conifers; deciduous trees may be co-dominant; understory dominated by shrubs, forbs, or
Eastside (Interior) Riparian Wetlands	Shrublands, woodlands and forest, less commonly grasslands; often multilayered canopy with shrubs, graminoids, forbs below.

Dramatic changes in wildlife habitat have occurred throughout the Ecoregion since pre-European settlement (circa 1850). The most significant habitat change throughout the Ecoregion is the loss of once abundant grasslands (Palouse prairie) (Figure 10 and Figure 11).

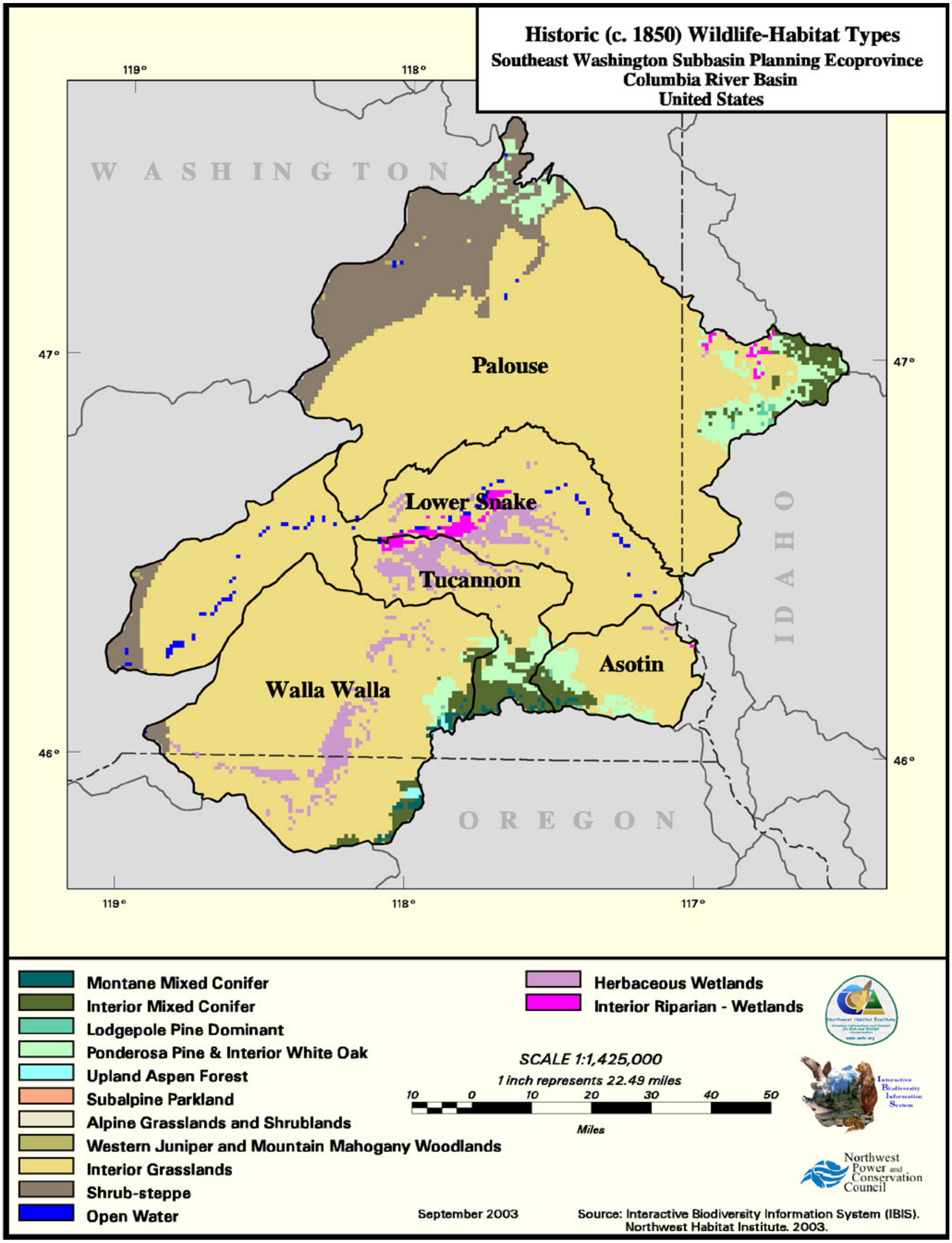

Figure 11. Historic wildlife habitat types of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

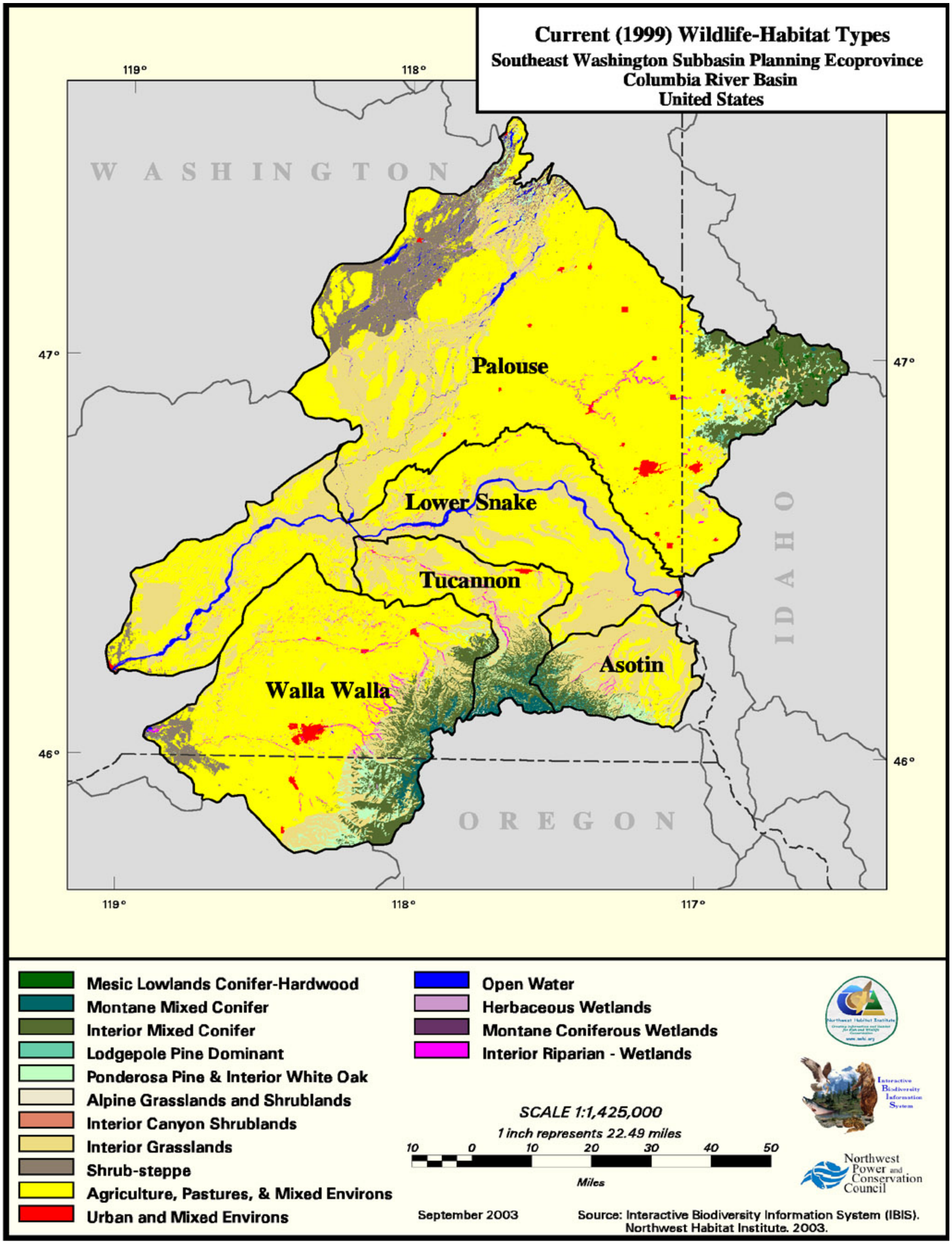

Figure 12. Current wildlife habitat types of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Quantitative and distribution changes in Ecoregion wildlife habitat types are further described in Table_8 and the maps illustrating these changes are included in Appendix_C. The protection status of all Ecoregion habitat types is shown in Table_9.

4.1.3 Focal Wildlife Habitat Selection and Rationale

To ensure that species dependent on given habitats remain viable, Haufler (2002) advocated comparing the current availability of the habitat against its historic availability. For more information on historic and current focal wildlife habitat availability, see Table_16 and section 4.1.6. According to Haufler, this ”coarse filter” habitat assessment can be used to quickly evaluate the relative status of a given habitat and its suite of obligate species. Haufler also advocated combining the coarse filter habitat analysis with a single species or “fine filter” analysis of one or more obligate species to further ensure that species viability for the suite of species is maintained. For a more detailed discussion of focal species selection and analysis, see section 5.1.

The following four key principles were used to guide selection of focal habitats (see Figure_13 for an illustration of the focal habitat/species selection process):

- Focal habitats were identified by WDFW at the Ecoregion level and reviewed and modified at the subbasin level.
- Focal habitats can be used to evaluate ecosystem health and establish management priorities at the Ecoregion level (course filter).
- Focal wildlife species/guilds can be used to represent focal habitats and to infer or measure response to changing habitat conditions at the subbasin level (fine filter).
- Focal wildlife species/guilds were selected at the subbasin level. To identify focal macro habitat types within the Ecoregion, Ecoregion planners used the assessment tools to develop a habitat selection matrix based on various criteria, including ecological, spatial, and cultural factors. As a result, subbasin planners selected four focal wildlife habitat types of the sixteen that occur within the Ecoregion (Table_10). Ecoregion focal habitats include ponderosa pine, shrubsteppe, eastside (interior) grasslands, and eastside (interior) riparian wetlands. For an illustration of where the focal wildlife habitat types occur in the Ecoregion, see Figure_14.

4.1.3.1 Focal Habitats Selection Justification

4.1.3.1.1 Ponderosa pine

The justification for ponderosa pine *(Pinus ponderosa)* as a focal habitat is the extensive loss and degradation of forests characteristic of this type, and the fact that several highly associated bird species have declining populations and are species of concern. In an analysis of source habitats for terrestrial vertebrates in the Interior Columbia Basin, declines of ponderosa pine forest are among the most widespread among habitat types (Wisdom *et al.* in press). In addition to the overall loss of this forest type, two features, snags and old-forest conditions, have diminished appreciably and resulted in declines of bird species associated with these features (Hillis *et al.* 2001). When compared with other eastside forest habitats, the ponderosa pine habitat type supports the highest number of vertebrate wildlife species (Table_11).

4.1.3.1.2 Shrubsteppe

Shrubsteppe was selected as a focal habitat because changes in land use over the past century have resulted in the loss of over half of Washington's shrubsteppe habitat (Dobler *et al.* 1996). Shrubsteppe communities support a wide diversity of wildlife. The loss of once extensive shrubsteppe communities has reduced substantially the habitat available to a wide range of shrubsteppe-associated wildlife species, including several birds found only in this community type (Quigley and Arbelbide 1997; Saab and Rich 1997). More than 100 bird species forage and

Table 8. Changes in wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion from circa 1850 (historic) to 1999 (current) (NHI 2003).

Subbasin	Status	Montane Mixed Conifer Forest	Interior Mixed Conifer Forest	Lodgepole Pine Forest & Woodlands	Ponderosa Pine	Upland Aspen Forest	Subalpine Parkland	Alpine Grasslands and Shrublands	Interior Canyon Shrublands	Eastside (Interior) Grasslands	Shrubsteppe	Agriculture, Pasture, and Mixed Environs	Urban and Mixed Environs	Lakes, Rivers, Ponds, and Reservoirs	Herbaceous Wetlands	Montane Coniferous Wetlands	Eastside (Interior) Riparian Wetlands
Palouse	Historic	0	0	4,699	**120,947**	0	0	0	0	**1,575,027**	**371,497**	0	0	2,226	495	0	**34,886**
	Current	5,738	329	2,866	**48,343**	0	0	273	0	**356,638**	**159,305**	1,351,525	14,277	18,289	21,385	11,476	**7,923**
	Change (acres)	+5,738	+329	-1,834	**-72,604**	0	0	+273	0	**-1,218,389**	**-212,192**	+1,351,525	+14,277	+16,063	+20,890	+11,476	**26,963**
	Change (percent)	999	999	-39	**-60**	0	0	999	999	**-77**	**-57**	999	999	+721	+4,223	999	**-77**
Lower Snake	Historic	0	0	0	**492**	0	0	0	0	**939,785**	**32,007**	0	0	21,913	42,348	0	**21,833**
	Current	0	52	0	**1,014**	0	0	0	95	**416,207**	**6,505**	596,268	1,609	34,652	352	0	**3,181**
	Change (acres)	0	+52	0	**+521**	0	0	0	+95	**-523,578**	**-25,502**	+596,268	+1,609	+12,740	-41,996	0	**18,652**
	Change (percent)	0	999	0	**+106**	0	0	0	999	**-56**	**-80**	999	999	+58	-99	0	**-85**
Tucannon	Historic	5,428	43,919	0	**32,322**	0	247	0	0	**188,013**	**0**	0	0	247	51,074	0	**7,881**
	Current	20,395	41,085	1,128	**9,918**	0	0	1,036	175	**114,263**	**0**	132,246	1,174	93	154	9	**4,512**
	Change (acres)	+14,967	-2,834	1,128	**-22,404**	0	-247	+1,036	+175	**-73,750**	**0**	+132,246	+1,174	-154	-50,920	+9	**-3,369**
	Change (percent)	+73	-6	999	**-69**	0	-100	999	999	**-40**	**0**	999	999	-62	-99	999	**-43**
Asotin	Historic	1,479	20,705	1,479	**34,756**	0	0	0	0	**185,363**	**0**	0	0	0	1,972	0	**6,096**
	Current	6,093	27,921	2,902	**14,997**	0	0	0	311	**134,789**	**0**	57,040	86	10	28	137	**1,687**
	Change (acres)	+4,614	+7,216	+1,423	**-19,758**	0	0	0	+311	**-50,575**	**0**	+57,040	+86	+10	-1,944	+137	**-4,409**
	Change (percent)	+76	+26	+51	**-57**	0	0	0	999	**-27**	**0**	999	999	999	-99	999	**-72**
Walla Walla	Historic	13,351	43,515	742	**23,241**	5,934	0	247	0	**962,275**	**6,676**	0	0	0	70,217	0	**22,283**
	Current	22,003	120,484	0	**49,904**	0	0	872	544	**154,619**	**29,252**	719,877	11,473	768	1,135	51	**15,217**
	Change (acres)	+8,652	+76,969	-742	**+26,663**	-5,934	0	+625	+544	**-807,656**	**+22,576**	+719,877	+11,473	+768	-68,083	+51	**-7,066**
	Change (percent)	+65	+177	-100	**+115**	-100	0	+253	999	**-84**	**+338**	999	999	999	-98	999	**-32**

Note: Values of 999 indicate a positive change from historically 0 (habitat not present or not mapped in historic data). NHI (2003) eastside (interior) riparian wetland data are inaccurate, so StreamNet data (2003) were used.

Table 9. GAP protection status of wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Subbasin	GAP Status	Mesic Lowland Conifer-Hardwood Forest	Montane Mixed Conifer Forest	Interior Mixed Conifer Forest	Lodgepole Pine Forest & Woodlands	Ponderosa Pine	Alpine Grasslands and Shrublands	Interior Canyon Shrublands	Eastside (Interior) Grasslands	Shrubsteppe	Agriculture, Pasture, and Mixed Environs	Urban and Mixed Environs	Lakes, Rivers, Ponds, and Reservoirs	Herbaceous Wetlands	Montane Coniferous Wetlands	Eastside (Interior) Riparian Wetlands
Palouse	High Protection	0	0	3	0	**19**	0	0	**0**	**0**	27	0	0	0	0	**0**
	Medium Protection	0	0	203	0	**3,137**	0	0	**7,057**	**0**	994	0	982	151	2,472	**18**
	Low Protection	3,061	294	51,633	1,273	**6,481**	81	0	**42,150**	**13,681**	37,374	0	983	1,267	523	**232**
	No Protection	2,671	35	75,656	1,598	**38,674**	192	0	**307,430**	**145,630**	1,313,037	14,274	16,335	19,969	8,479	**7,672**
Lower Snake	High Protection	0	0	0	0	**0**	0	0	**7,379**	**0**	4	0	0	0	0	**0**
	Medium Protection	0	0	0	0	**0**	0	0	**7,910**	**198**	186	17	128	0	0	**2**
	Low Protection	0	0	39	0	**59**	0	29	**34,148**	**930**	25,678	6	104	51	0	**151**
	No Protection	0	0	17	0	**956**	0	66	**366,767**	**5,381**	570,391	1,586	34,417	300	0	**3,025**
Tucannon	High Protection	0	6,431	5,295	0	**771**	290	0	**1,005**	**0**	0	0	0	0	0	**0**
	Medium Protection	0	0	1,886	0	**1,013**	0	0	**6,617**	**0**	26	0	35	6	9	**707**
	Low Protection	0	13,888	31,461	1,129	**6,971**	720	7	**17,692**	**0**	4,983	116	0	11	0	**179**
	No Protection	0	0	2,499	0	**1,185**	0	168	**88,970**	**0**	127,232	1,061	57	138	0	**3,629**
Asotin	High Protection	0	0	0	0	**0**	0	0	**0**	**0**	0	0	0	0	0	**0**
	Medium Protection	0	0	23	0	**212**	0	34	**4,464**	**0**	28	0	0	0	4	**210**
	Low Protection	0	6,100	26,098	2,897	**6,512**	0	166	**35,195**	**0**	3,172	0	0	0	16	**534**
	No Protection	0	0	1,770	0	**8,332**	0	110	**95,170**	**0**	53,763	84	10	28	117	**950**
Walla Walla	High Protection	0	2,148	4,005	0	**544**	37	0	**1,478**	**0**	0	0	0	0	0	**8,211**
	Medium Protection	0	0	0	0	**0**	0	0	**0**	**0**	0	0	0	0	0	**8,500**
	Low Protection	0	19,071	54,301	0	**11,229**	835	49	**16,457**	**1,555**	20,567	141	0	19	0	**124,645**
	No Protection	0	785	62,185	0	**38,130**	0	495	**136,674**	**27,691**	699,316	11,333	768	1,115	51	**993,342**

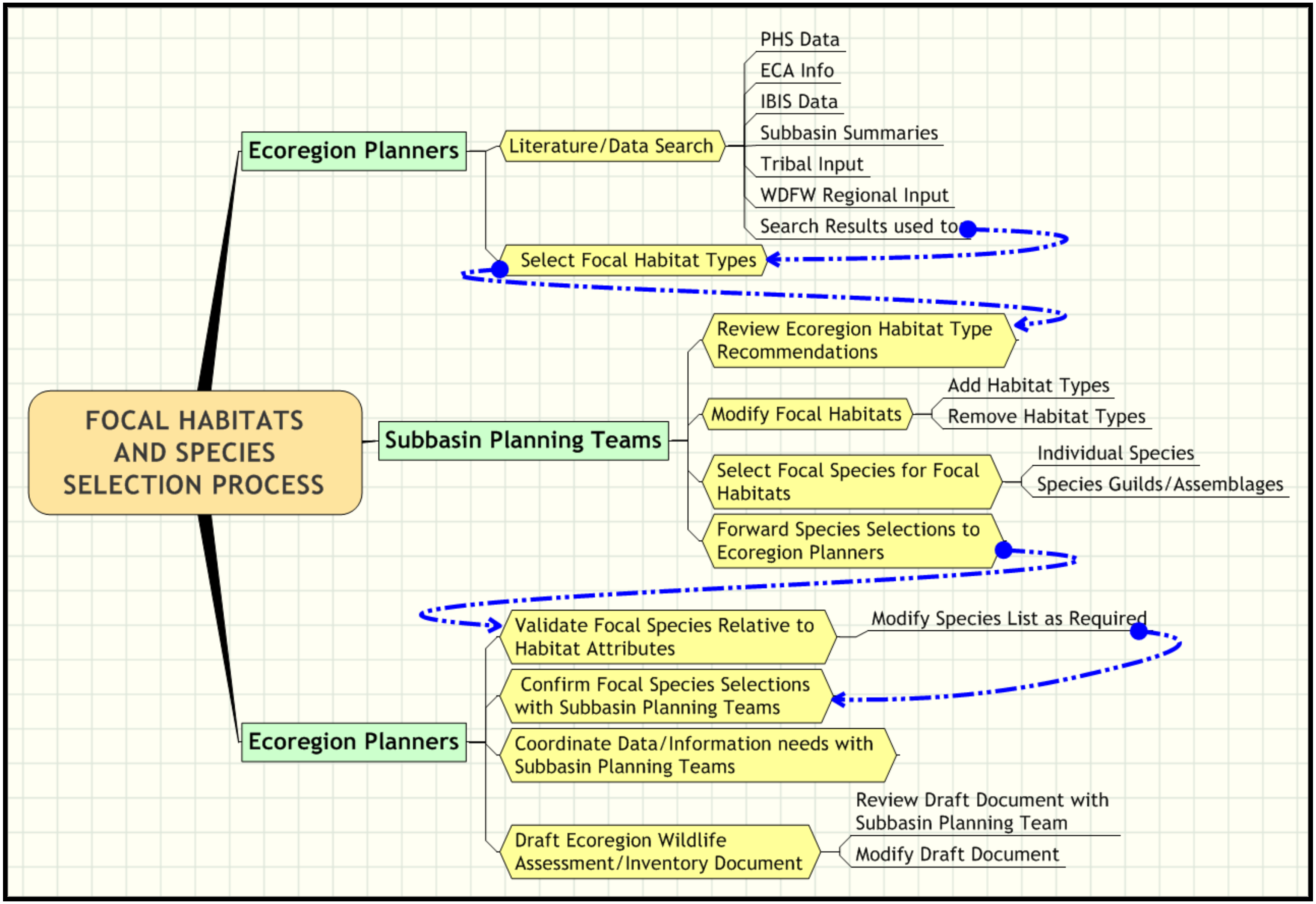

Figure 13. Focal habitat and species selection process..

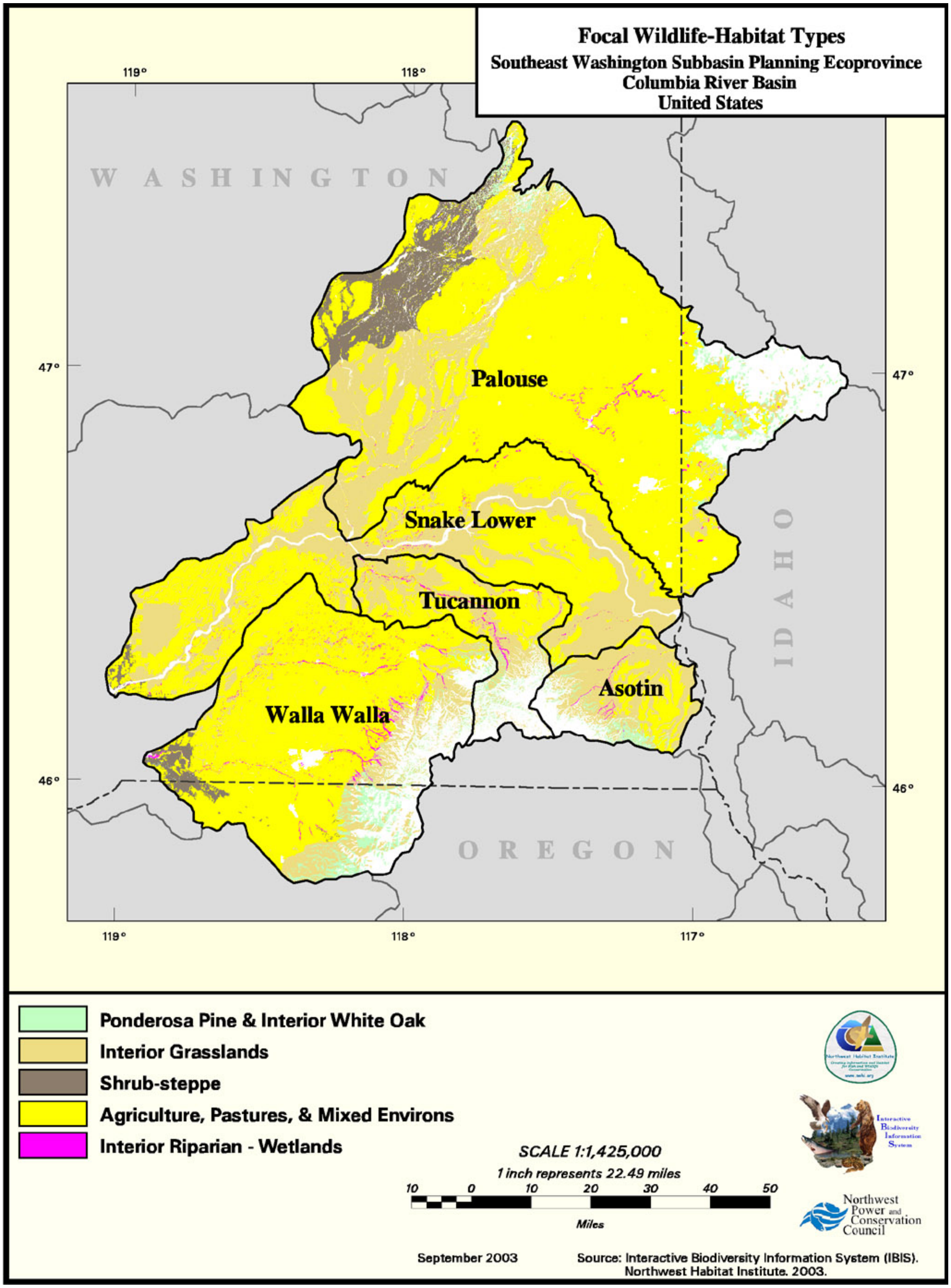

Figure 14. Focal wildlife habitat types of the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 10. Focal habitat selection matrix for the Southeast Washington Subbasin Planning Ecoregion.

Habitat Type	Criteria						
	PHS Data	**ECA Data**	**NHI Data**	**Culturally significant**	**Present in all subbasins**	**Listed in Subbasin Summaries**	**Historically present in macro quantities[1]**
Ponderosa pine	No	No	Yes	Yes	Yes	Yes	No
Shrubsteppe	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastside (Interior) Grasslands	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastside (Interior) Riparian Wetlands	Yes	Yes	Yes	Yes	Yes	Yes	No
Agriculture[2]	No	No	Yes	No	Yes	Yes	No

[1] Habitat types historically comprising more than 5 percent of the Ecoregion land base. This does not diminish the importance of various micro habitats.
[2] Agriculture is not a focal habitat; it is a habitat of concern. Because agricultural habitat is a result of the conversion of other native wildlife habitat types, planners chose to discuss agricultural land use within the text rather than prioritizing it as a focal wildlife habitat type. Therefore, specific focal species were not selected to represent this habitat type.

Table 11. Number of vertebrate wildlife species known to occur in eastside forest and woodland habitats in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Taxonomic Class	Ponderosa Pine	Mixed Conifer	Lodgepole Pine	Upland Aspen
Amphibians	13	12	9	4
Reptiles	21	11	12	5
Birds	131	116	83	77
Small Mammals	31	43	26	24
Bats	15	11	9	5
Carnivores	14	18	13	10
Ungulates	7	9	8	5
All Species	**232**	**220**	**160**	**130**

nest in sagebrush communities, and at least four of them (sage grouse, sage thrasher, sage sparrow, and Brewer's sparrow) are shrubsteppe obligates, or almost entirely dependent upon sagebrush (Braun *et al.* 1976). In a recent analysis of birds at risk within the interior Columbia Basin, the majority of species identified as high management concern were shrubsteppe species (Vander Haegen *et al.* 1999). Moreover, over half these species have experienced long-term population declines according to the Breeding Bird Survey (Saab and Rich 1997).

4.1.3.1.3 Eastside (Interior) Grasslands

Eastside (interior) grasslands were selected as a focal habitat type because land use practices in the past 100 years have reduced this habitat type by 97 percent, significantly impacting grassland dependent species such as sharp-tailed grouse (NHI 2003). Of the once continuous native prairie dominated by mid-length perennial grasses, little more than 1 percent of the Palouse grasslands remain. It is one of the most endangered ecosystems in the United States (Noss *et al.* 1995), and all other remaining parcels of native prairie are subject to weed invasions and occasional drifts of aerially applied agricultural chemicals.

4.1.3.1.4 Eastside (Interior) Riparian Wetlands

Riparian wetlands was selected as a focal habitat because its protection, compared to other habitat types, may yield the greatest gains for fish and wildlife while involving the least amount of area (Knutson and Naef 1997). Riparian habitat:

- covers a relatively small area, yet it supports a higher diversity and abundance of fish and wildlife than any other habitat type;
- provides important fish and wildlife breeding habitat, seasonal ranges, and movement corridors;
- is highly vulnerable to alteration; and
- has important social values, including water purification, flood control, recreation, and aesthetics.

4.1.4 Habitats of Concern

4.1.4.1 Agriculture

Agriculture is the dominant land use throughout the Ecoregion and is a result of the conversion of other native wildlife habitat types. Therefore, this assessment treats agriculture in that context rather than as a focal wildlife habitat.

4.1.5 Protection Status of Focal Wildlife Habitats

The protection status of focal wildlife habitats is depicted in Table 12 through Table 15. With the exception of CRP lands, which could be classified as having low protection status in some cases, agricultural lands have no protection. Therefore, the table for the agriculture was omitted.

Less than five percent of the remaining ponderosa pine habitat is in the high and medium protection categories. Similarly, approximately 2.6 percent of the remaining shrubsteppe is in the high and medium protection classes. Less than three percent of the remaining interior grasslands is afforded high and medium protection status, while only 2.8 percent of riparian wetland habitat is classified as having high or medium protection status. Clearly, the vast majority of these focal wildlife habitats has either low protection or no protection and is therefore subject to further degradation and/or conversion to other uses. Further habitat loss and degradation will negatively impact habitat dependant obligate wildlife species.

Table 12. Protection status of ponderosa pine habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Status: Ponderosa Pine	Subbasin					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	19	0	771	0	544	**1,334**
Medium Protection	3,137	0	1,013	212	0	**4,362**
Low Protection	6,481	59	6,971	6,512	11,229	**31,252**
No Protection	38,674	956	1,185	8,332	38,130	**87,277**
TOTAL (Subbasin)	**48,311**	**1,015**	**9,940**	**15,056**	**49,903**	**124,225**

Table 13. Protection status of shrubsteppe habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Status: Shrubsteppe	Subbasin					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	0	0	0	0	**0**
Medium Protection	0	198	0	0	0	**198**
Low Protection	13,681	930	0	0	1,555	**16,166**
No Protection	145,630	5,381	0	0	27,691	**178,702**
TOTAL (Subbasin)	**159,311**	**6,509**	**0**	**0**	**29,246**	**195,066**

Table 14. Protection status of eastside (interior) grassland habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Status: Eastside (Interior) Grasslands	Subbasin					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	7,379	1,005	0	1,478	**9,862**
Medium Protection	7,057	7,910	6,617	4,464	0	**26,048**
Low Protection	42,150	34,148	17,692	35,195	16,457	**145,642**
No Protection	307,430	366,767	88,970	95,170	136,674	**995,011**
TOTAL (Subbasin)	**356,637**	**416,204**	**114,284**	**134,829**	**154,609**	**1,176,563**

Table 15. Protection status of eastside (interior) riparian wetland habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Status: Eastside (Interior) Riparian Wetlands	Subbasin					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	0	0	0	0	**0**
Medium Protection	18	2	707	210	0	**937**
Low Protection	232	151	179	534	421	**1,517**
No Protection	7,672	3,025	3,629	950	14,799	**30,075**
TOTAL (Subbasin	**7,922**	**3,178**	**4,516**	**1,695**	**15,220**	**32,529**

4.1.6 Changes in Focal Wildlife Habitat Quantity and Distribution

Changes in focal habitat quantity at the Ecoregion level are depicted in Table 16. Forest succession, logging, and development account for 41 percent of the total change (loss) in ponderosa pine habitat (NHI 2003). Similarly, agricultural conversion accounts for a 69 percent decline in eastside (interior) grassland habitat (NHI 2003). The NHI data further suggest that shrubsteppe habitat has also decreased by 52 percent, likely as a result of conversion to agriculture and disturbance factors, including livestock grazing (Daubenmire 1970). Focal wildlife habitats at the subbasin level have experienced similar changes and are included in ‹**bold**› in Table 8. Maps comparing changes for all historic habitats are located in Appendix C.

The NHI riparian habitat data are incomplete. Therefore, riparian wetland habitat is not well represented on NHI maps. Accurate habitat type maps, especially those detailing riparian wetland habitats, are needed to improve assessment quality and support management strategies and actions. Ecoregion wildlife managers, however, believe that significant physical and functional losses have occurred to these important riparian habitats from hydroelectric facility construction and inundation, agricultural development, and livestock grazing.

Table 16. Changes in focal wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion from circa 1850 (historic) to 1999 (current) (NHI 2003; StreamNet 2003).

Focal Habitat Type	Historic (Acres)	Current (Acres)	Change (Acres)	Change (%)
Ponderosa Pine	211,758	124,176	-87,582	-41
Shrubsteppe	410,180	195,062	-215,118	-52
Eastside (Interior) Grassland	3,850,463	1,176,516	-2,673,947	-69
Eastside (Interior) Riparian Wetlands*	90,033	32,518	-57,515	-64
Total	**4,562,434**	**1,528,272**	**-3,034,162**	**-66**
Agriculture	0	2,856,956	+2,856,956	+100

* The margin of error for NHI riparian wetland acreage is substantial, therefore Streamnet data were used.

4.1.7 Conditions of Focal Wildlife Habitats

This section contains historic information, current conditions, and recommended future conditions for each focal habitat. Historic descriptions are derived primarily from Washington GAP data and, to a lesser extent, Daubenmire (1970), Daubenmire and Daubenmire (1968), NHI (2003), and other contributors. The ponderosa pine, shrubsteppe, and interior grassland focal wildlife habitat types have been subdivided into vegetation zones where possible. Riparian wetland habitat was not subdivided due to minimal information pertaining to this habitat type.

The purpose of delineating vegetation zones within broader habitat types is to use vegetation zones as a fine filter assessment tool in order to aid subbasin planners in identifying and prioritizing critical habitat protection and restoration needs, and develop strategies to protect and enhance wildlife populations within the Ecoregion.

For example, general Ecoregion/subbasin strategies, goals, and objectives could be developed, in part, based on focal habitats. These strategies, goals, and objectives could be further refined, and/or areas needing protection and enhancement could be identified and prioritized by comparing the overlap between vegetation zones, ECA, EDT, and NHI data.

4.1.7.1 Ponderosa pine

4.1.7.1.1 Historic

Prior to 1850, ponderosa pine habitat was open and park-like with relatively few undergrowth trees. The ponderosa pine ecosystem has been heavily altered by past forest management. Specifically, the removal of overstory ponderosa pine since the early 1900s and nearly a century of fire suppression have led to the replacement of most old-growth ponderosa pine forests by younger forests with a greater proportion of Douglas-fir (*Pseudotsuga menziesii*) than ponderosa pine (Habeck 1990). Fire scar evidence in the northern Rocky Mountains indicates that ponderosa pine forests burned approximately every 1-30 years prior to fire suppression, preventing contiguous understory development and, thus, maintaining relatively open ponderosa pine stands (Arno 1988; Habeck 1990).

The 1930s-era timber inventory data (Losensky 1993) suggest large diameter ponderosa pine-dominated forests occurred in very large stands, encompassing large landscapes. Such large stands were fairly homogeneous at the landscape scale, but were relatively heterogeneous at a small scale, with "patchy" tree spacing, and multi-age trees (Hillis *et al.* 2001).
Clear cut logging and subsequent reforestation have converted many older stands of ponderosa pine/Douglas-fir forest to young, structurally simple ponderosa pine stands (Wright and Bailey 1982). Changes in the distribution of ponderosa pine habitat from circa 1850 (historic) to 1999 (current) are illustrated in Figure_15 and Figure_16.

4.1.7.1.2 Current

General:
The ponderosa pine zone covers 3.7 million acres in Washington and is one of the most widespread zones of the western states. This dry forest zone between unforested steppe and higher elevation, closed forests corresponds to Merriam's Arid Transition zone.

Ponderosa pine forms climax stands that border grasslands and is also a common member in many other forested communities (Steele *et al.* 1981). Ponderosa pine is a drought tolerant tree that usually occupies the transition zone between grassland and forest. Climax stands are characteristically warm and dry, and occupy lower elevations throughout their range. Key understory associates in climax stands typically include grasses such as bluebunch wheatgrass *(Pseudoroegneria spicata)* and Idaho fescue *(Festuca idahoensis),* and shrubs such as bitterbrush *(Purshia tridentata)* and common snowberry *(Symphoricarpus albus)*. Ponderosa pine associations can be separated into three shrub-dominated and three grass-dominated habitat types. Four community types are associated with ponderosa pine (Cooper *et al.* 1991):

1. *Physocarpus malvaceus* (ninebark; limited; northeast to northwest aspects)
2. *Symphoricarpos albus* (common snowberry; sporadic from Coeur d'Alene south along western forest edge in northern Idaho
3. *Festuca ovina ingrata* (Idaho fescue; most prevalent along Clearwater, Snake, and Salmon River drainages)
4. *Pseudoroegneria spicatum* (bluebunch wheatgrass; steep south-facing slopes overlooking the Snake and Salmon Rivers)

Daubenmire and Daubenmire (1984) recognize two more habitat types within the *P. ponderosa* series:
1. *Stipa comata* (needlegrass)
2. *Purshia tridentata* (bitterbrush)

Ponderosa pine has many fire resistant characteristics. Seedlings and saplings are often able to withstand fire. Pole-sized and larger trees are protected from the high temperatures of fire by thick, insulative bark, and meristems are protected by the surrounding needles and bud scales. Other aspects of the pine's growth patterns help in temperature resistance. Lower branches fall off the trunk of the tree, and fire caused by the fuels in the understory will usually not reach the upper branches. Ponderosa pine is more vulnerable to fire at more mesic sites where other conifers such as Douglas-fir, and grand fir (*Abies grandis*) form dense understories that can carry fire upward to the overstory. Ponderosa pine seedlings germinate more rapidly when a fire has cleared the grass and the forest floor of litter, leaving only mineral rich soil. (Fischer and Bradley 1987).

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

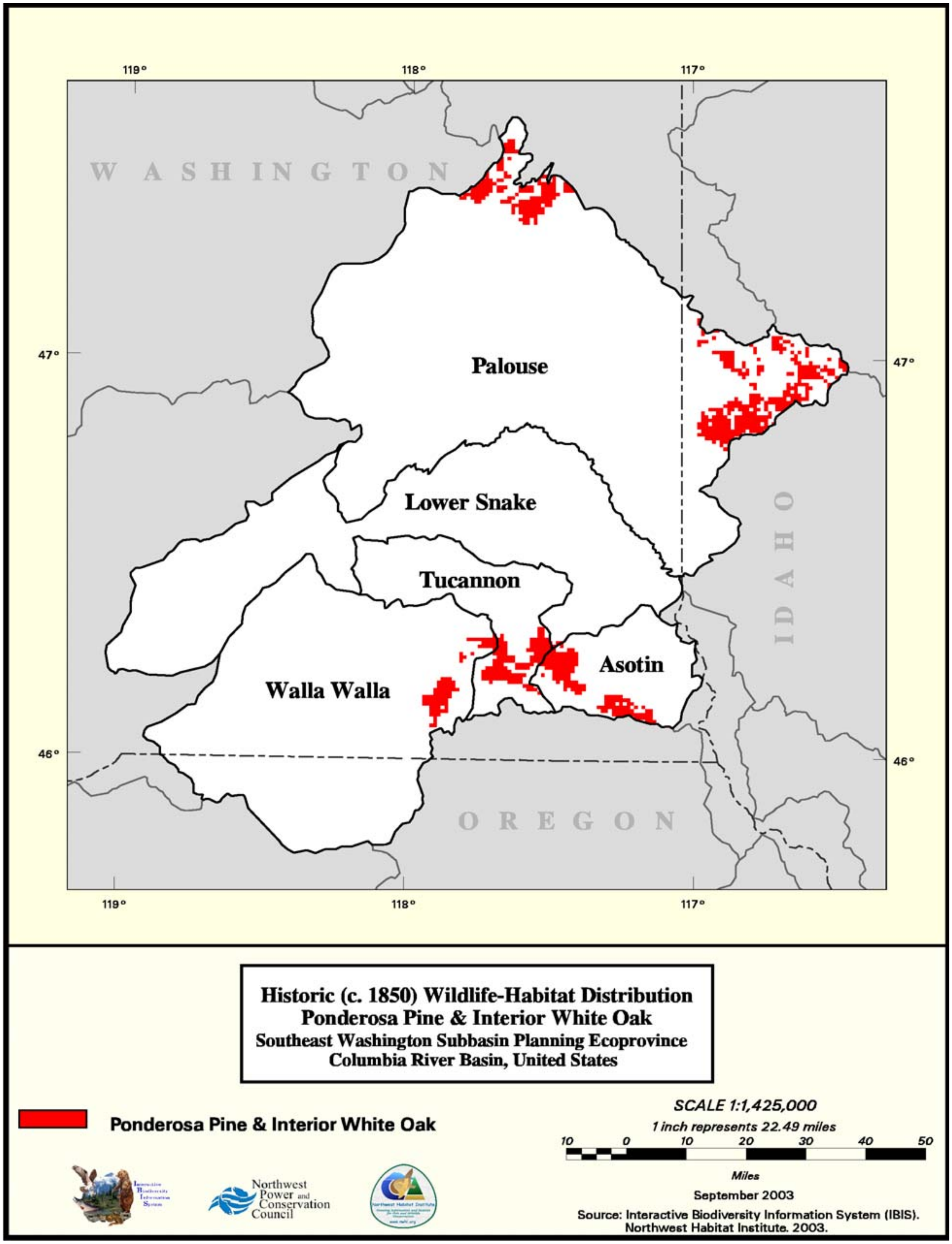

Figure 15. Historic ponderosa pine distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

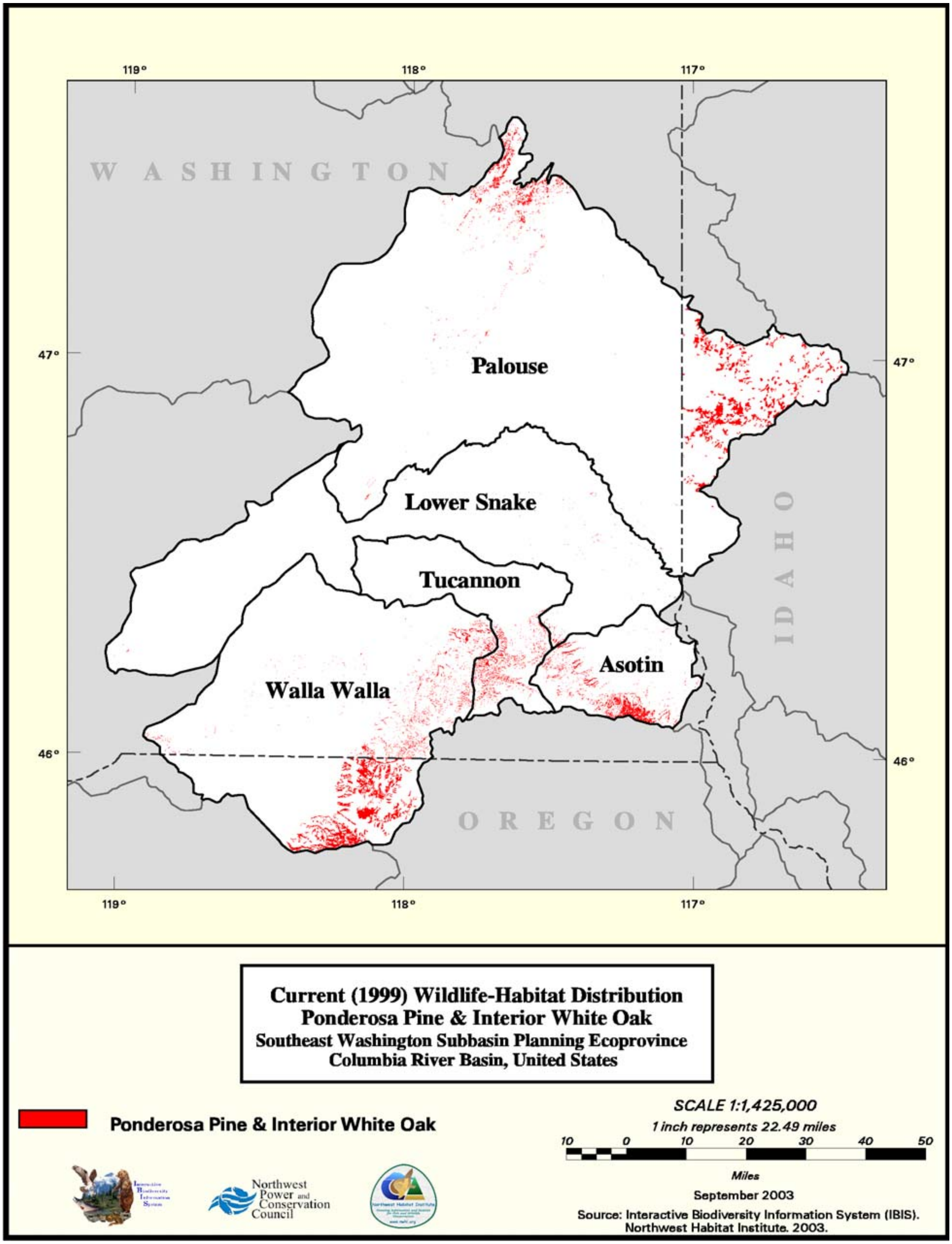

Figure 16. Current ponderosa pine distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

shrub and conifer species. Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by conifers. Ponderoas pine is shade intolerant and grows most rapidly in full sunlight (Franklin and Dyrness 1973; Atzet and Wheeler 1984). Logging is usually performed by a selection-cut method. Older trees are taken first, leaving younger, more vigorous trees as growing stock. This effectively regresses succession to earlier seral stages and eliminates climax, or old growth, conditions. Logging also impacts understory species by machine trampling or burial by slash. Clearcutting generally results in dominance by understory species present prior to logging, with invading species playing only a minor role in post logging succession (Atzet and Wheeler 1984).

Currently, much of this habitat type has a younger tree cohort of more shade-tolerant species that give the habitat a more closed, multi-layered canopy. For example, ponderosa pine habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Under most management regimes, typical tree size decreases and tree density increases in this habitat type. Ponderosa pine-Oregon white oak habitat is now denser than in the past and may contain more shrubs than in historic habitats. In some areas, new woodlands have been created by patchy tree establishment at the forest-steppe boundary.

Annual precipitation in this vegetation zone is between 14 and 30 inches. Wide seasonal and diurnal temperature fluctuations are the rule. In Washington, the ponderosa pine zone generally lies between 2,000 and 5,000 feet, but its occurrence at any particular location is strongly influenced by aspect and soil type (Cassidy 1997).

In the Blue Mountains, it is possible to find ponderosa pine at nearly 5,000 feet on southern aspects and subalpine fir (*Abies lasiocarpa*) communities at the same elevation on opposite northern aspects (Hall 1973). In some places, the change from steppe to closed forest occurs without the transitional ponderosa pine zone at locations along the east slopes of the north central Cascades for example. More commonly, the aspect dependence of this zone creates a complex inter-digitization between the steppe and ponderosa pine stands, so that disjunct steep zone fragments occur on south-facing slopes deep within forest while ponderosa pine woodlands reach well into steppe habitats along drainages and north slopes.

A similar process occurs between the ponderosa pine zone and the higher elevation closed forest zones. At higher elevations, ponderosa pine is seral to trees more shade tolerant and moisture demanding. In the Pacific Northwest, this generally includes Douglas-fir, grand fir, and white fir (*Pinaceae abies*) (Howard 2001). Also common are mosaics created by soil type in which ponderosa pine stands on coarse-textured soil are interspersed with steppe communities on finer soils. Because of variations in soil types and topography, ponderosa pine habitat in Washington varies from a discontinuous zone, especially in the northeast Cascades, east central Cascades, and Blue Mountains, to a broad, relatively unbroken transition zone above steppe zones in the Ecoregion and along the southeast Cascade slopes (Figure_17).

Climax Vegetation:
The successional status of ponderosa pine can best be expressed by its successional role, which ranges from seral to climax depending on specific site conditions. It plays a climax role on sites toward the extreme limits of its environmental range and becomes increasingly seral with more favorable conditions. On more mezic sites, ponderosa pine encounters greater competition and must establish itself opportunistically, and is usually seral to Douglas-fir and true firs such as grand fir and white fir. On severe sites it is climax by default because other species cannot establish. On such sites, establishment is likely to be highly dependent upon the cyclical nature of large seed crops and favorable weather conditions (Steele 1988).

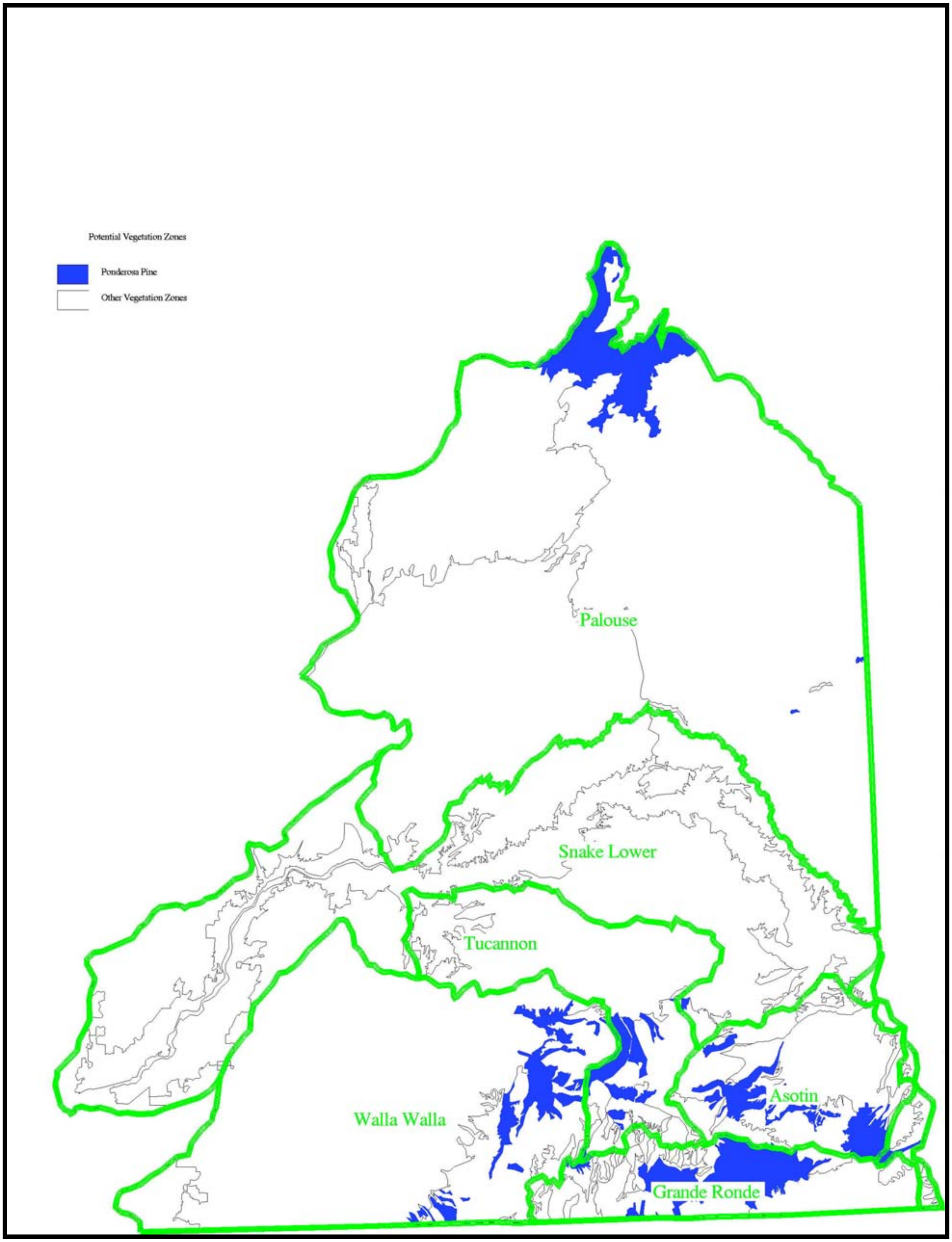

Figure 17. Historic (potential) ponderosa pine vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Successional and climax tree communities are inseparable in this zone because frequent disturbance by fire is necessary for the maintenance of open woodlands and savanna. Natural fire frequency is very high, with cool ground fires believed to normally occur at 8 to 20-year intervals by one estimate and 5 to 30-year intervals by another. Ponderosa pine trees are killed by fire when young, but older trees survive cool ground fires. Fire suppression favors the replacement of the fire-resistant ponderosa pine by the less tolerant Douglas-fir and grand fir.

High fire frequency maintains an arrested seral stage in which the major seral tree, ponderosa pine, is the "climax" dominant because other trees are unable to reach maturity. The ponderosa pine zone is most narrowly defined as the zone in which ponderosa pine is virtually the only tree. As defined in this document, the ponderosa pine zone encompasses most warm, open-canopy forests between steppe and closed forest, thus it includes stands where other trees, particularly Douglas-fir, may be co-dominant with ponderosa pine (Daubenmire and Daubenmire 1968).

Throughout most of the zone, ponderosa pine is the sole dominant in all successional stages. At the upper elevation limits of the zone, on north-facing slopes in locally mesic sites, or after long-term fire suppression, other tree species such as Douglas-fir, grand fir, western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta latifolia*), western juniper (*Juniperus occidentalis*), or Oregon white oak (*Quercus garryanna*) may occur. At the upper elevation limits of the zone, in areas where the ponderosa pine belt is highly discontinuous, and in cooler parts of the zone, Douglas-fir, and occasionally western larch, lodgepole pine, and grand fir become increasingly significant. In the Blue Mountains, small amounts of western juniper commonly occur. Lodgepole pine is common in the northeast Cascades and northeastern Washington (Daubenmire and Daubenmire 1968).

The major defining structural feature of this zone is open-canopy forest or a patchy mix of open forest, closed forest, and meadows. On flat terrain, trees may be evenly spaced. On hilly terrain, the more common pattern is a mix of dry meadows and hillsides, tree clumps, closed forest in sheltered canyons and north-facing slopes, shrub patches, open forest with an understory of grass, and open forest with an understory of shrubs. Without fire suppression, the common belief is that the forest would be less heterogeneous and more savanna-like with larger, more widely spaced trees and fewer shrubs (see Daubenmire and Daubenmire 1968 for a dissenting opinion).

Understory associations in Washington are broadly differentiated into a mesic shrub group and a xeric grass/shrub group. Soil type appears to be the major determining factor separating these groups. The mesic shrub group usually occurs on deeper heavier-textured, more fertile soils than the xeric grass/shrub group. Understories of the mesic shrub associations are usually dominated by snowberry or ninebark. The snowberry association is widespread. The ninebark association, the most mesic of the ponderosa pine associations, is rare outside of northeastern Washington. Where the ninebark association occurs outside of northeast Washington, it appears to be a seral association of the Douglas-fir zone (Daubenmire and Daubenmire 1968).

The xeric grass/shrub associations usually occur on stony, coarse-textured or rocky soils. They have an understory dominated by bluebunch wheatgrass, Idaho fescue, needle and thread grass (*Stipa comata*), bitterbrush, or combinations of these species. Bluebunch wheatgrass and Idaho fescue associations are common throughout Washington. Needle and thread associations occur on sandy soils. The bitterbrush association, which has a shrub layer dominated by bitterbrush over a xeric grass layer, is most common along the east slope of the Cascades (Daubenmire and Daubenmire 1968) .

Disturbance:
In addition to timber harvest as a disturbance factor, heavy grazing of ponderosa pine stands in the mesic shrub habitat type tends to lead to swards of Kentucky bluegrass *(Poa pratensis)* and Canada bluegrass *(Poa compressa).* Native herbaceous understory species are replaced by introduced annuals, especially cheatgrass (*Bromus tectorum*) and invading shrubs under heavy grazing pressure (Agee 1993). In addition, four exotic knapweed species *(Centaurea* spp.*)* are spreading rapidly through the ponderosa pine zone and threatening to replace cheatgrass as the dominant increaser after grazing (Roche and Roche 1988). Dense cheatgrass stands eventually change the fire regime of these stands resulting in stand replacing, catastrophic fires.

Along with anthropogenic disturbances and weed infestations, diseases and insects impact and define ponderosa pine sites. Parasites, root diseases, rusts, trunk decays, and needle and twig blights cause significant damage. Dwarf mistletoe (*Arceuthobium* spp.) causes the most damage. A major root disease of pine is caused by white stringy root rot *(Fomes annosus*) and is often found in concert with bark beetle infestations. Western gall rust *(Endocronartium harknessii*), limb rust *(Peridermium filamentosum*), and comandra blister rust *(Cronartium comandrae*) cause damage only in localized areas. Various silvicultural treatments can minimize damage caused by dwarf mistletoe. Clearcutting is used only if regeneration is not a problem. The pruning of branches and witches brooms, fertilization, watering, and the planting of nonsusceptible species also aid in combating dwarf mistletoe (Hawksworth *et al.* 1988 in Howard 2001).

Similarly, approximately 200 insect species may impact ponderosa pine from its cone stage to maturity (Schmid 1988 in Howard 2001). The effects of insect damage are decreased seed and seedling production, reforestation failures or delays, and reduction of potential timber productivity (Schmid 1988 in Howard 2001). Several insect species, the most damaging being the ponderosa pine cone beetle (*Conophthorus ponderosae*) and the pine seed chalcid (*Megastigmus albifrons*) destroy seeds before they germinate. Seedlings and saplings are deformed by tip moths (*Rhyacionia bushnelli*), shoot borers (*Eucosma sonomana*), and budworms (*Choristoneura lambertiana*). Two major lepidopteran pests, the pine butterfly (*Neophasia menapia*) and Pandora moth (*Coloradia pandora*), severely defoliate their hosts causing growth reductions. Extensive mortality in defoliated stands usually results from simultaneous infestations by bark beetles. Bark beetles, primarily of the genus *Dendroctonus* and *Ips*, kill thousands of pines annually and are the major mortality factor in commercial timber stands (Schmid 1988 in Howard 2001).

Edaphic and other Special Communities:
Wetlands: Quaking aspen (*Populus tremuloides*) stands occur on moist sites, riparian areas, and deep rich soils. Black cottonwood (*Populus trichocarpa*) occurs along rivers and on gravel terraces (Franklin and Dryness 1973). Topographic and topoedaphic: In cooler sites on northern slopes or on favorable microsites, closed-canopy Douglas-fir-dominated communities may form. Steppe communities similar to those in adjacent steppe zones often occur in patches among ponderosa pine woodlands. An apparently unique steppe-like Idaho fescue/Wyeth buckwheat (*Eriogonum heracleoides*) association occurs in a matrix with ponderosa pine woodlands in the Okanogan Highlands. On steep, rocky talus slopes in the canyons of the Blue Mountains, ponderosa pine stands with a smooth sumac (*Rhus glabra*)-dominated understory form a rare association (Franklin and Dyrness 1973).

Land Use and Land Cover:
Agriculture – Approximately 9.70 percent of the potential ponderosa pine zone is in agriculture (irrigated – 1.92 percent; non-irrigated – 0.89 percent; mixed/unknown irrigation status – 6.88

percent). Pastures, grain fields, and orchards along the larger rivers are the major crop types. Most fields are relatively small compared to the agricultural fields in the Columbia Basin. Irrigation status is usually difficult to determine in this zone with satellite imagery alone (Cassidy 1997).

Open water/wetlands – Cassidy (1997) suggests that 3.76 percent of this zone is composed of open water/wetland habitats (open water – 3.23 percent; marsh – 0.03 percent; riparian – 0.50 percent). The disproportionately high open water cover is due to the presence of several large rivers that flow through the zone, notably sections of the Columbia and Spokane Rivers.

Within the Ecoregion, open water/ wetland habitats in this vegetation zone consist primarily of numerous small lakes and marshes scattered throughout the zone. They are especially abundant near Cheney in the vicinity of the Turnbull National Wildlife Refuge within the Palouse subbasin.

Non-forested – Almost 21 percent of the entire zone is unforested (grassland – 5.08 percent; shrub savannah – 4.99 percent; unknown/mixed type – 4.22 percent; tree savanna – 1.47 percent; shrubland – 5.07 percent).

Alternately: Created by fire or logging disturbance – 7.19 percent; apparently natural meadows and steppe vegetation – 0.75 percent; unknown disturbance status – 12.90 percent. In viewing the satellite imagery, most logging cuts are not readily distinguished from the "natural" dry meadows and shrub fields typical of this zone. Given the uncertainty of distinguishing non-forested structural types from one another using satellite imagery, non-forested cover appears to be evenly split between grassland, shrub savanna, and shrubland (Cassidy 1997).

Hardwood forest – 0.15 percent. These are primarily Oregon white oak stands near the oak zone. Other hardwoods may also form small stands, usually along drainages pine (Williams and Smith 1990).

Mixed hardwood/conifer forest – 0.95 percent. This is usually conifers and hardwoods along drainages. Conifer species include ponderosa pine, Douglas-fir, and lodgepole pine. Typical hardwoods are quaking aspen, black cottonwood, and willows *(Salix* spp.*)*. Oregon white oak is common along the southeast Cascades (Williams and Lillybridge 1983; Annable and Peterson 1988; Williams and Smith 1990; Williams *et al.* 1990; Johnson and Clausnitzer 1992).

Conifer forest – Approximately 62.31 percent of this zone is comprised of conifer forest (open-canopy – 52.40 percent; closed-canopy – 9.30 percent; mixed/unknown canopy closure – 0.62 percent). Open-canopy conifer forest, the defining feature of this zone, covers slightly more than half the area of the zone. Open-canopy forests are dominated by ponderosa pine over most of the zone. At the higher-elevations and in northern parts of the zone, Douglas-fir may be codominant or dominant. Closed-canopy forests are usually a mix of Douglas-fir and ponderosa pine, with lesser amounts of western larch and lodgepole pine (Williams and Lillybridge 1983; Annable and Peterson 1988; Williams and Smith 1990; Williams *et al.* 1990; Johnson and Clausnitzer 1992).

Conservation Status of the Ponderosa Pine Vegetation Zone (Cassidy 1997):
Conservation Status 1 – The largest blocks of land in this category within the Ecoregion are in the Wenaha-Tucannon Wilderness (Tucannon subbasin).

Conservation Status 2 – Lands in this category within the Ecoregion include the Turnbull National Wildlife Refuge (Palouse subbasin), the Asotin Creek Wildlife Area (Asotin subbasin), and the Tucannon Wildlife Area (Tucannon subbasin).

Conservation Status 3 – Lands in this category within the Ecoregion include Washington Department of Natural Resources (WDNR) lands that form moderately large contiguous areas within the Asotin subbasin. The Smoot Hill Facility (owned by Washington State University) also has a very small disjunct piece of the ponderosa pine zone (183 acres) in the Palouse subbasin.

Conservation Status 4 – Lands in this category within the Ecoregion are privately owned. At the landscape scale, about two-thirds of Conservation Status 4 lands are privately owned and about one-third are on Indian Reservations.

Land Management Considerations (Cassidy 1997)
Ponderosa pine and oak zones, the major transition zones between steppe and closed forest in Washington, are the east-side forest zones with the poorest protection status. Both zones have similarly low percentages of their area (3 to 4 percent) on Conservation Status 1 and 2 lands, but the ponderosa pine zone is better represented on Conservation Status 3 lands, which allows more flexibility for future land management options. Both zones present some similar problems in biodiversity management. Both tend to be intermingled in a complex pattern with steppe and higher elevation closed forest and support species that depend on the interface between steppe and forest, so management policies in neighboring higher and lower elevation zones have a greater affect on these zones than on most zones. Because frequent fire is important in maintaining the pine woodlands and savanna that characterize this zone, biodiversity management of the zone must also consider the problem of fire management where houses and farms are scattered within dry woodlands.

The pattern of land ownership in the ponderosa pine zone varies considerably across the State of Washington. The ponderosa pine zone in the Ecoregion is more intermingled with other zones than anywhere else in the state, but land ownership is less complicated. Management of the zone is evenly divided among Conservation Status 1 lands (the Wenaha-Tucannon Wilderness), Conservation Status 3 lands (the Umatilla National Forest) and Conservation Status 4 lands (privately owned). In contrast, the Turnbull National Wildlife Refuge (Conservation Status 2) lies in a ponderosa pine zone "peninsula" at the northern edge of the Palouse subbasin, south of Spokane. The city of Spokane occupies a large part of this zone in Spokane County and complicates management because of surrounding high population densities and because the expansion of Spokane suburbs threatens to isolate Turnbull National Wildlife Refuge from the rest of the zone. Turnbull National Wildlife Refuge should be a major focus in any landscape-scale management strategy. Tumbull National Wildlife Refuge is best known for its wetlands, while its position as one of the best representatives of the poorly protected ponderosa pine zone is often overlooked.

Management strategies for the ponderosa pine zone in these regions must consider the needs of private and tribal landowners, the effect of suburban sprawl around Spokane, and the management of higher-elevation forest zones. Potential improvement of biodiversity protection on public lands in this zone depends primarily on management policies of the National Forests and the WDNR, but the relative influence of those owners varies across the zone. National Forests are most prominent in the northeast Cascades, east central Cascades, and Blue Mountains; the WDNR has the greatest relative influence throughout the zone in areas where private land predominates and most public land is comprised of WDNR section blocks.

Status and Trends:
Quigley and Arbelbide (1997) concluded that the interior ponderosa pine habitat type is significantly less in extent than pre-1900 and that Oregon white oak habitat type is greater in extent than pre-1900. They included much of this habitat in their dry forest potential vegetation group, 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.

4.1.7.1.3 Recommended Future Condition

Recognizing that extant ponderosa pine habitat within the Ecoregion currently covers a wide range of seral conditions, wildlife habitat managers identified three general ecological/ management conditions that, if met, will provide suitable habitat for multiple wildlife species at the Ecoregion scale within the ponderosa pine habitat type. These ecological conditions correspond to life requisites represented by a species assemblage that includes white-headed woodpecker *(Picoides albolarvatus),* flammulated owl *(Otus flammeolus),* and Rocky Mountain elk *(Cervus canadensis)* (Table_31)*.* Species account information is included in Appendix F. These species may also serve as a performance measure to monitor and evaluate the impacts of future management strategies and actions.

Subbasin wildlife managers will review the conditions described below to plan and, where appropriate, guide future protection and enhancement actions in ponderosa pine habitats. Specific desired future conditions, however, are identified and developed within the context of subbasin-level management plans.

Condition 1 – Mature ponderosa pine forest: The white-headed woodpecker represents species that require large patches (greater than 350 acres) of open mature old growth ponderosa pine stands with canopy closures of 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches diameter at breast height [DBH]). Abundant white-headed woodpecker populations can be present in burned or cut forests with residual large diameter live and dead trees and understory vegetation that is usually very sparse. Openness however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989).

Condition 2 – Multiple canopy ponderosa pine mosaic: Flammulated owls represent wildife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine or mixed ponderosa pine/Douglas-fir forests interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner *et al.* 1990), two-layered canopies, tree density of 508 trees/acre (9-foot spacing), basal area of 250 feet^2/acre (McCallum 1994b), and snags 3 - 39 feet tall and greater than 20 inches DBH (Zeiner *et al.* 1990). Food requirements are met by the presence of at least one snag greater than12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

Condition 3 – Dense canopy closure ponderosa pine forest: Rocky Mountain elk was selected to characterize ponderosa pine habitat that is greater than 70 percent canopy closure and 40 feet in height. This habitat condition provides both summer and winter thermal cover for large ungulate species such as deer and elk.

Change in the extent of ponderosa pine from circa 1850 to 1999 is illustrated at the 6th-level HUC in Figure_18 (NHI 2003). Red color tones indicate negative change while blue color tones indicate positive change. Although the data are displayed at the 6th-level HUC, it does not necessarily mean that the entire hydrologic unit was historically or is currently comprised entirely of the ponderosa pine habitat type. The data simply indicate that the ponderosa pine habitat type occurred somewhere within a particular hydrologic unit.

The data displayed in Figure_18 can be used by subbasin planners to identify and prioritize conservation and restoration areas and strategies. For example, planners may develop a hierarchical approach to protecting ponderosa pine habitat where hydrologic units that have exhibited positive change receive a higher initial prioritization than those that have experienced a negative change. Ecoregion planners could then cross-link this information with other data such as ECA and GAP management-protection status to develop comprehensive strategies to identify and prioritize critical areas and potential protection actions.

4.1.7.2 Shrubsteppe

4.1.7.2.1 Historic

Historically, shrubsteppe occurred on the western edge of the Ecoregion and included three shrub-dominated steppe vegetation zones: three-tipped sage, central arid, and big sage/fescue (Cassidy 1997) (Figure_27). Similarly, Daubenmire (1970) identified six primary habitat types within the Ecoregion: four dominated by shrubs and two dominated by grasses.

Daubenmire (1970) habitat types include:

1. *Artemesia tridentate – Pseudoroegneria spicatum* (big sagebrush – bluebunch wheatgrass)
2. *Artemesia tridentate – Festuca Idahoensis* (big sage – Idaho fescue)
3. *Artemesia tripartita – Festuca Idahoensis* (three-tip sage – Idaho fescue)
4. *Festuca Idahoensis – Symphoricarpos albus* (Idaho fescue – snowberry)
5. *Festuca Idahoensis – Rosa nutkana* (Idaho fescue – nutkana rose)
6. *Artemisia rigida – Poa sandbergii* (rigid sagebrush – Sandberg bluegrass)

The sagebrush-dominated shrublands occurred in the western sections of the Walla Walla and Palouse subbasins and along the Snake River. In contrast, the Idaho fescue/snowberry habitat type occurred primarily in the eastern part of the Palouse subbasin while the Idaho fescue/nutkana rose habitat types occurred in the Blue Mountains region.

Shrublands were historically co-dominated by shrubs and perennial bunchgrasses with a microbiotic crust of lichens and mosses on the surface of the soil. Dominant shrubs were sagebrush of several species and subspecies, including among others Wyoming (*A. tridentata Wyomingensis*), and mountain big sagebrush (*A. tridentata vaseyana*), rigid (*A. rigida*), and three-tip (*A. tripartita*). Bitterbrush also was important in many shrubsteppe communities. Bunchgrasses were largely dominated by four species, including bluebunch wheatgrass, Idaho fescue, needle and thread grass, and Sandberg bluegrass. Soils, climate and topography acted to separate out distinct plant communities that paired sagebrush species with specific bunchgrasses across the landscape. Within the shrubsteppe landscape there also were alkaline basins, many of which contained large lakes during wetter pluvial times, where extensive salt desert scrub communities occur. This characteristic Great Basin vegetation contained numerous shrubs in the shadscale group including greasewood which has wide ecological amplitude, being equally at home in seasonally flooded playas and on dunes or dry hillsides.

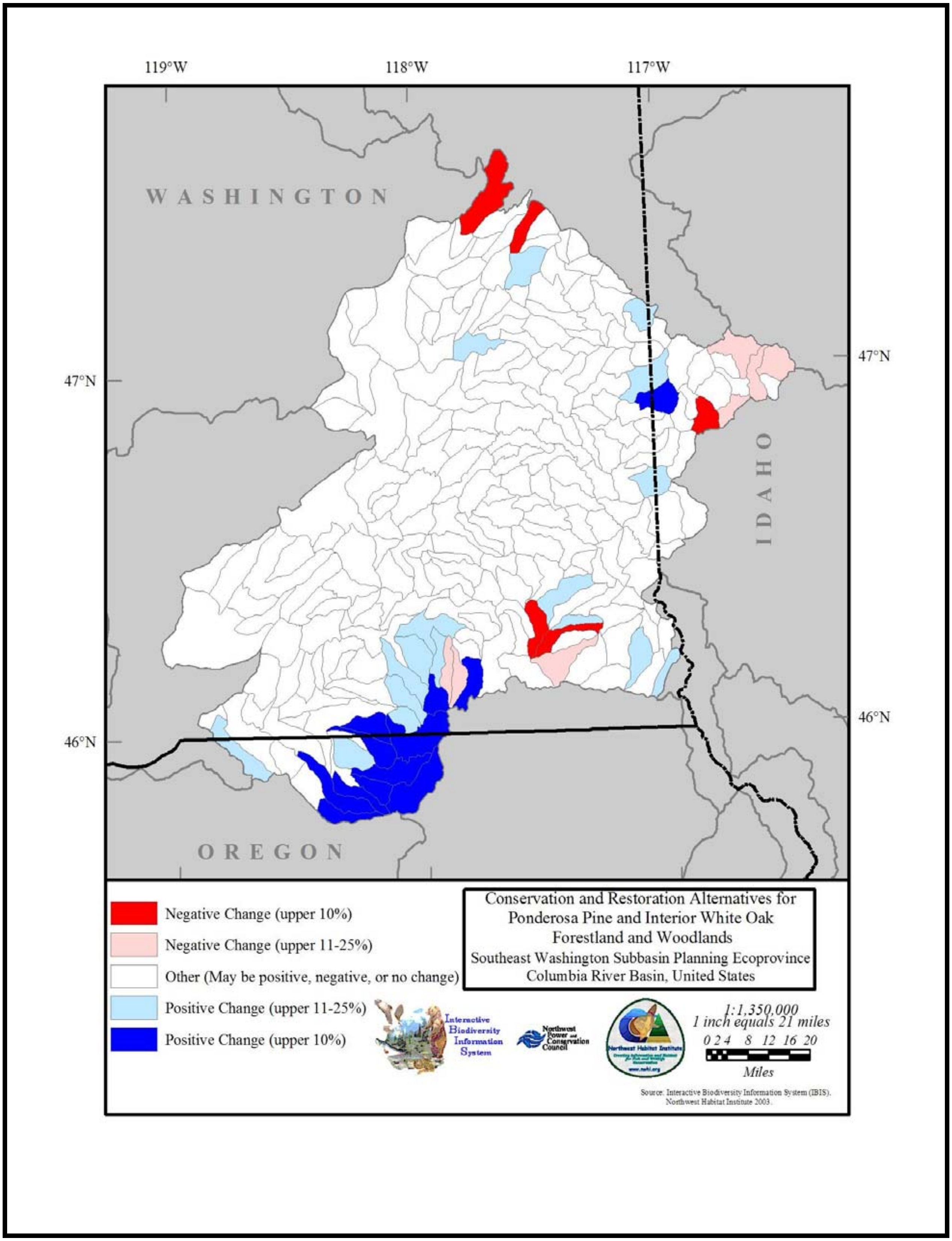

Figure 18. Ponderosa pine conservation and restoration alternatives (NHI 2003).

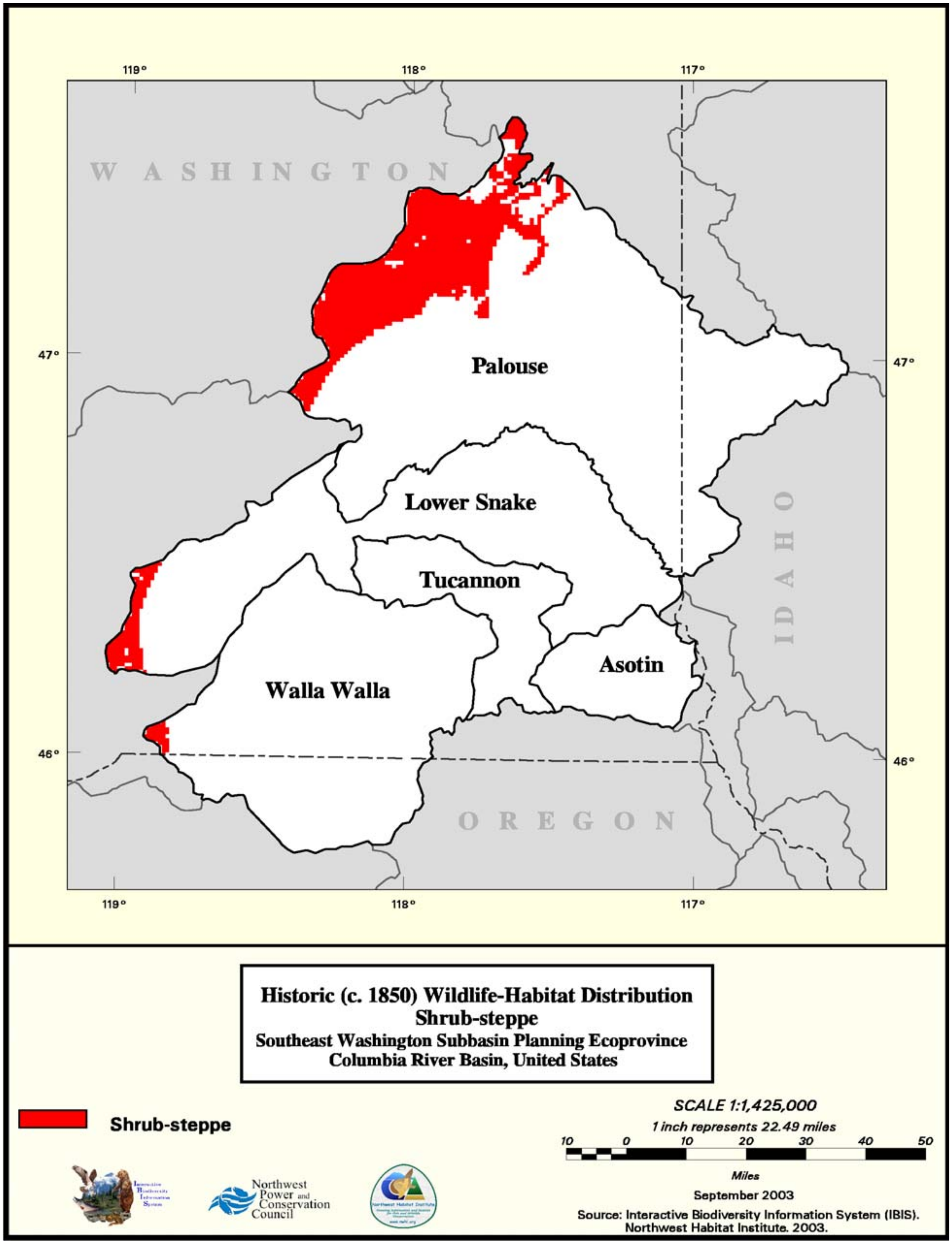

Figure 19. Historic shrubsteppe distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

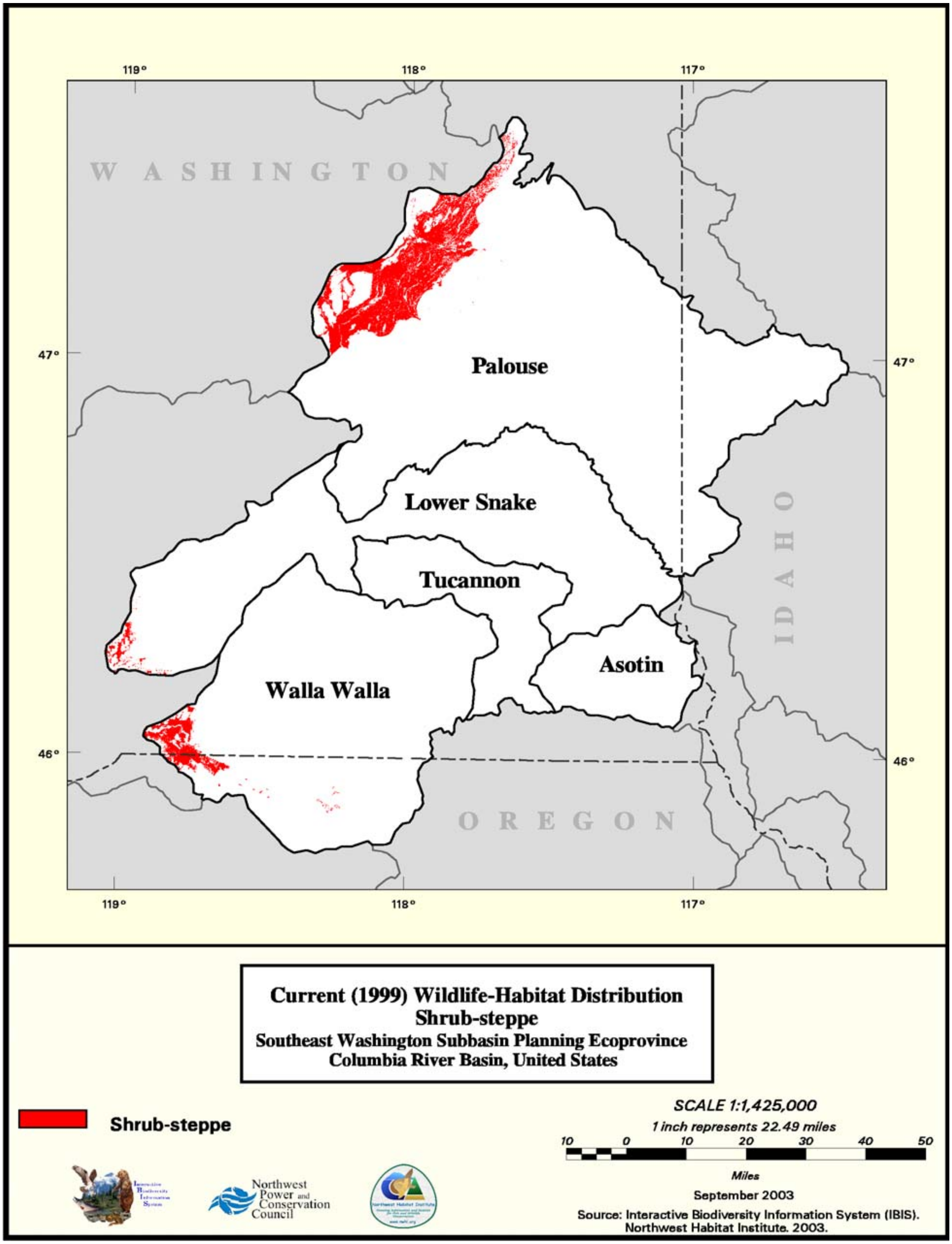

Figure 20. Current shrubsteppe distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Shrublands that were located in areas of deep soil have largely been converted to agriculture leaving shrublands intact on shallow lithosols soil. Floristic quality, however, has generally been impacted by decades of heavy grazing, introduced vegetation, wild fires, and other anthropogenic disturbances. Changes in the distribution of shrubsteppe habitat from circa 1850 (historic) to 1999 (current) are illustrated in Figure_19 and Figure_20.

4.1.7.2.2 Current

Today, shrubsteppe habitat is 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 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 in the northern and western Columbia Basin in Washington and occasionally appears in the lower valleys of the Blue Mountains and in the Owyhee uplands of Oregon. Mountain silver sagebrush is more prevalent in the East Cascades of Oregon and in montane meadows in the southern Ochoco and Blue Mountains.

Characteristic and dominant mid-tall shrubs in the shrubsteppe habitat include all three subspecies of big sagebrush, Wyoming, or mountain, antelope bitterbrush, and two shorter sagebrushes, silver (*A. cana*) and three-tip (Daubenmire 1970). 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 co-dominate 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.

Cassidy (1997) identified three shrub-dominated vegetation zones within the Ecoregion. These include the three-tip sagebrush, central arid steppe, and big sagebrush/fescue vegetation zones. Although the combined total acreage represents a small percentage of the entire Ecoregion, these are important wildlife habitats as they provide structural diversity and varying plant communities amidst a largely agricultural landscape punctuated by fragmented grasslands.

4.1.7.2.2.1 Three-tip Sage Vegetation Zone

The three-tip sage zone, the second largest steppe zone in Washington, covers over 2.4 million acres on the northern margins of the Columbia Basin and in parts of the east slope of the Cascades (Cassidy 1997).

Although this zone occurs in much of the central basin of Washington, it currently occupies only 7,225 acres in the northwest portion of the Ecoregion within the Palouse subbasin (Figure_21). Cassidy (1997) indicated that, historically, there were approximately 28,125 acres of three-tip

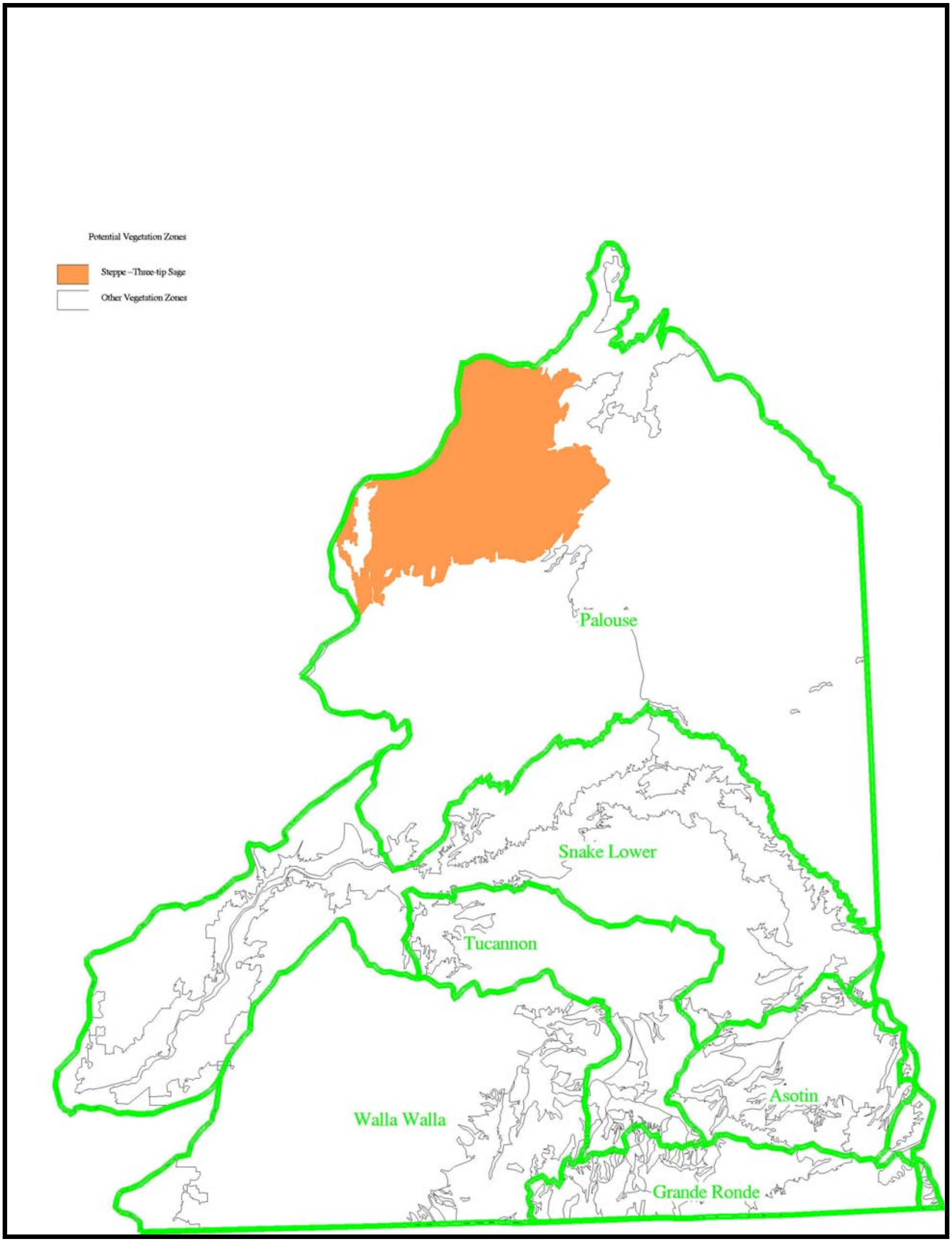

Figure 21. Historic (potential) three-tip sage steppe vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

sage in the Palouse subbasin; however, at least 20,900 acres were converted to (and remain in) agricultural production.

Climax Vegetation:
The characteristic undisturbed vegetation of this zone forms a continuous herbaceous layer with a taller discontinuous layer of three-tip sage. Big sagbrush is confined to disturbed sites. Snowberry and bitterbrush are rare (Daubenmire 1970). Three-tip sage looks very much like big sagebrush but is about half as tall, so the sagebrush component of this zone is less visually imposing than in zones where big sagebrush is the dominant shrub.

This zone is large, and the variability in herbaceous dominants reflects its broad precipitation range. The most mesic sites are dominated by Idaho fescue with lesser amounts of bluebunch wheatgrass, threadleaf sedge (*Carex filifolia*), Sandberg bluegrass, and needle and thread grass. On the drier end of the spectrum, bluebunch wheatgrass and Sandberg bluegrass tend to be the dominants, though Idaho fescue usually remains in significant amounts. Forbs are diverse and include many perennials common to other meadow steppe zones. The average shrub cover is about 12 percent and ranges from near 0 percent to greater than 30 percent. Consequently, the native vegetation generally falls under the definition of a grassland (less than 10 percent shrub cover) or shrub savanna (10 to 25 percent shrub cover). Shrublands are mostly limited to ravines and draws, and extensive shrublands are uncommon (Franklin and Dyrness 1973).

Disturbance:
Fire has relatively little effect on native vegetation in this zone, since three-tip sagebrush and the dominant graminoids resprout after burning. Three-tip sagebrush does not appear to be much affected by grazing, but the perennial graminoids decrease and are eventually replaced by cheatgrass, plantain (*Plantago* spp.), big bluegrass (*Poa secunda*), and/or gray rabbitbrush. In recent years, diffuse knapweed (*Centaurea diffusa*) has spread through this zone and threatens to replace other exotics as the chief increaser after grazing (Roche and Roche 1998). A 1981 assessment of rangelands rated most of this zone in fair range condition, with smaller amounts in good and poor range condition; however, ecological condition is generally worse than range condition (Harris and Chaney 1984).

Edaphic and other Special Communities:
Lithosols: Parts of this zone, especially in Whitman, Lincoln, and Adams Counties, occur where flooding during the last ice age washed the soil away nearly to the basalt bedrock. These “channeled scablands” support low shrubs and herbs such as rigid sagebrush and buckwheat (*Eriogonum* spp). Wetlands: Riparian habitats are dominated by black cottonwood and white alder (*Alnus rhombifolia*). Others: At the margins of the zone and in sheltered ravines, ponderosa pine woodlands may occur.

Land Use and Land Cover
Agriculture – Approximately 39.26 percent of this entire vegetation zone is in agriculture (irrigated – 2.1 percent; non-irrigated – 35.90 percent; mixed irrigation status – 1.02 percent). This zone is not as productive as Palouse wheatlands, but winter wheat, the bulk of the non-irrigated agriculture, is an economical crop. At least 2.4 percent of the area is maintained in CRP lands (which are included in non-irrigated agriculture). This estimate of CRP lands is a minimum because early CRP fields are indistinguishable using satellite imagery from row crops and older fields look increasingly like steppe as shrubs invade the CRP fields. Irrigated fields include pastures, row crops, and orchards (Cassidy 1997).

Areas composed of this vegetation type within the Ecoregion (Palouse subbasin) not already converted to dryland agriculture, are used primarily for livestock grazing. All remaining areas of this vegetation zone within the Ecoregion occur on shallow lithosols soils punctuated by “biscuit and swale” areas.

Open water/wetlands – Less than 3 percent of the entire vegetation zone is composed of open water/wetlands (open water – 0.97 percent; riparian – 1.12 percent; marshes and small ponds – 0.42 percent). Open water and wetlands that lie within the relatively small area of the three-tip sagebrush vegetation zone within the Ecoregion are comprised of shallow perennial and ephemeral ponds, lakes, and one major perrenial stream (Rock Creek).

Non-forested – The largest proportion of this zone is non-forested. Large blocks of channeled scabland in the eastern part of the zone have remained in steppe encompassing those lands occuring within this Ecoregion.

Conservation Status of the Three-Tip Sage Vegetation Zone (Cassidy 1997):
This vegetation zone historically did not occupy large tracts of land within this Ecoregion and even less remains today. Areas where this zone occurred on deep soils have been converted to agriculture. Therefore, deep soil three-tip sagebrush plant communities are missing from the landscape while wildlife populations dependent upon this vegetation type are severely impacted, or extirpated. What remains of this vegetation zone within the Ecoregion occurs on shallow soils. Conservation status is described below.

Conservation Status 1 – There are no Conservation Status 1 lands in this vegetation zone.

Conservation Status 2 – Conservation Status 2 lands in this zone are primarily wildlife areas managed or owned by WDFW (i.e., Revere Wildlife Area).

Conservation Status 3 – Conservation Status 3 lands within the Palouse subbasin are predominately owned by WDNR, followed by the Bureau of Land Management (BLM). Washington Department of Natural Resources lands in the eastern part of the zone (Lincoln, Adams, and Whitman Counties) have the typical pattern of regularly spaced section.

Conservation Status 4 – Conservation Status 4 lands in this zone occuring in Whitman County (Palouse subbasin) are almost entirely on private land except for WDNR sections.

Management Considerations:
With only 1.2 percent of this zone in the Conservation Status 2 category, its representation on reserves is low compared to the rest of the state, but better than most other steppe zones. Although this vegetation zone is severely impacted in the Ecoregion, many Conservation Status 2 lands elsewhere in this zone are in moderately large contiguous or nearly contiguous blocks and/or adjacent to undeveloped state or National Forest lands. Few Conservation Status 2 lands are in the deep loess of Douglas, Lincoln, Whitman, and Adams Counties where the best agricultural land occurs.

Focusing biodiversity management efforts on the best agricultural sections of this zone is likely to be expensive because of the high economic value of these lands. However, restoration of fauna associated with deep soil sites or lush grasslands (e.g., the sharp-tailed grouse) may require the expense. The thinly soiled channeled scablands and areas of glacial scouring and deposition among valuable farmland in Adams, Whitman, Lincoln Counties have less agricultural value. These lands have largely escaped cultivation, provide wildlife corridors across the Columbia Basin, and contain ponds valuable for wildlife. Northern Douglas County has small oases of deeper soil sites that have escaped cultivation because of uneven topography and large boulders stranded by glaciers and floods. These oases may serve as refuges for plants and animals in the zone, and the associated topography may reduce the value of the land for farming (Cassidy 1997).

Compared to the other steppe zones, the three-tip sagebrush zone has the second highest percentage of its area in the Conservation Status 3 category. Many of the Conservation Status 3 tracts occur as relatively large contiguous blocks (WDNR lands in northern Douglas County) or are interspersed with Conservation Status 2 lands. Thus, Conservation Status 3 land managers, particularly the WDNR, will have a major influence on future biodiversity management in this zone.

4.1.7.2.2.2 Central Arid Steppe Vegetation Zone

General:
An estimated 7.4 million acres of the central arid steppe vegetation zone account for half of the 14.8 million acres of steppe zones in Washington and 18 percent of the 42 million acres in the state. Of the steppe zones that occur in Washington, the central arid steppe is the most widespread outside of Washington; it occurs in southern Idaho, central Oregon, the northern Great Basin in Utah, and parts of Montana (Cassidy 1997).

Like the three-tipped sagebrush vegetation zone, only a small percentage of the central arid steppe vegetation zone occurs in the Ecoregion (i.e., Walla Walla, Palouse, and Lower Snake subbasins) (Figure_22). Historically, the Walla Walla subbasin had approximately 12,252 acres of this vegetation zone, while 30,923 acres occurred in the Lower Snake subbasin. Washington GAP data indicate that 6 acres of this vegetation zone extended into the Palouse subbasin. Cassidy (1997) further suggested that 789 acres occur in the Washington portion of the Walla Walla subbasin, and 11,477 acres within the Lower Snake subbasin were converted to agriculture.

Annual precipitation over most of this zone is 8 to 12 inches, falling mostly in winter and early spring. The driest part of the Columbia Basin is at the lowest elevations of the Hanford Nuclear Reservation, where the average annual precipitation is about 6.5 inches. After June, rainfall is sparse until September or October.

Climax Vegetation:
The characteristic climax vegetation is dominated by big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass (Daubenmire 1970). Other grass species occur in much smaller amounts, including needle and thread, Thurbers needlegrass (*S. thurberiana*), Cusick's bluegrass (*Poa cusickii*), and/or bottlebrush squirreltail grass (*Sitanion* hystrix). Forbs play a minor role. A cryptogamic crust of lichens and mosses grows between the dominant bunchgrasses and shrubs. Without disturbance, particularly trampling by livestock, the cryptogamic crust often completely covers the space between vascular plants. Most plants respond to the summer dry period by flowering by June, followed by senescence of their above-ground parts. Some of the taller shrubs with deep roots are able to utilize deeper water supplies and remain photosynthetically active through the summer. Big sagebrush, the latest bloomer, flowers in October near the beginning of the fall rainy season.

This big sagebrush/bluebunch wheatgrass association is often perceived and described as shrubland. Big sagebrush is indeed prominent because of its height, but in the absence of grazing and fire suppression it rarely covers enough area to create a true shrubland (i.e., one with greater than 25 percent shrub cover). Shrub cover is generally between 5 and 20 percent,

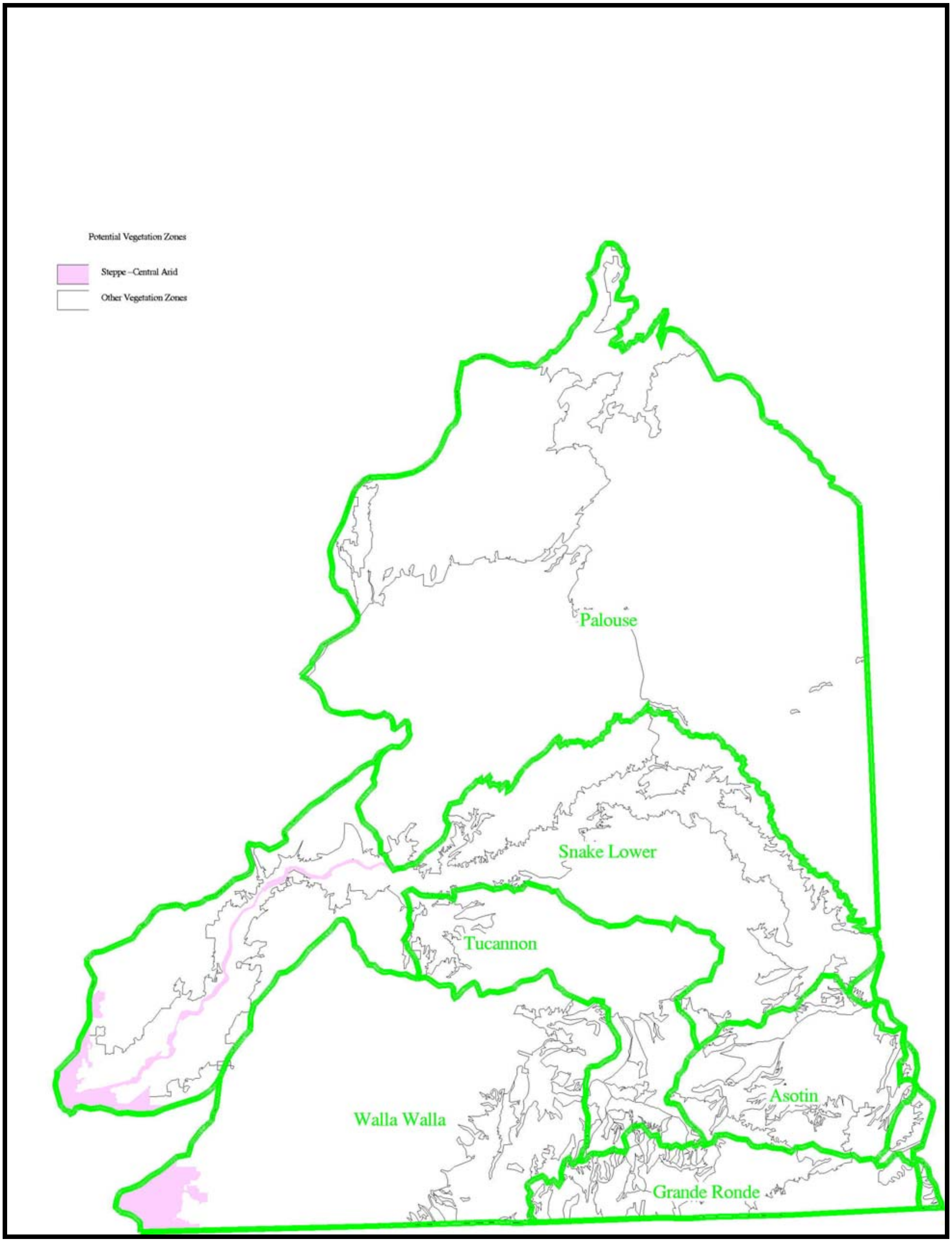

Figure 22. Historic (potential) central arid steppe vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

so most stands are more correctly described as shrub savanna (10 to 25 percent shrub cover)or, less often, as grasslands (less than 10 percent shrub cover). True shrublands in the Columbia Basin are generally confined to ravines and draws and areas of fire suppression and overgrazing. At the hottest, driest, and lowest elevations (in the Hanford basin area), however, big sagebrush/Sandberg bluegrass communities may form true shrublands that are apparently natural. Cheatgrass, an introduced annual, is so well adapted to the climate of this zone that, once established, it can apparently persist indefinitely as a dominant of climax communities in the absence of further disturbance. Big sagebrush/cheatgrass shrub savanna associations on the Hanford Nuclear Reservation have persisted in the absence of grazing or cultivation for decades and are apparently stable.

Disturbance:
Big sagebrush is killed by fire, leaving the relatively unaffected grasses as dominants (Daubenmire 1975). Cattle and horses preferentially graze Cusick's bluegrass followed by bluebunch wheatgrass, then other grasses. They avoid big sagebrush, which tends to increase with grazing unless livestock density is so high that its branches are broken. In areas with a history of heavy grazing and fire suppression, true shrublands are common and may even be the predominant cover on non-agricultural land. Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock. Grazing eventually leads to replacement of the bunchgrasses with cheatgrass, Nuttall's fescue (*Festuca microstachys*), eight flowered fescue (*F. octofiora*), and Indian wheat (*Plantago patagonica*) (Harris and Chaney 1984).

Cultivated and abandoned fields are initially dominated by Russian thistle (*Salsola kali*) and tumble mustard (*Sisymbrium altissimum*). These tumbleweeds are eventually crowded out by cheatgrass (Mack 1986). Cheatgrass swards can also change the intensity and frequency of fires (from cool, infrequent fires to hot, frequent ones) such that natives are excluded from becoming re-established when grazing is removed. In recent years, several knapweeds (*Centaurea* spp.) have become increasingly widespread. Russian starthistle (*Centaurea repens*) is particularly widespread, especially along and near major watercourses (Roche and Roche 1988). A 1981 assessment of range conditions rated most rangelands in this zone in poor to fair range condition, but ecological condition is usually worse than range condition.

Edaphic and other Special Communities:
This large zone encompasses numerous habitats influenced by edaphic and topographic factors that support floral associations different from the characteristic big sagebrush/bluebunch wheatgrass association. <u>Sand</u>: Sandy soils support needle and thread communities with co-dominants of big sagebrush, bitterbrush, Sandberg bluegrass, and/or three-tip sagebrush. Indian ricegrass (*Oryzopsis hymenoides*) is locally common in sandy areas. Drifting sand communities along the Columbia River in the Priest Rapids area include gray cryptantha (*Cryptantha leucophaea*), turpentine cymopterus (*Cymopterus terebinthinus*), and white abronia (*Abronia mellifera*) (Mastroguiseppe and Gill 1983). <u>Lithosols</u>: Shallow soil supports communities dominated by buckwheat species, Sandberg bluegrass, and rigid sagebrush. <u>Saline/alkaline</u>: Extensive playas like those found in desert regions further south are not found in Washington State, but small saline or alkaline areas are scattered through the basin. Saline and alkaline soils most commonly support saltgrass communities, with co-dominants of ryegrass and/or greasewood (*Sarcobatus vermiculatus*). Spiny hopsage (*Atriplex spinosa*) communities are locally common but their soil association is poorly understood (Franklin and Dyrness 1973). <u>Wetlands</u>: Natural springs support a variety of lush communities that are very important to wildlife in this dry zone. Species composition is variable, but species commonly encountered are mock orange (*Philadelphus lewisii*), yellow monkey flower (*Mimulus guttatus*), swamp willow-herb (*Epilobium palustre*), common chokecherry (*Prunus virginiana*), smooth sumac, Woods' rose (*Rosa woodsii*), willows, serviceberry (*Amelanchier alnifolia*), and black cottonwood.

Western juniper dominates a few springs and washes near the Columbia River, but is otherwise rare in the central arid steppe. Irrigation has vastly increased the amount of marshy and riparian vegetation. Cattail (*Typha* spp.) communities grow in ditches alongside irrigated fields. Russian olive (*Eleagnus angustifolia*), originally introduced to enhance wildlife habitat, has become the dominant riparian tree throughout much of the basin (Franklin and Dyrness 1973). <u>Topographic</u>: North-facing slopes often support different climax communities. Three-tip sagebrush/Idaho fescue and three-tip sagebrush/bluebunch wheatgrass communities, sometimes mixed with big sagebrush, are commonly found of north-facing slopes above 1,500 feet. Bitterbrush is often mixed with big sagebrush near the western edge of the zone. On north-facing slopes at the western edge of the zone, bitterbrush, big sagebrush, and three-tip sagebrush, may occur together (Chappell 1996).

Land Use and Land Cover
Bare ground: 0.09 percent. These are mostly basalt cliffs, rarely extensive sand dunes (most sand dunes have a sufficient amount of vegetation that they fall into the "non-forested, sparse cover" class.). To a ground-based observer, basalt cliffs are a prominent feature of the Columbia Basin. They are also an important wildlife habitat feature.

Agriculture: At least 45.49 percent of the entire vegetation zone is in agriculture (Irrigated – 27.34 percent; Non-irrigated – 17.65 percent; Mixed irrination status – 0.50 percent). This steppe zone is the only one in which irrigated agriculture exceeds non-irrigated agriculture. Irrigated fields are concentrated in extensive reclamation projects outside of the Ecoregion. Lands within this vegetation zone, however, are predominantly used for livestock grazing.

Open water/wetlands: Approximately 4.62 percent of the entire vegetation zone is in open water/wetland habitats (open water – 2.78 percent; marshes, small ponds, irrigation canals – 6.68 percent; riparian – 1.17 percent). Open water includes the surface of the major rivers and several lakes. Northwest Habitat Institute data (2003) suggest that there is considerably less open water/wetlands in this Ecoregion.

Conservation Status of the Central Arid Steppe Vegetation Zone (Cassidy 1997):
This vegetation zone historically did not occupy large tracts of land within the Ecoregion and even less remains today. Many areas where this zone occurred on deep soils have been converted to agriculture except in areas adjacent to the Snake River where livestock grazing occurs. The conservation status of this vegetation zone is described below.

Conservation Status 1 – There are no Conservation Status 1 lands in this vegetation zone.

Conservation Status 2 – Conservation Status 2 lands are scattered within the zone, but the largest contiguous tracts lie at the base of the east central Cascades and in the center of the Columbia Basin. The eastern, southern, and northern parts of the zone tend to have smaller more isolated parcels of Conservation Status 2 lands. The Department of Defense owns or manages a relatively narrow linear corridor of Conservation Status 2 lands along the Snake River (G. Wilhere, WDFW, personal communication, 2003).

Conservation Status 3 – These lands are predominantly WDNR trust lands, followed by lesser amounts of BLM and U.S. Forest Service (USFS) lands. Washington Department of Natural Resources lands are comprised of regularly spaced section.

Conservation Status 4 – Within the Ecoregion, lands in this category are predominantly privately owned.

Management Considerations:
This zone has the second lowest proportion (84.9 percent) of Conservation Status 4 lands among the steppe zones. The conservation status of this zone is further enhanced by the size and connectivity of many of the Conservation Status 2 land and the defacto conservation status of Conservation Status 4 federal lands.

A long-term management priority is the need for creation and/or maintenance of the connections between steppe within this zone and steppe and forest adjacent to this zone. The Columbia River splits the Columbia Basin into an east and west side, and forms a natural barrier to many animal species. Conservation Status 2 lands on the west side are generally well-connected to one another by other Conservation 2 lands, Conservation Status 3 lands, or relatively undeveloped Conservation Status 4 lands.

Another important management consideration is maintenance of the continuity of the major riparian areas and protection of the link between riparian wetlands and adjacent steppe. The big rivers and streams of the central arid steppe vegetation zone are critical to wildlife in this zone of low rainfall. Besides the obvious presence of water, these rivers are associated with many important wildlife habitat features. Cliffs provide roosts for some bat species and nest sites for some bird species. Cliff-dwelling bats and birds forage in the adjacent steppe and over the river. The cliffs are in little danger of development, but cliff-dwelling animals may be affected by habitat alteration of the surrounding steppe and the riparian strip. Species that rely on the combination of sheer cliffs and large rivers have no alternate refuge.

4.1.7.2.2.3 Big Sagebrush/Fescue Vegetation Zone

General:
This 508,820-acre zone is transitional between the central arid steppe zone and neighboring meadow steppe zones (the Palouse and three-tip sage zones). The zone covers the central parts of Adams and Lincoln Counties and a small portion of the northwest corner of the Ecoregion (Palouse subbasin) (Figure_23). Its annual precipitation of 12 inches is similar to that of the central arid steppe zone but its higher elevation and cooler temperatures increase the effective precipitation (Cassidy 1997).

Climax Vegetation:
Native vegetation is similar to that of the central arid steppe zone, except that Idaho fescue joins bluebunch wheatgrass as a co-dominant bunchgrass. A cryptogamic crust of mosses and lichens covers the ground between the vascular plants (Daubenmire 1970; Franklin and Dyrness 1973).

Disturbance:
Most of the native bunchgrasses and forbs are poorly adapted to heavy grazing and trampling by livestock. Grazing tends to lead to increasing dominance by cheatgrass. Several exotic knapweed species have become more common in recent years (Harris and Chaney 1984). A 1981 survey estimated most of the remaining rangeland to be in generally poor to fair range condition, but ecological condition is generally worse than range condition.

Edaphic and other Special Communities:
Lithosols: Several old flood channels (the channeled scablands) cut through the deep loess. Communities of Sandberg bluegrass, rigid sagebrush, and buckwheat form on the shallowest soils (Daubenmire 1970). Saline/alkaline: Poorly drained saline or alkaline soils support communities dominated by saltgrass, sometimes with wildrye or greasewood co-dominants (Daubenmire 1970).

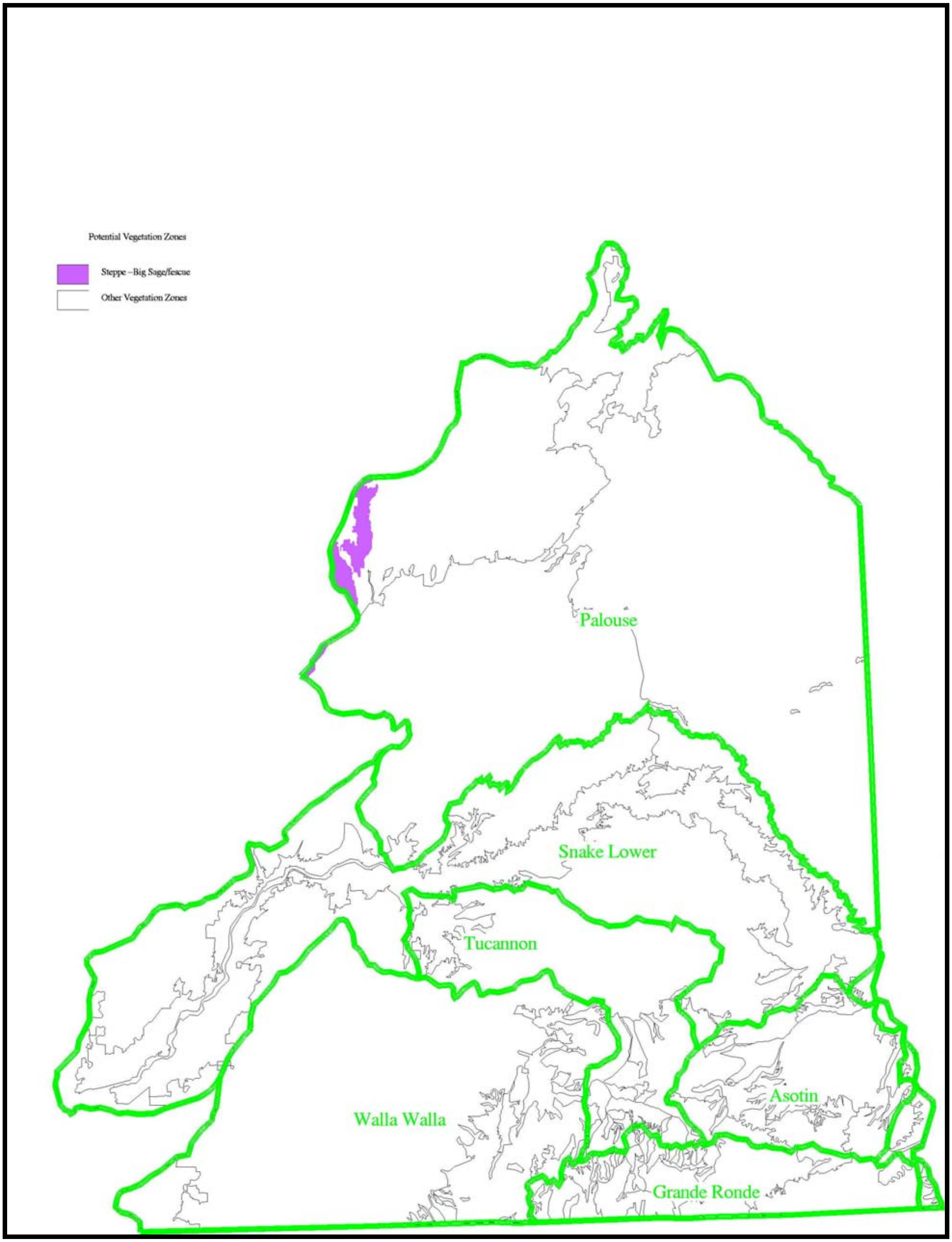

Figure 23. Historic (potential) big sage/fescue steppe vegetation zone of the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Current Land Use and Land Cover:
Agriculture – Over 75 percent of the entire vegetation zone is in agriculture (irrigated – 5.18 percent; non-irrigated – 69.86 percent; mixed irrigation status – 0.07 percent). Most sites on loess soil have been sown to winter wheat. Irrigated pastures and some crops are mostly along valleys, especially along Crab Creek, Lake Creek and near Lind. Only 43,499 acres of this vegetation zone occur in the Ecoregion. Cassidy (1997) reported that 9,090 acres have been converted to agriculture or CRP.

Open water/wetlands – Less than one percent (0.59 percent) of this vegetation zone is in open water/wetland habitats (open water – 0.14 percent; marshes, small ponds – 0.05 percent; riparian – 0.40 percent) The open water is primarily in the form of channeled scabland lakes and ponds. Wetlands are mostly narrow riparian strips along drainages.

Non-forested – Slightly more than 24 percent of the vegetation zone is composed of non-forested areas (grasslands – 21.48 percent; shrub savanna – 2.53 percent). Most of the non-forested vegetation of this zone occurs in the channeled scablands in the northern part of the zone in Lincoln County. Virtually none of the zone within the Ecoregion (Adams County) is left uncultivated.

Forested – No woodlands of any size occur in this zone.

Conservation Status of the Big Sage/Fescue Steppe Vegetation Zone (Cassidy 1997):
Conservation Status 1 – There are no Conservation Status 1 lands in the big sage/fescue steppe vegetation zone.

Conservation Status 2 – The sole parcel of land in Conservation Status 2 is owned by TNC and is situated in Rocky Coulee in northern Adams County (no Conservation Status 2 lands occur in this vegetation zone within the Ecoregion).

Conservation Status 3 – These lands consist almost entirely of regularly spaced section blocks owned by the WDNR. They are usually leased and either plowed or grazed. A very small amount of land is owned by the BLM.

Conservation Status 4 – All Conservation Status 4 lands in this vegetation zone within the Ecoregion are privately owned (Cassidy 1997).

Management Considerations:
A greater proportion of this vegetation zone than any other steppe zone, except the Palouse, has been converted to agriculture. It ranks second (after the Palouse) among steppe zones in the proportion of its area in private ownership. The single Conservation Status 2 parcel, a plot owned by TNC, is isolated from any other Conservation Status 2 land by many miles of private land. Wildlife corridors are primarily along the uncultivated coulees in Lincoln County. These coulees link the three-tip sage vegetation zone with the central arid steppe vegetation zone.

After Palouse steppe, native communities in the big sage/fescue vegetation zone, especially on deep soil sites, are more at risk of being completely lost than any others in the state. Since the WDNR is the major public land owner in the zone, any improvement of biodiversity protection on deep soil sites will depend heavily on WDNR land management policies (Cassidy 1997). Clearly, this vegetation zone warrants additional protection measures.

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 more than 800 exotic plant species have changed the character of shrubsteppe habitat. It is difficult to find stands which are still in relatively natural condition. The greatest changes from historic conditions are the reduction of bunchgrass cover in the understory and an increase in sagebrush and rabbitbrush cover. Soil compaction is also a significant factor in heavily grazed lands affecting water percolation, runoff and soil nutrient content.

In some areas, western juniper woodlands have greatly expanded their range, now occupying much more of the sagebrush ecosystem than in pre-European settlement times. The reasons for the expansion are complex and include interactions between climate change and changing land use, but fire suppression and grazing have played a prominent role in this dramatic shift in structure and dominant vegetation.

Quigley and Arbelbide (1997) concluded that big sagebrush and mountain sagebrush areas are significantly smaller than before 1900, and the bitterbrush/bluebunch wheatgrass association is similar to the pre-1900 extent. They concluded that successional pathways of basin big sagebrush and big sagebrush-warm potential vegetation types 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 (Anderson *et al.* 1998).

4.1.7.2.3 Recommended Future Condition

The general recommended future condition of sagebrush-dominated shrubsteppe habitat includes expansive areas of high quality sagebrush with a diverse understory of native grasses and forbs (non-native herbaceous vegetation less than 10 percent). More specific desired conditions include large unfragmented multi-structured patches of sagebrush with shrub cover varying between 10 and 30 percent. Good-condition shrubsteppe habitat has very little exposed bare ground, and supports mosses and lichens (cryptogammic crust) that carpet the area between taller plants. Similarly, Ecoregion land managers will manage diverse shrubsteppe habitats to protect and enhance desirable shrub species such as bitterbrush while limiting the spread of noxious weeds and increaser native shrub species such as rabbitbrush.

Sage thrasher (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), and mule deer (*Odocoileus hemionus hemionus*) were selected to represent the range of recommended conditions for shrubsteppe (shrubland) habitats within the Ecoregion. These wildlife species will also serve as performance measures to monitor and evaluate the results of implemementing future management strategies and actions (species accounts are located in Appendix F).

Subbasin wildlife managers will review the conditions described below to plan and, where appropriate, guide future enhancement/protection actions on shrubsteppe habitats. Specific desired future conditions; however, will be identified and developed within the context of subbasin-level management plans.

Condition 1 – Sagebrush dominated shrubsteppe habitat: The sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat (Knock and Rotenberry 1995; Paige and Ritter 1999; Vander Haegen *et al.* 2000).

Suitable habitat includes 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover.

Similarly, the Brewer's sparrow was selected to represent wildlife species that require sagebrush-dominated sites, but prefer a patchy distribution of sagebrush clumps 10-30 percent cover (Altman and Holmes 2000), lower sagebrush height (between 20 and 28 inches), (Wiens and Rotenberry 1981), native grass cover 10 to 20 percent (Dobler 1994), non-native herbaceous cover less than 10 percent, and bare ground greater than20 percent (Altman and Holmes 2000). It should be noted, however, that Johnsgard and Rickard (1957) reported that shrublands comprised of snowberry, hawthorne (*Crataegus douglasii*), chokecherry, serviceberry, bitterbrush, and rabbitbrush were also used by Brewer's sparrows for nesting in southeast Washington (within the Ecoregion). Specific, quantifiable habitat variable information for this mixed shrub landscape could not be found.

Condition 2 – Diverse shrubsteppe habitat: Mule deer was selected to represent species that require/prefer diverse, dense (30 to 60 percent shrub cover less than 5 feet tall [1.5 meters]) shrubsteppe habitats (Ashley *et al.* 1999) comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld *et al.* 1973; Sheehy 1975; Jackson 1990) with a palatable herbaceous understory exceeding 30 percent cover (Ashley *et al.* 1999).

Change in the extent of shrubsteppe habitat from circa 1850 to 1999 is illustrated at the 6^{th} – level HUC in Figure_24 (NHI 2003). Red color tones indicate negative change while blue color tones indicate positive change. The positive change is likely the result of shrub encroachment on grassland habitats due to over-grazing and fire suppression. In contrast, the negative change is due primarily to conversion of shrubsteppe to agriculture.

Although the data is displayed at the 6^{th} – level HUC, it does not necessarily mean that the entire hydrologic unit was historically, or is currently comprised completely of the shrubsteppe habitat type. The data simply indicates that the shrubsteppe habitat type occurred somewhere within a particular hydrologic unit.

The data displayed in Figure_24 can be used by subbasin planners to identify and prioritize conservation and restoration areas and strategies. For example, planners may develop a hierarchal approach to protecting shrubsteppe habitats where hydrologic units that have exhibited positive change receive a higher initial prioritization than those that have experienced a negative change. Ecoregion planners could then cross-link this information with other data such as ECA and GAP management-protection status to develop comprehensive strategies to identify and prioritize critical areas and potential protection actions.

The data could also be used to identify areas formerly occupied by grassland habitats and/or grassland vegetation zones that are currently shrubsteppe. If protecting or increasing grassland habitats is a higher priority than shrubsteppe habitats within the Ecoregion or particular subbasin, areas could be identified and prioritized in which encroaching shrubsteppe habitats would be returned to grasslands. Management strategies to accomplish this, such as the use of controlled burns, could then be developed and linked to specific goals and objectives.

4.1.7.3 Eastside (Interior) Grasslands

4.1.7.3.1 Historic

Prior to 1870, the rolling hills of the Palouse were covered by grassland prairie (steppe grassland). Early settlers cleared trees in the lowlands, shrubs on the steep north sides, and

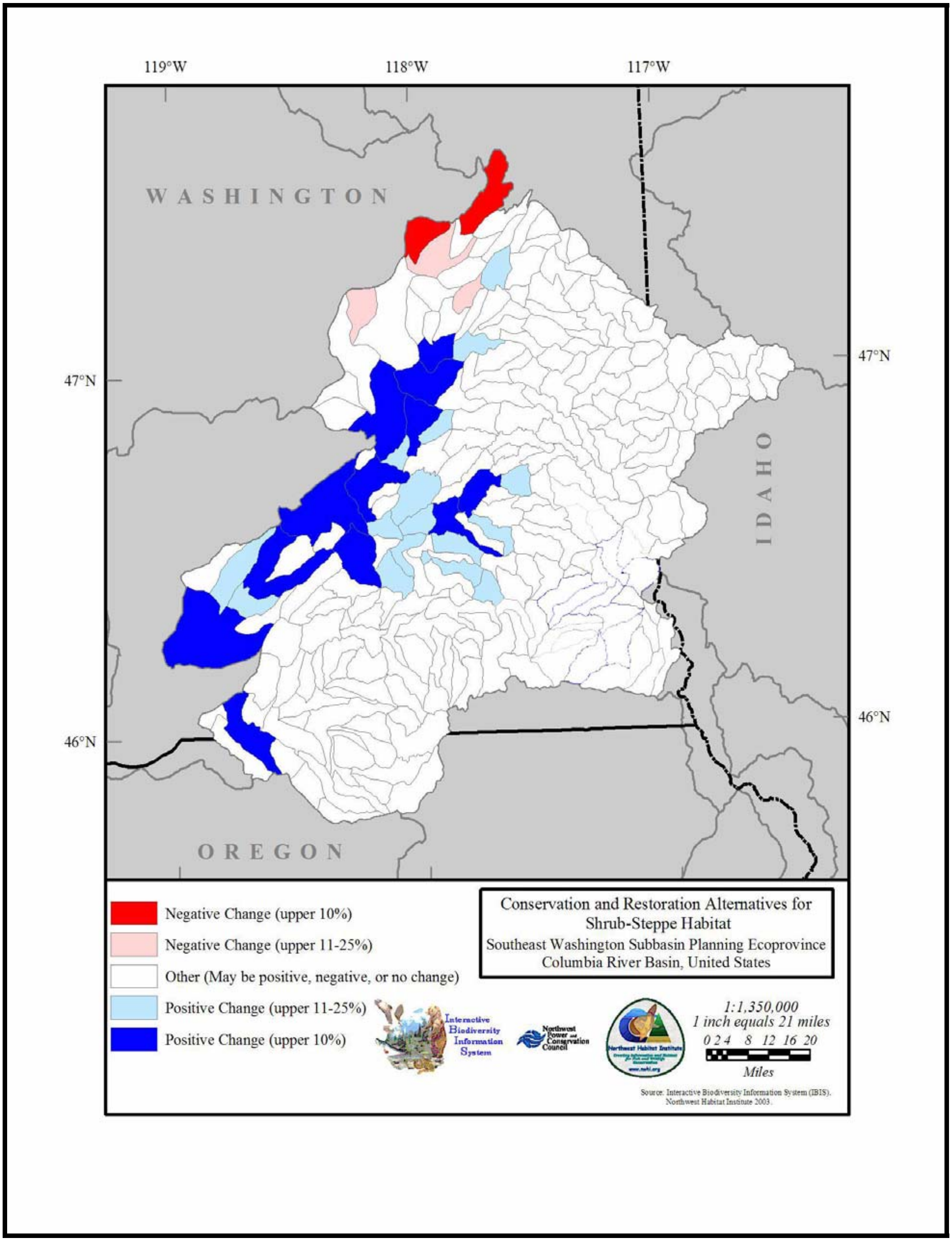

Figure 24. Shrubsteppe conservation and restoration alternatives (NHI 2003).

burned and plowed the prairie grasses to plant crops. In addition, miles of fence were built to contain livestock and act as property boundary markers.

Buss (1965) suggested that early pioneers homesteaded in the valleys and canyons and that deep soil grasslands were the first areas to be converted to commercial crop production as farming became more mechanized. Virtually all arable land in the basin was settled from 1870-1885. Domestic livestock brought by settlers overgrazed riparian zones and rangelands and contributed towards habitat fragmentation.

Daubenmire (1970) suggested that prior to European settlement bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass were the dominant native perennial grasses within interior grasslands and that specific grass dominance changed based on plant association type. Daubenmire (1970) further concluded that astragalus (*Astragalus* spp*.*), balsam root (*Balsamorhiza sagittata*)*,* Carex, potentilla (*Potentilla gracilis*)*,* and brodia (*Brodiaea douglasii*) were present and decreased with livestock grazing.

Extant shrubs consisted of scattered rabbitbrush, big sagebrush, snowberry, and rose; again depending on plant association type. On shallow lithosols soils, rigid sagebrush and buckwheats provided woody structure (Daubenmire 1970). Historic and current grassland distribution within the Ecoregion is illustrated in Figure_25 and Figure_26.

4.1.7.3.2 Current

Throughout much of the Ecoregion, native interior grasslands have either been replaced by agricultural crops or severely reduced as a result of competition from introduced weed species, such as cheatgrass. Native perennial bunchgrasses and shrubs are presently found only on a few "eyebrows" on steep slopes surrounded by wheat fields, or in non-farmed canyon slopes and bottoms within agricultural areas (Figure_38).

Daubenmire (1970) stated that bluebunch wheatgrass and Idaho fescue are the characteristic native bunchgrasses of this habitat type and either or both can be dominant. Idaho fescue is common in more moist areas, and bluebunch wheatgrass is more abundant in drier areas. Rough fescue (*F. campestris*) is characteristically 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 is usually present and occasionally co-dominant in drier areas. Bottlebrush squirreltail and Thurber needlegrass (*Stipa thurberiana*) can be locally dominant. Where present, alkali sites are still predominantly giant wildrye (*Elymus cinereus*) and salt grass (*Distichlis stricta*).

Annual grasses are usually present; cheatgrass is the most widespread. Medusahead (*Taeniatherum caput-medusae)*, and other annual bromes such as meadow brome (*Bromus commutatus*), soft brome (*B. hordeaceus*), and Japanese brome (*B. japonicus*) may be present to co-dominant. Moist environments, including riparian bottomlands, are often co-dominated by Kentucky bluegrass (*Poa pratensis*)*.*

Interior grasslands historically included four vegetation zones: Palouse steppe (1,160,000 acres), Blue Mountain steppe (160,295 acres), wheatgrass/fescue steppe (2,148,000 acres), and canyon grassland steppe (516,230 acres) (Figure_27) (Daubenmire 1970; Cassidy 1997). The more mesic zone, located on the wet eastern edge of the Palouse Prairie, was dominated by Idaho fescue and bluebunch wheatgrass. The drier western portion of the Palouse Prairie was dominated by bluebunch wheatgrass. Most interior grassland vegetation zones are currently under cultivation. The four grassland vegetation zones are described below.

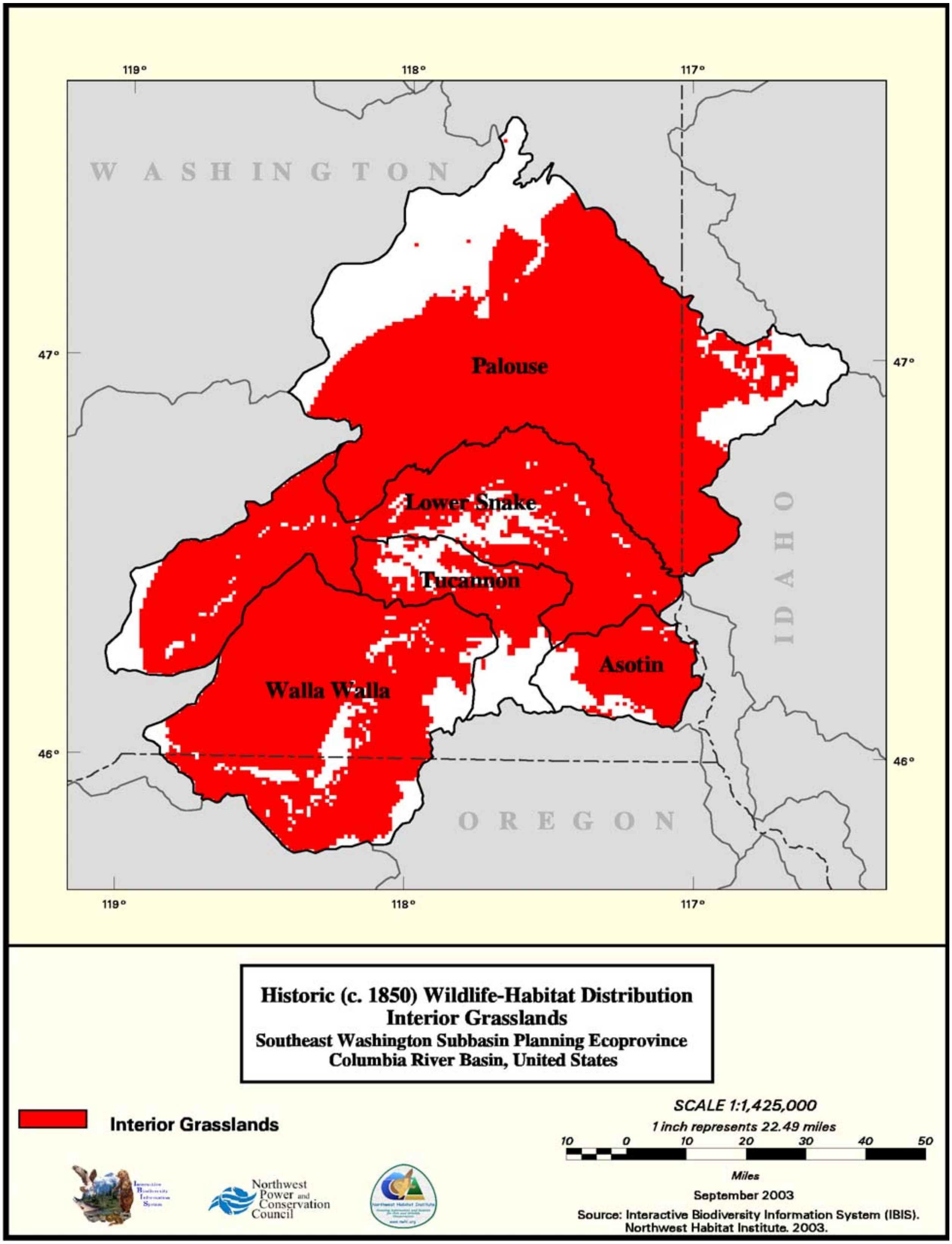

Figure 25. Historic eastside (interior) grassland distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

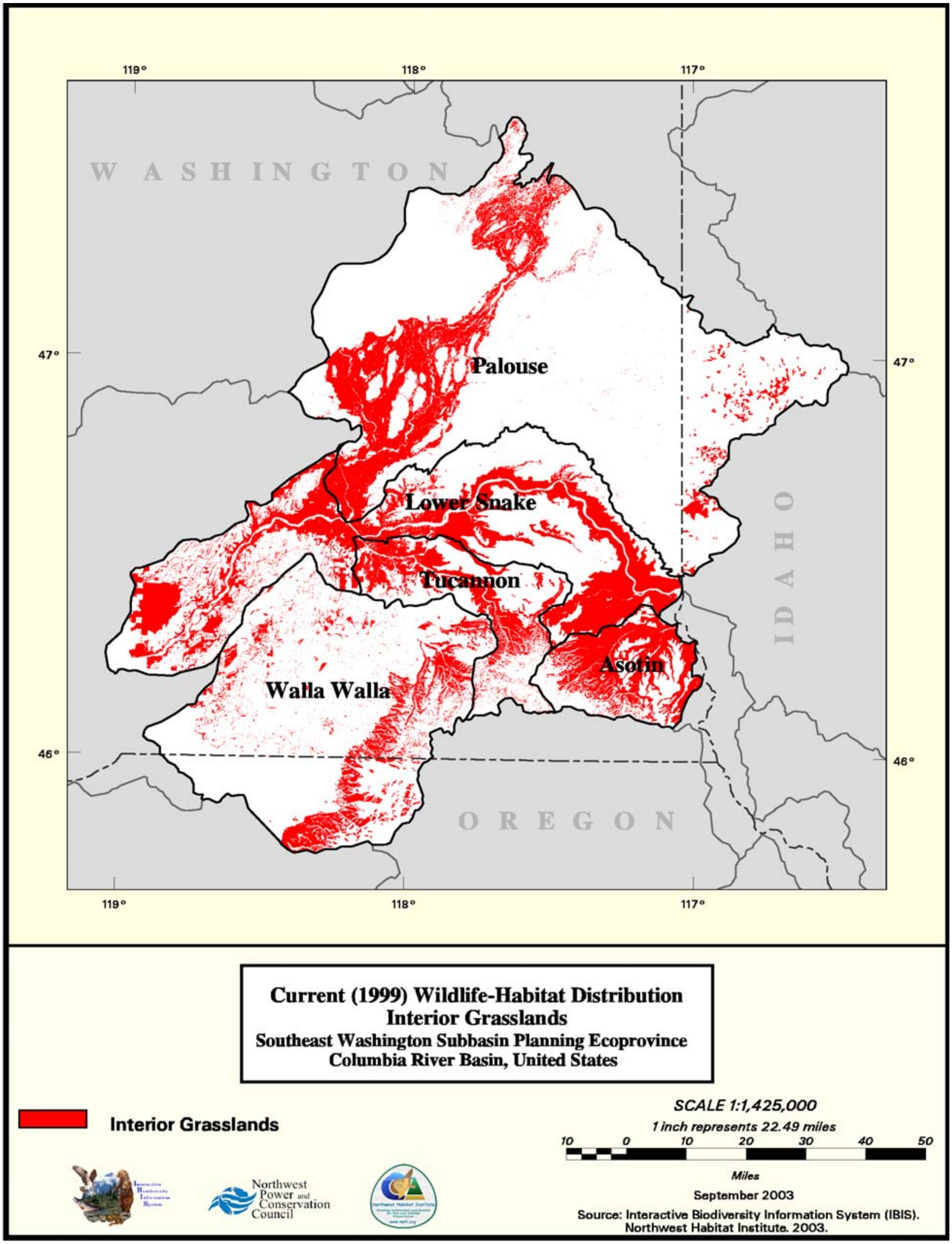

Figure 26. Current eastside (interior) grassland distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

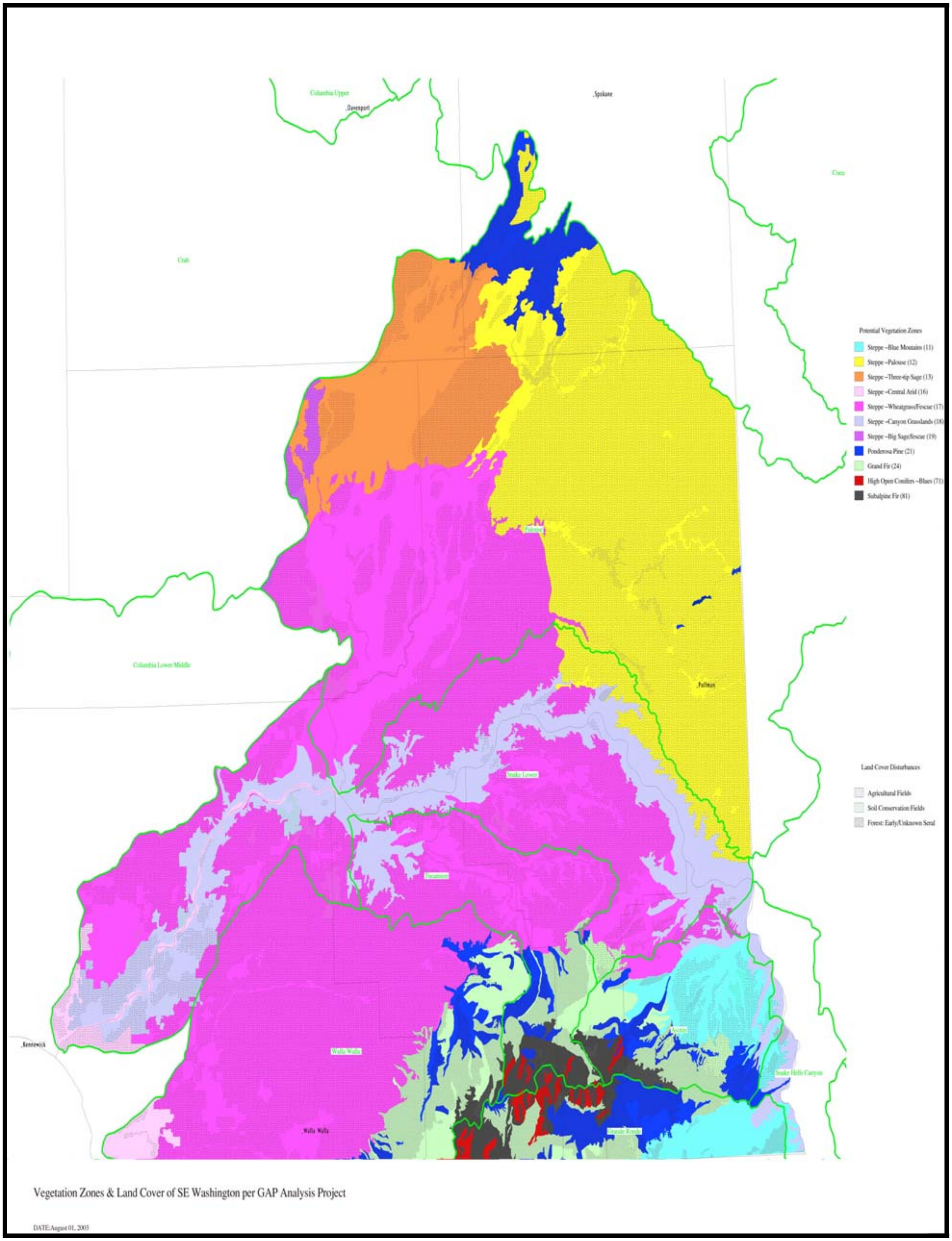

Figure 27. Historic (potential) vegetation zones of the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

4.1.7.3.2.1 Palouse Vegetation Zone

General:
The Palouse vegetation zone covers 1,160,000 acres in Washington and extends to the east into Idaho (Figure_28). Annual precipitation of 17 to 21 inches falls mostly on rolling hills of deep loess. Climax native vegetation is lush herbaceous growth punctuated with shrub thickets. The distribution of shrub thickets, grassy stands, and sedge stands appears to be related to the depth of the soil layers.

The dominant shrub is snowberry, with nutkana rose, Wood's rose, and common chokecherry also playing major roles (Despain *et al.* 1983). Dominant grasses are Idaho fescue, bluebunch wheatgrass, Junegrass (*Koeleria cristata*), and big bluegrass (*Poa ampla*). The forb flora is especially diverse. The forbs with the greatest mean percent cover are balsamroot (*Balsamorhiza sagittata*), old man's beard (*Geum trifiorum*), and northwest cinquefoil (*Potentilla gracilis*), but numerous others are common (Despain *et al.* 1983).

Fire evidently has little effect on Palouse species composition, since most species resprout after burning (Daubenmire 1975). The Palouse, like most of the steppe zones, has been very susceptible to invasion by exotic plants. Grazing in particular leads to replacement of the native flora by a variety of exotic species. Eventual domination by Kentucky bluegrass is common on deep soil sites.

On the shallower soils and drier parts of the zone, cheatgrass is usually the eventual dominant (Mack 1986). A 1981 survey of range conditions rated the few remaining rangelands on the Palouse in fair to good range condition, but ecological condition is usually worse than range condition (Aller *et al.* 1981; Harris and Chaney 1984).

Edaphic and other Special Communities:
Lithosols: The northwestern edge of the Palouse zone extends into the channeled scablands where the characteristic loess was washed away by Ice Age floods. Shallow soils of the scablands support rigid sagebrush and buckwheat communities (Desdain *et al.* 1983). Eyebrows: An interesting feature of this zone is the presence of "eyebrows" on loess hills. The loess hills have a dune-like formation with a southwest/northeast alignment created by the prevailing southwest winds. The eyebrows form on the lee sides of the dunes, generally the northeast faces. The steep, uncultivated eyebrows are conspicuous among the monotonous wheat fields. Though usually small (on the order of 2 acres or less), they often support relatively undisturbed patches of native Palouse vegetation (Desdain *et al.* 1983). Topoedaphic: South-facing slopes may support climax associations more common in warmer, drier parts of the Basin, such as wheatgrass. Steep north slopes with perched water tables may support an elk sedge (*Carex geyeri*) dominated association.

Land Use and Cover:
Wetlands: Riparian areas, bottomlands, and some north slopes support black hawthorn, ponderosa pine, and quaking aspen groves. Cow parsnip (*Heracleum maximum*) is a common dominant of the understory.

Agriculture: Over 88 percent of the Palouse vegetation zone is used for agriculture (irrigated – 0.58 percent; non-irrigated – 87.16 percent; mixed – 0.33 percent). The overwhelming predominant land cover in this zone is dryland agriculture. The major crop is winter wheat, with lesser amounts of dry peas and lentils, rape seed, and spring wheat. The dryland agricultural fields are generally unbroken monocultures of wheat. Fence rows are rare. The only significant breaks in row crops over much of the Palouse are roadside ditches and the eyebrows of loess

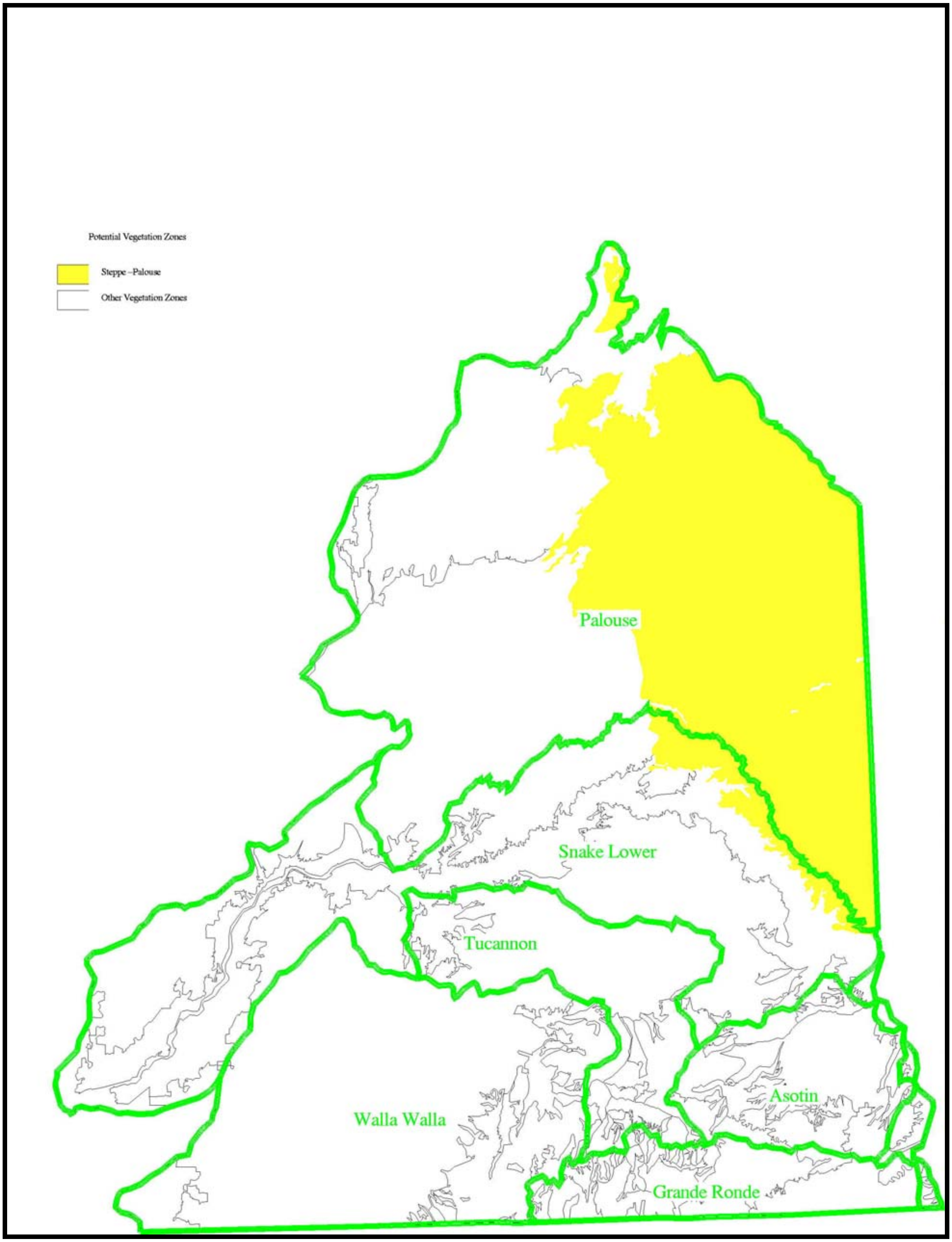

Figure 28. Historic (potential) Palouse vegetation zone of the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

hills. Other agricultural lands are irrigated fields or a mix of irrigated and non-irrigated fields concentrated in the Palouse River valley and other low-lying areas along drainages.

Open water/wetlands: Less than 1.5 percent of the vegetation zone remains in riparian wetland habitats (open water – 0.27 percent; marshes and ponds – 0.07 percent; riparian – 0.96 percent). The Palouse River, including its North and South Forks, and Union Flat Creek are the major wetlands in this zone. Channeled scabland ponds and drainages at the northwestern edge of the zone are also important.

Forest: Approximately 3.09 percent (hardwood/mixed – 0.01 percent; conifer – 3.09 percent). Forests are usually ponderosa pine woodlands in sheltered ravines, along the Palouse River canyon, and along creeks in the northwestern part of the zone. Quaking aspen groves are small, but are common among coniferous forests and in riparian areas (Franklin and Dyrness 1973 in Cassidy 1997).

Conservation Status of the Palouse Vegetation Zone (Cassidy 1997):
The Palouse vegetation zone is the most extreme case in Washington of a common conservation dilemma: should resources be expended to preserve or reconstruct a habitat type that is virtually gone and that would be expensive to restore? Or, would these resources be better expended on other habitats? The Palouse owes its destruction to its value as cropland. A greater proportion of this zone has been converted to agriculture than any other zone in Washington. It is among the most productive of dryland wheat areas in the world, and the cost of land is high. Potential reconstruction of previously plowed lands is further complicated by the large numbers of aggressive exotic plants that have become firmly established on the Palouse and by the problems of managing habitat islands. The Conservation status of lands within the Palouse vegetation zone is depicted in Table_17.

Table 17. Conservation status of the Palouse vegetation zone (Cassidy 1997).

Manager/Owner	High Protection (Acres)	Medium Protection (Acres)	Low Protection (Acres)	No or Unknown Protection (Acres)
Private	0	0	0	1,119,969
NWR	0	906	0	0
DOD	0	0	0	487
WDNR/State Park	0	69	0	0
WDNR Trust	0	0	31,033	0
State University, Research	0	0	556	0
State University, Reserve	0	30	0	0
State University, Other	0	0	0	1,573
TNC	0	22	0	0
Total	**0**	**986**	**31,589**	**1,122,029**
Percent Protected	0.0	0.09	2.74	97.17

Conservation Status 1 – There are no Conservation Status 1 lands in the Palouse vegetation zone.

Conservation Status 2 – The largest areas of Palouse Conservation Status 2 lands are the 906 acres located at the southeastern and southwestern edge of the Turnbull National Wildlife Refuge. The Turnbull National Wildlife Refuge includes riparian and steppe vegetation. The steppe vegetation is on shallower soil than is typical for the Palouse, but appears to be dominated by native vegetation rather than exotics (Cassidy 1997). The second largest area in the Conservation Status 2 category is Kamiak Butte State Park, which is owned by the WDNR. Most of the park lies in the Douglas-fir zone; however, approximately 69 acres on its southern edge support steppe vegetation.

The 30-acre Kramer Palouse Natural Area is owned by Washington State University and is managed as a reserve. This relatively undisturbed tract 20 miles west of Colton (Whitman County) supports the modal Palouse Idaho fescue/snowberry association with relatively few invading exotics. The site also has small patches of black hawthorn associated with bottomlands, plus a topographic climax association of bluebunch wheatgrass/Sandberg bluegrass on a south-facing slope. The 22-acre Rose Creek Preserve owned by TNC is on a low-lying riparian area and includes representative Palouse riparian vegetation. A few small areas of steppe vegetation also occur on the Rose Creek Preserve.

Conservation Status 3 – Conservation Status 3 lands are regularly spaced sections of WDNR land. In this zone, many of these lands are farmed. Conservation Status 3 lands also include the Smoot Hill Facility, a semi-natural research parcel near Albion owned by Washington State University. Smoot Hill, which is adjacent to the Rose Creek Preserve, includes annual-dominated grasslands, CRP lands planted to perennial grass, riparian areas, and a few patches of relatively undisturbed Palouse steppe.

Conservation Status 4 – These lands comprise a greater proportion of this zone than any other vegetation zone in the state. The vast majority of these lands are private and used for agriculture. The bulk of Washington State University lands and a portion of Fairchild Airforce Base in the extreme north edge of the zone are also in this category.

Increased biodiversity protection and restoration of the Palouse might be most effectively accomplished by expansion around existing Conservation Status 2 lands. Possibilities include increased protection and expansion of the Smoot Hill Facility and Turnbull National Wildlife Refuge. The Palouse River corridor, including its north and south forks, offers another option for improved biodiversity management of the zone. Though none of the Palouse River valley is currently categorized as Conservation Status 2, the steeper, uncultivated river banks form a fragmented corridor through nearly unbroken wheat fields, connecting channeled scablands to the west and forested land in Idaho to the east (Cassidy 1997). The Palouse vegetation zone extends into the northern edge of the Blue Mountains which supports a narrow, discontinuous strip of the Idaho fescue/snowberry plant community.

4.1.7.3.2.2 Blue Mountains Steppe Vegetation Zone

General:
The small, distinctive Blue Mountains steppe vegetation zone occupies 160,550 acres in the extreme southeastern corner of Washington. This zone lies in the rain shadow on the eastern side of the Blue Mountains. It receives less precipitation and has a more shallow loess cover than the west side of the Blue Mountains. The zone is on the folded basalt that forms the Blue Mountains, hence its inclusion in the Blue Mountains region rather than the Columbia Basin region (Figure_29).

Climax Vegetation:
The floristic composition of Blue Mountains steppe is similar to that of the Palouse zone, but the folded basalt topography gives Blue Mountains steppe vegetation a different spatial pattern. While the Palouse is a mosaic of random-appearing shrub patches among lush herbaceous

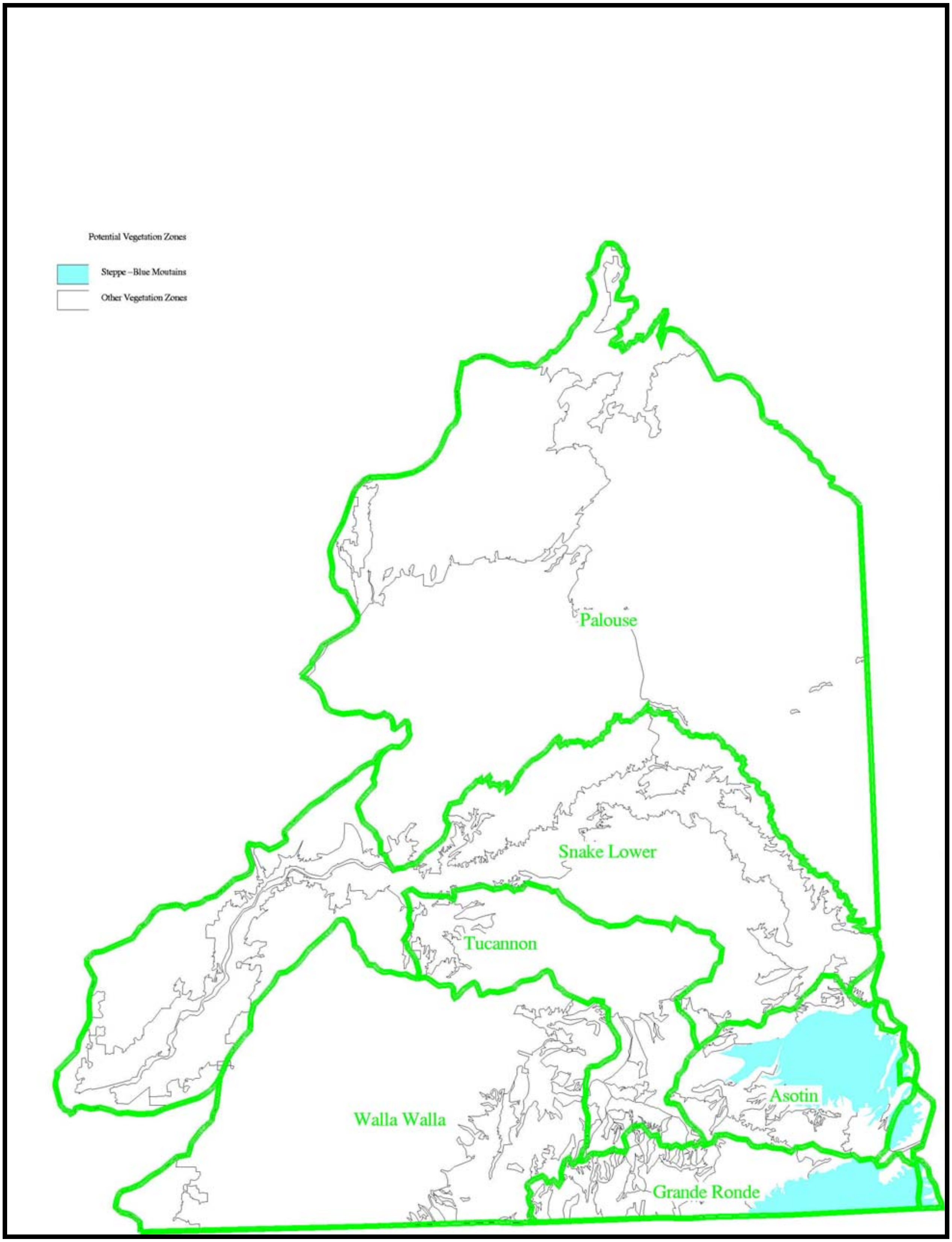

Figure 29. Historic (potential) Blue Mountains steppe vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

growth, the characteristic pattern in the Blue Mountains steppe zone is one of shrubby swales regularly alternating with herb-covered “humps” on slopes. Another difference between the two zones is that snowberry, the dominant shrub of the Palouse, is rare in the Blue Mountains steppe zone, appearing primarily as an understory species in ponderosa pine woodlands that occur on north slopes and ravines. The dominant shrubs of Blue Mountains steppe are nutkana rose and Woods’ rose. The herbaceous component is diverse and similar to that of the Palouse. Dominant perennial grasses are Idaho fescue, bluebunch wheatgrass, June grass, and Sandberg bluegrass. A large number of forbs are present. Balsamroot, cinquefoil, and old man’s whiskers (*Geum triflorum*) are among those with the highest mean cover (Daubenmire 1970; Franklin and Dyrness 1973).

Disturbance:
Grazing leads to replacement of native vegetation by exotic annuals, particularly cheatgrass and yellow starthistle (*Centaurea solstitialis*) (Mack 1986; Roche and Roche 1988). Though much of the zone is grazed, a 1981 survey rated most of the rangeland in fair to good range condition; however, ecological condition is usually worse than range condition (Harris and Chaney 1984).

Edaphic and Other Special Communities:
<u>Riparian</u>: The Grande Ronde River and its lower tributaries flow through this zone. Riparian areas are dominated by black hawthorn, black cottonwood, white alder, and netleaf hackberry (*Celtis reticulata*). <u>Topographic</u>: Precipitation is nearly as high as the adjacent forested zones, and draws on north slopes often support ponderosa pine stands. The transition between this zone and the neighboring zones is an aspect-dependent interdigitation of vegetation of the neighboring zones. Near the ponderosa pine zone, the pattern of shrubs in draws and herbs on humps gives way to ponderosa pine in draws and shrubs on humps. The drier edges of the Blue Mountains steppe fade into canyon grassland, its characteristic Idaho fescue/nutkana rose association increasingly shifts to north slopes, while southern aspects support the characteristic canyon grassland association of bluebunch wheatgrass/sandberg bluegrass. Though this area is sufficiently mesic for winter wheat, the topography prevents much cultivation. Croplands, which occupy 23 percent of this vegetation type, are usually on plateaus of relatively deep loess in the northern part of the zone. The southern part of the zone has few fields. Crops are primarily dryland wheat with some CRP fields (Frank and Dyrness 1973).

Land Use and Cover:
Open water/wetlands comprise little more than 2 percent of this vegetation zone (open water – 0.41 percent; riparian – 1.89 percent). Part of the Grande Ronde River accounts for the open water. Major riparian zones occur along the Grande Ronde River, Joseph Creek, and Asotin Creek and are dominated by hardwoods.

Non-forested areas total over 61 percent of the vegetation zone (grasslands – 45.63 percent; shrub savanna – 0.08 percent; shrublands – 15.70 percent; tree savanna – 0.04 percent). The most common land cover in this zone is a slope in which the primary cover of herbaceous vegetation on the “humps” occupies 50 to 75 percent of the slope and the secondary cover of shrubs in the swales occupies 25 to 50 percent of the slope. Most of the non-forested cover is grazed but the level of disturbance caused by grazing is difficult to estimate in such rugged topography.

Forest lands within this zone encompasses approximately 13 percent of the landscape (all conifer; open-canopy – 11.42 percent; closed-canopy – 0.57 percent; mixed/unknown canopy closure – 1.1 percent). The high precipitation in this zone combined with the complex topography provides numerous edaphic and topographic situations where conifer forest can grow. The result is the highest conifer forest component of any steppe zone. Primary cover on many north-facing slopes is predominately open ponderosa pine woodlands. Ponderosa pine woodlands also occur as secondary cover in drier parts of the zone in swales and ravines. The small amount of closed conifer forest is mostly dominated by Douglas-fir, ponderosa pine, western larch, and grand fir, and generally occurs as secondary cover with a primary cover of open forest.

Conservation Status of the Blue Mountains Steppe Vegetation Zone (Cassidy 1997):
Conservation Status 1 – Like the Palouse vegetation zone, there are no Conservation Status 1 lands in the Blue Mountains vegetation zone (Cassidy 1997).

Conservation Status 2 – Compared to other steppe zones, this zone has a high percentage (11.2 percent) of its area categorized as Conservation Status 2 lands, but since it is a small zone, the actual area (17,968 acres) in this category is small. The protection status of this zone is enhanced by its relatively low fragmentation by agriculture and development, especially in the Grand Ronde River valley.

Parts of the Asotin Creek and Chief Joseph Wildlife Areas provide Conservation Status 2 protection. The Chief Joseph Wildlife Area lies mostly in this zone with a small part in the neighboring canyon grassland zone along the Snake River. The fragmented Asotin Creek Wildlife Area is mixed with USFS and WDNR tracts at the northwestern part of the zone.

Conservation Status 3 – Tracts of WDNR and BLM land mingle around and among the Chief Joseph Wildlife Area. Tracts of USFS and WDNR lands are mixed with the Asotin Creek Wildlife Area. Other WDNR lands are regularly spaced section blocks. The northeast corner of the zone lies partly on the Umatilla National Forest.

Conservation Status 4 – Conservation Status 4 lands, all privately owned, occupy the largest part of the zone. The conservation status of all lands within this vegetation zone is shown in Table_18.

Table 18. Conservation status of the Blue Mountains vegetation zone (Cassidy 1997).

Manager/Owner	High Protection (Acres)	Medium Protection (Acres)	Low Protection (Acres)	No or Unknown Protection (Acres)
Private	0	0	0	119,397
USFS	0	0	4,187	0
BLM	0	0	6,694	0
WDFW	0	17,928	0	0
State Parks and Recreation	0	40	0	0
WDNR Trust	0	0	12,049	0
State University, Other	0	0	0	0
Total	**0**	**17,968**	**22,930**	**119,397**
Percent Protected	0.0	11.2	14.3	74.5

The existing protection status of this zone is high for a steppe zone, especially for a mesic steppe zone. Because grazing represents the greatest current extractive land use, short-term management goals should center on strategies to avoid over-grazing. Long-term planning should consider the effects of population expansion from nearby Lewiston and Clarkston that could result in extensive development along the scenic Grande Ronde River. Development could lead to isolation of the Chief Joseph Wildlife Area.

4.1.7.3.2.3 Wheatgrass/Fescue Steppe

"This part of the country to the north is an entire level plain of gravel and sand. Destitute of timber, not even a shrub exceeding 4 feet in height, except a few low straggling birch and willows on the sides of rivulets or springs."

- David Douglas, June 18, 1826, west of the Blue Mountains in Washington or Oregon (Davies 1981:71)

General:
The 2,148,000-acre wheatgrass/fescue zone is the third largest steppe zone in Washington (Figure_30). It extends into northeastern Oregon, but is largely absent from southeastern Oregon. Annual precipitation is 13 – 17 inches. Soils are typically wind-deposited loess. The deep loess that covers most of this zone is ideal for winter wheat. Poorer soil types are often used as pasture.

Climax Vegetation:
In its undisturbed condition, the characteristic community is monotonous grassland dominated by bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. Shrubs and perennial forbs are inconspicuous except for scattered gray rabbitbrush. The Snake River splits this zone into northern and southern halves. The southern half, influenced by more complex topography and soils and partly in the rain shadow of the Blue Mountains, supports vascular species, such as prickly pear cactus (*Opuntia polyacantha*), that do not occur in the northern half. In the rain shadow of the Blue Mountains, this zone reaches just under 3,000 feet on south-facing slopes. At high elevations, bluebunch wheatgrass and Idaho fescue may share dominance with mountain big sagebrush, the diploid high-elevation subspecies of big sage (Franklin and Dymess 1973).

Disturbance:
Most of the native bunchgrasses and forbs are poorly adapted to grazing and trampling by livestock. Introduced cheatgrass tends to increase with grazing until it dominates. In recent decades, another introduced annual, yellow starthistle, has been replacing cheatgrass as the dominant species of disturbed sites (Roche and Roche 1988). Yellow starthistle is now more common than cheatgrass in some grasslands south of the Snake River (Mack 1986). In 1981, rangeland north of the Snake River was estimated to be in generally poor or fair range condition. Rangeland south of the Snake River was estimated to be in generally poor range condition, but ecological condition is usually worse than range condition (Harris and Chaney 1984).

Edaphic and other Special Communities:
Saline/alkaline: Heavy valley soils support basin wildrye/saltgrass dominated communities. Lithosols: Shallow soils, which predominate the channeled scablands on the northwestern side of the zone, support communities dominated by Sandberg bluegrass, buckwheat, and rigid sagebrush. Sand: The western edge of the zone north of the Snake River in Franklin County lies on an extensive sandy area. Stabilized sandy soils support needle and thread communities. Unstabilized sand dunes in southern Franklin County support a western juniper community that is unique in Washington and disjunct from the far more extensive juniper communities to the south in Oregon and Idaho. On the juniper dunes, juniper forms tracts of savanna, with a

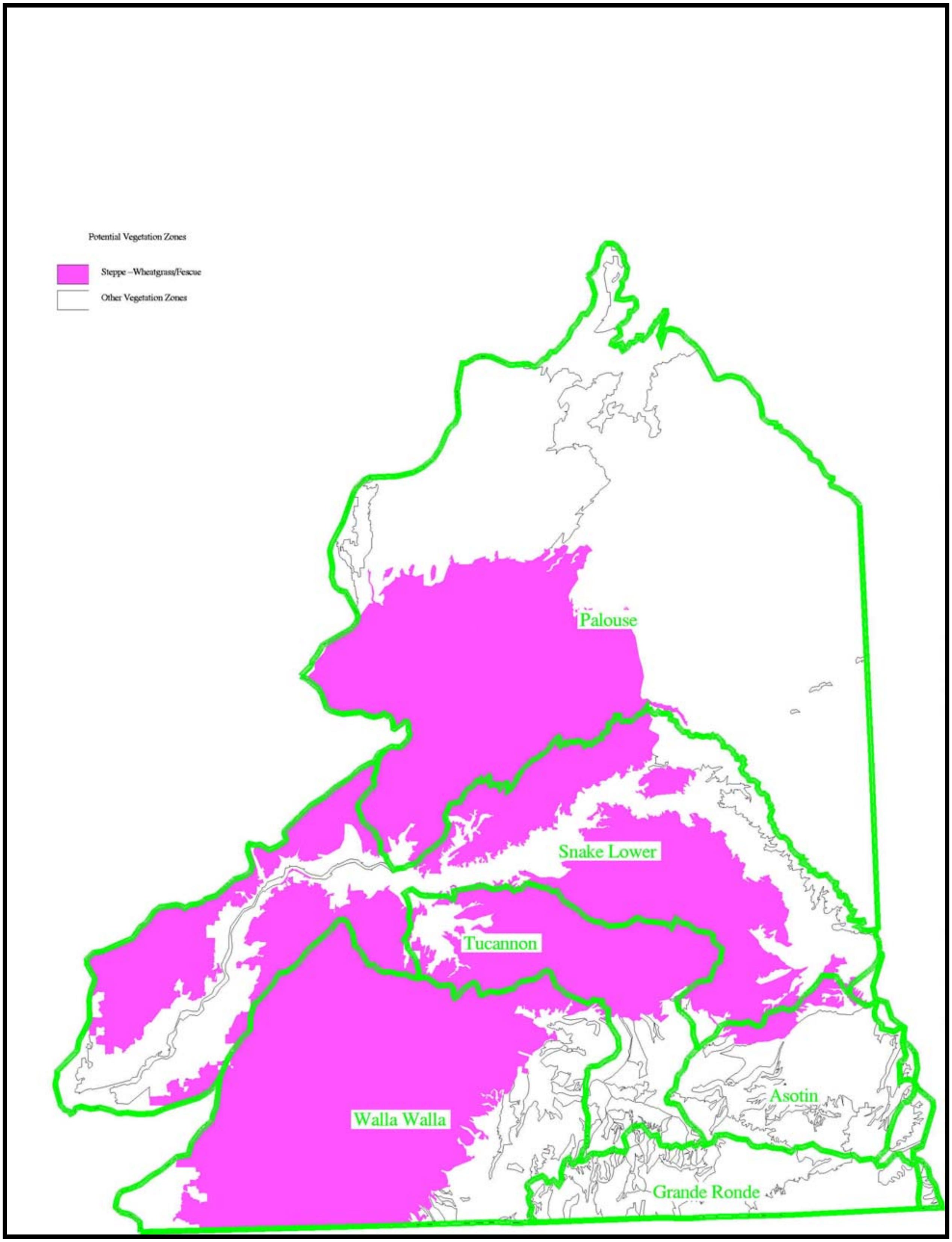

Figure 30. Historic (potential) wheatgrass/fescue steppe vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

maximum plant height of 22 feet, between tracts of moving dunes. A variety of other shrubs and herbs grow between the junipers, including cheatgrass, bitterbrush, big sagebrush, and gray rabbitbrush, but none obtains dominance. The moving dune surfaces support only a sparse vegetation cover dominated by yellow wildrye (*Elymus flavescens*) (Daubenmire 1970).

Current Land Use and Land Cover:
Agriculture: Over 69 percent of this zone is in agricultural production (irrigated – 3.95 percent; non-irrigated – 64.95 percent; mixed irrigation status – 0.67 percent). This zone ranks third among steppe zones in proportion of its area under cultivation. The deep soils and gentle topography of this zone make it a productive dryland wheat area. Irrigated fields are concentrated along the Walla Walla River where a variety of crops are grown.

Open water/wetlands: Approximately one percent (0.99 percent) of this zone is comprised of open water and wetlands (open water – 0.01 percent; marshes, small ponds – 0.14 percent; riparian – 0.84 percent). The largest riparian areas are along the Walla Walla River and its tributaries. Other rivers include part of the lower Tucannon, the Touchet, and the lower Palouse.

Non-forested: Just under 28.5 percent of the zone is non-forested (sparse timber – 0.03 percent; grassland – 24.68 percent; shrub savanna – 1.72 percent; tree savanna – 0.17 percent; mixed/indeterminate – 0.39 percent; and shrubland – 1.49 percent). Non-forested cover is limited mostly to channeled scablands, sandy soils and the uneven rocky topography near the Blue Mountains. The coulees and scablands in eastern Adams and western Whitman Counties are the most extensive areas of steppe (disturbed and undisturbed) vegetation. The sandy Juniper Dunes area of southern Franklin County is a relatively large contiguous uncultivated area. Other breaks in the wheat fields are the ravines and coulees in northern Garfield County, the canyons associated with the lower Touchet River in western Walla Walla County, and the ridges and gulches of northwestern Asotin County. The latter are a mix of steppe and open ponderosa pine woodlands.

Forested: Less than 0.5 percent of the zone is forested (all conifer). The rare forests are open ponderosa pine woodlands on north slopes near the Blue Mountains. Most of these are in northeastern Asotin County.

Conservation Status of the Wheatgrass/Fescue Vegetation Zone (Cassidy 1997):
As with other steppe zones, most land falls under the “no or unknown” protection status category and are held under private ownership (Table 19). Less than one percent of this steppe zone has high or medium protection status combined, while slightly more than 6 percent is afforded low protection status.

Conservation Status 1 – These lands are the BLM lands that form the Juniper Dunes Wilderness in Franklin County. The wilderness lies on sandy soil and includes unstabilized dune communities and juniper savanna. The Conservation Status 2 BLM lands are adjacent to or near the wilderness.

Conservation Status 2 – The vast majority of Conservation Status 2 lands are the BLM lands around the Juniper Dunes Wilderness. These parcels lie mostly on sandy soil. Other Conservation Status 2 lands are much smaller (on the order of 640 acres or less in size). They include the Kahlotus Ridgetop Preserve (Franklin County), Palouse Falls State Park (Franklin County), the edge of Lyons Ferry State Park (Franklin and Whitman Counties), and a piece of the W. T. Wooten Wildlife Area (Columbia and Garfield Counties). The Kahlotus Ridgetop Preserve includes one of the largest remaining examples of undisturbed vegetation on deep

Table 19. Protection status of lands within the wheatgrass/fescue vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Manager/Owner	High Protection (Acres)	Medium Protection (Acres)	Low Protection (Acres)	No or Unknown Protection (Acres)
Private	0	0	0	2,002,412
BLM, ACEC	0	7,741	0	0
BLM, Wilderness	7,378	0	0	0
BLM, other	0	0	7,892	0
DoE	0	0	0	714
WDFW	0	701	0	0
State Parks and Recreation	0	284	0	0
WDNR, State Park	0	247	0	0
WDNR Trust	0	0	121,200	0
State Dept. of Corrections	0	0	0	995
Total (Acres)	**7,378**	**8,973**	**129,092**	**2,004,121**
Percent Protected	0.34	0.42	6.01	93.23

loess, but about half of it is now dominated by introduced annuals (Cassidy 1997). Lyons Ferry and Palouse Falls State Parks are at the edge of this zone where it meets the canyon grasslands zone. Palouse Falls State Park features sheer basalt cliffs, a waterfall, areas of relatively undisturbed steppe vegetation above the cliffs, and riparian vegetation along the Palouse River. The W. T. Wooten Wildlife Area is directly north of the Umatilla National Forest where the wheatgrass/fescue zone meets the forested zones of the Blue Mountains.

Conservation Status 3 – Conservation Status 3 lands are almost entirely composed of regularly spaced WDNR sections. A few parcels of BLM land are in Franklin County.

Conservation Status 4 – Conservation Status 4 lands are overwhelmingly private, but include small tracts of land managed by the Department of Energy and the State Department of Corrections.

Management Considerations:
Virtually all of the Conservation Status 1 and 2 lands lie on an edaphic habitat type (the Sandy Juniper Dunes). Conservation Status 3 lands, in isolated section blocks and often leased for farming, add little to the conservation network in this zone. Most of the remaining uncultivated treated area is on private land, where the predominant land use is grazing.

This zone provides an excellent example of the tendency to provide protection for unusual and unproductive habitats while the more characteristic and productive communities are nearly lost. Conservation Status 1 lands in this zone cover one of the most unique vegetation types in Washington (the Juniper Dunes), but other habitat types in the zone have virtually no representation on conservation lands, and most of the characteristic bunchgrass/fescue association on deep soil has been lost to cultivation. Since the WDNR is the major public land owner in the zone, any improvement of biodiversity protection on deep soil sites will depend heavily on WDNR land management policies.

There are more opportunities for improved conservation status in parts of the zone where the soil tends to be more shallow and the topography more rugged. For example, conversion of steppe to agriculture in the north and northeastern part of the Blue Mountains is small compared to other parts of the zone. However, these areas at the zone periphery on poorer soil are more likely to support communities transitional between bluebunch wheatgrass/Idaho fescue and those of the neighboring Blue Mountains steppe or ponderosa pine zones; some are similar to communities of the Palouse (Cassidy 1997).

Existing habitat corridors through this zone that link neighboring zones to one another are uncultivated (though usually grazed) canyons and coulees (Harris and Chaney 1984). The channeled scablands through Whitman and Adams Counties connect the canyon grassland zone (and the Snake River) with the three-tip sage and Palouse zones. Major uncultivated corridors through the zone between the Snake River and the Blue Mountains are along theTucannon River canyon and through the rugged canyons and coulees of Asotin County.

4.1.7.3.2.4 Canyon Grassland Steppe

"Cut through the layers of basalt, in a mighty canyon, 1,600 feet deep, the Snake River winds its way through the prairie belt. Upon descending into the canyon, one finds the bunch-grasses and sagebrush vegetation growing in a climate markedly different from that of the plateau above."

- John Ernest Weaver, 1917

General:
This 516,230-acre zone occurs in two disjunct segments in Washington. One is along the Snake River drainage; the other is along the Columbia River bordering Oregon (Figure_31). This zone also occurs on the southeastern slopes of the Wallowa Mountains in Oregon.

Climax Vegetation:
The characteristic vegetation community consists of little besides bluebunch wheatgrass and Sandberg bluegrass with widely scattered individuals of gray rabbitbrush. A cryptogamic crust of mosses and lichens covers the soil between the grass clumps.

Disturbance:
Fire has minimal effect on the climax community, since it usually occurs after the grasses have died back in summer. Most of the native bunchgrasses and forbs arc poorly adapted to heavy grazing and trampling by livestock (Daubenmire 1970). Grazing by cattle leads to dominance by cheatgrass (invader) and gray rabbitbrush (increaser), and broom snakeweed (*Gutierrezia sarothrae*) in the Columbia River segment. Yellow starthistle is becoming increasingly common on disturbed sites as well (Mack 1986). In 1981, rangeland condition of the Snake River section was estimated to be generally poor; condition of the Columbia River section was fair or poor; however, ecological condition is usually worse than range condition (Harris and Chaney 1984).

Edaphic and other Special Communities:
Lithosols: Shallow soils support snow buckwheat/Sandberg bluegrass communities. Wetlands: netleaf hackberry and smooth sumac are common dominants of riparian areas and drainages. White alder grows along the Snake River (Franklin and Dryness 1973).

Current Land Use and Land Cover:
Bare ground: Approximately 0.05 percent of the land area within this zone is composed of basalt cliffs. Though these cliffs are a visually imposing feature of this zone and are a critical habitat feature for many animal species, their horizontal area is a relatively small proportion of the total area in the zone.

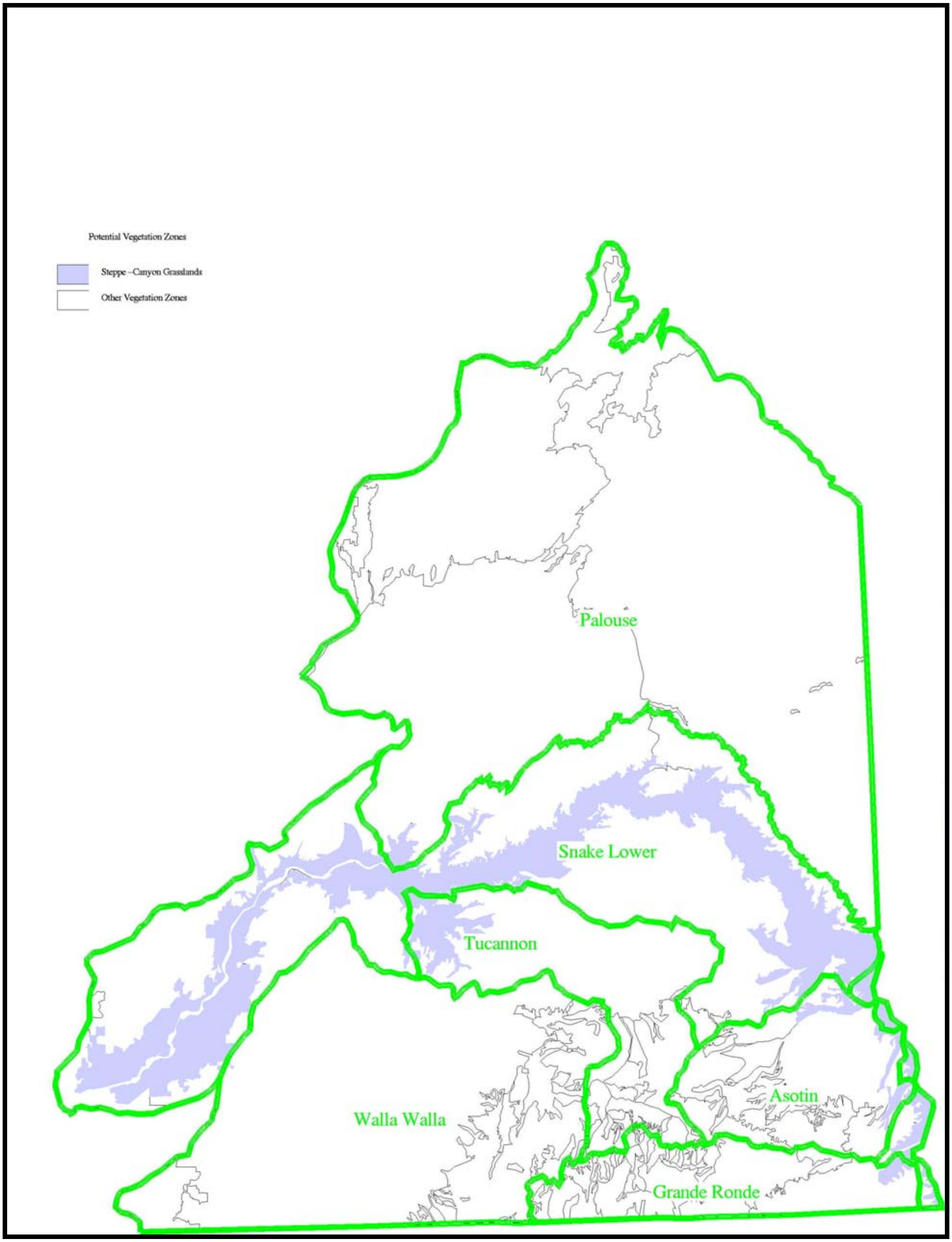

Figure 31. Historic (potential) canyon steppe grassland vegetation in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Agriculture: Almost 18.5 percent of the zone is used for agricultural purposes (irrigated – 8.23 percent; non-irrigated – 10.22 percent; mixed irrigation status – 0.05 percent). Steep topography makes most of this zone unsuitable for farming. A smaller proportion of its area is in agriculture than any other steppe zone. Fields tend to be small and irregularly shaped. Non-irrigated fields tend to be on moderate slopes above rivers, while irrigated fields are usually adjacent to rivers.

Open water/wetlands: Comprise 6.45 percent of this zone (open water – 5.44 percent; ponds, marshes – 0.01 percent; riparian – 1.00 percent). The relatively large amount of open water in this zone is due to the disproportionate representation of the Columbia and Snake Rivers.

Non-forested: Over 71 percent of the canyon steppe zone is non-forested (sparse – 0.55 percent: grassland – 60.41 percent; shrub savanna – 3.69 percent; shrubland – 4.69 percent; tree savanna – 0.11 percent; mixed/indeterminate – 1.8 percent). Though much of the native cover has been replaced by species that increase under grazing limited development and agriculture have left a more or less continuous grassland through both segments of this zone (Harris and Chaney 1984).

Forested: Almost 2 percent of the zone supports forest habitat (hardwood/mixed – 0.34 percent; conifer – 1.54 percent). Conifer forests are ponderosa pine woodlands on north slopes in ravines. Mixed and hardwood forests occur primarily along the Columbia River segment where Oregon white oak appears.

Conservation Status of the Canyon Steppe Grassland Vegetation Zone (Cassidy 1997): Lands under high protection status are non-existent in the canyon grassland zone. Like other steppe zones, the majority of the area has “no or unknown” protection status and is in private ownership (Table_20).

Table 20. Conservation status of the canyon grassland vegetation zone in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Manager/Owner	High Protection (Acres)	Medium Protection (Acres)	Low Protection (Acres)	No or Unknown Protection (Acres)
Private	0	0	0	486,588
BLM	0	57	0	0
BLM, other	0	0	771	0
WDFW	0	899	0	0
State Parks and Recreation	0	2,102	0	0
WDNR Trust	0	0	26,014	0
Total (Acres)	**0**	**3,058**	**26,785**	**486,588**
Percent Protected	0.0	0.59	5.19	94.22

Conservation Status 1 – There are no Conservation Status 1 lands in this vegetation zone.

Conservation Status 2 – In the Snake River segment of this zone, Conservation Status 2 lands consist of Lyons Ferry State Park (Franklin and Whitman Counties), Central Ferry State Park (Whitman County), a small part of the Chief Joseph Wildlife Area, and a small corner of BLM lands around the Juniper Dunes. In the Columbia River segment, Conservation Status 2 lands are limited to Horsethief Lake State Park and Maryhill State Park. All of the State parks are along rivers, and all contain some representative riparian vegetation. Lyons Ferry State Park, along the Palouse River and its confluence with the Snake River, is the largest of the State parks. The BLM parcel is at the edge of the zone on sandy soil. Most of the Chief Joseph Wildlife Area lies in the adjacent Blue Mountains steppe zone.

Conservation Status 3 – These lands are almost entirely in the form of regularly spaced section blocks owned by WDNR.

Conservation Status 4 – All Conservation Status 4 lands are privately owned.

Management Considerations:
The proportion of Conservation Status 2 lands in this zone is very low, but its topography has protected much of it from development and agriculture. The Snake River section has more and larger Conservation Status 2 lands than the Columbia River section. For biodiversity management, the two segments should be treated separately. They are adjacent to different zones and do not support identical vertebrate fauna.

Much of the importance of this zone is due to its association with large rivers. Many of the resident animal species are dependent on its mix of cliffs, open water, and riparian areas as well as the presence of its steppe vegetation. Biodiversity management should seek to maintain the integrity of these components as a group. This zone also serves as the link between adjacent steppe zones and the large rivers. The steep river banks and sheer cliffs will limit future agriculture but they do not necessarily limit development.The scenic river banks are vulnerable to construction of homes and resort communities.

Interior Grassland Status and Trends:
Information about the actual condition of grassland biodiversity is far less common than information about pressures threatening biodiversity, such as habitat loss and fragmentation. Direct measurements of biodiversity condition in grasslands are sparse. However, where information is available it shows that species introductions are common and that populations of many native wildlife species are dropping (WRI 2000). This suggests that, at least regionally, the capacity of grasslands to support biodiversity is decreasing. Indeed, the extensive conversion of grasslands to agriculture and urban areas and the growing degree of fragmentation suggest that many grassland ecosystems may already be unable to provide goods and services related to biodiversity. Within the entire Columbia Basin, overall decline in source habitats for grasshopper sparrow (71 percent) was third greatest among 91 species of vertebrates analyzed (Wisdom *et al.* in press).

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. Large expanses of remaining interior grasslands are currently used for livestock ranching while 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 (Tisdale 1986). 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.

Currently, fires burn less frequently in Ecoregion grasslands than historically because of fire suppression, roads, and conversions to cropland (Morgan *et al.* 1996). 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 grassland habitat. Fires that follow heavy grazing or repeated early season fires can result in annual grasslands of cheatgrass.

Many native dropseed grasslands have been submerged by reservoirs created by hydroelectric facilities. Fifty percent of the plant associations recognized as components of interior grassland habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson *et al.* 1998). Two of the native plant communities, bluebunch wheatgrass-snowberry and bluebunch wheatgrass-rose, are globally rare, and eight local plant species are threatened globally (Lichthardt and Moseley 1996). All these areas are subject to weed invasions of medusahead, knapweed, and/or yellow starthistle and drift of aerial biocides.

The Palouse portion of the interior grassland complex is one of the most endangered ecosystems in the United States (Noss *et al.* 1995). With only 1 percent of the original habitat remaining, it is highly fragmented with most sites less than 10 acres in size. Since 1900, 94 percent of the Palouse grasslands have been converted to crop, hay, or pasture lands. Quigley and Arbelbide (1997) 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 that time.

Ashley (unpublished data 2003) reported nested frequency (BLM 1998) results for an interior grassland reference site located in the Asotin subbasin (Figure 32). Note the high frequency of native bluebunch wheatgrass (PSSPS – 100 percent frequency) and Idaho fescue (FEID – 50 percent frequency) and the low occurrence of invading cheatgrass (BRTE – 5 percent frequency) in this relatively undisturbed site (survey results are very similar to what Daubenmire

FREQUENCY SUMMARY

Study Number: Schlee
Date: 07/11/2003
Examiner: Ashley
Transect Number: 485
Sample number: 1
Transect location: Smoothing Iron
Number of Quadrats: 20
Quadrat Size: .25m square
Digital Picure #:

	Frequency summary by plot size									
	1		2		3		4		5	
Plant Species	Hits	% Freq	Hits	% Freq	Hits	% Freq	Hits	% Freq	Hits	% Freq
PSSPS	4	20.0%	9	45.0%	12	60.0%	17	85.0%	20	100.0%
ACMI	0	0.0%	0	0.0%	0	0.0%	1	5.0%	4	20.0%
BRJA	0	0.0%	3	15.0%	5	25.0%	6	30.0%	9	45.0%
LULA	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
BRBR5	0	0.0%	3	15.0%	7	35.0%	8	40.0%	10	50.0%
POSE	3	15.0%	7	35.0%	13	65.0%	16	80.0%	19	95.0%
BASA3	0	0.0%	0	0.0%	1	5.0%	1	5.0%	2	10.0%
FEID	1	5.0%	2	10.0%	6	30.0%	8	40.0%	10	50.0%
OXCAC2	1	5.0%	1	5.0%	2	10.0%	2	10.0%	2	10.0%
BRTE	0	0.0%	0	0.0%	0	0.0%	1	5.0%	1	5.0%
LIRU4	1	5.0%	1	5.0%	2	10.0%	2	10.0%	2	10.0%
KOMA	0	0.0%	0	0.0%	2	10.0%	3	15.0%	3	15.0%
POA	0	0.0%	1	5.0%	1	5.0%	1	5.0%	2	10.0%
TRAGO	0	0.0%	0	0.0%	1	5.0%	1	5.0%	1	5.0%
ORTHO	0	0.0%	0	0.0%	0	0.0%	1	5.0%	1	5.0%

Figure 32. Nested frequency results for an interior grassland reference site (Ashley, unpublished data, 2003).

reported in 1970).

In contrast, nested frequency results on an adjacent, moderately disturbed interior grassland site indicate a high incidence of non-native cheatgrass (85 percent) and Japanese brome (BRJA – 80 percent frequency) while bluebunch wheatgrass and Idaho fescue experienced a significant reduction in percent frequency (65 percent and 20 percent frequency respectively, $p<0.05$) (Figure 33). Also note the decrease in plant diversity on the moderately grazed site.

FREQUENCY SUMMARY

Study Number: Schlee
Date: 07/08/2003
Examiner: Ashley, Gerlinger
Transect Number: 376
Sample number: 1
Transect location: Smoothing Iron
Number of Quadrats: 20
Quadrat Size: .25m squared
Digital Picure #:

	Frequency summary by plot size									
	1		2		3		4		5	
Plant Species	Hits	% Freq	Hits	% Freq	Hits	% Freq	Hits	% Freq	Hits	% Freq
BRJA	2	10.0%	6	30.0%	13	65.0%	16	80.0%	16	80.0%
BRBR5	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	10.0%
PSSPS	2	10.0%	3	15.0%	10	50.0%	12	60.0%	13	65.0%
BRTE	11	55.0%	13	65.0%	14	70.0%	16	80.0%	17	85.0%
FEID	0	0.0%	0	0.0%	1	5.0%	3	15.0%	4	20.0%
BASA3	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.0%
ACMI	1	5.0%	1	5.0%	2	10.0%	2	10.0%	3	15.0%
POSE	1	5.0%	3	15.0%	5	25.0%	9	45.0%	10	50.0%

Figure 33. Nested frequency results for a moderately disturbed interior grassland site (Ashley, unpublished data, 2003).

Introduced vegetation and noxious weeds have displaced desirable native vegetation on heavily disturbed sites (Ashley, unpublished data, 2003) resulting in negative impacts to endemic wildlife populations and habitat quality. When native plant communities are displaced by exotic vegetation on xeric, brittle landscapes, it is extremely costly and very difficult to reintroduce native plant communities (J. Benson, WDFW, personal communication, 1995). Land managers believe the vast majority of the remaining interior grassland habitat within the Ecoregion is moderate to heavily disturbed and is plagued with similar invader plant species, noxious weeds, and nested frequencies as those found on the Asotin subbasin sites.

Information about the actual condition of grassland biodiversity is far less common than information about pressures threatening biodiversity, such as habitat loss and fragmentation. The North American Breeding Bird Survey (BBS) provides 30-year population trends for a wide range of bird species. Survey data from 1966 to 1995 for bird species that breed in grasslands show declines throughout most of the United States and Canada.

4.1.7.3.3 Recommended Future Condition

Subbasin planners selected the grasshopper sparrow (*Ammodramus savannarum*) and sharp-tailed grouse (*Tympanuchus phasianellus*) to represent the range of habitat conditions required by grassland obligate wildlife species (Table 31) and to serve as potential performance measures to monitor and evaluate the results of implemementing future management strategies and actions in interior grassland habitats. Species accounts are located in Appendix F. In addition, sharp-tailed grouse winter food and roosting needs account for macrophyllus shrub draws and riparian shrublands that historically punctuated interior grassland habitats.

Generalized recommended conditions for grassland habitats include contiguous tracts of native bunchgrass and forb communities with less than five percent shrub cover and less than ten percent exotic vegetation. In xeric, brittle environments and sites dominated by shallow lithosols soils, areas between bunchgrass culms should support mosses and lichens (cryptogamic crust). In contrast, more mesic (greater than12 inches annual precipitation), deep soiled sites could sustain dense (greater than 75 percent cover) stands of native grasses and forbs (conclusions drawn from Daubenmire 1970).

Subbasin wildlife managers will review the conditions described below to plan and, where appropriate, guide future protection and enhancement actions in interior grassland habitats. Specific desired future conditions will be identified and developed within the context of subbasin-specific management plans.

Recommended interior grassland habitat attributes/conditions:

1. Native bunchgrass greater than 40 percent cover
2. Native forbs 10 to 30 percent cover
3. Herbaceous vegetation height greater than 10 inches
4. Visual obstruction readings (VOR) at least 6 inches
5. Native non-deciduous shrubs less than 10 percent cover
6. Exotic vegetation/noxious weeds less than 10 percent cover
7. Multi-structured fruit/bud/catkin-producing deciduous trees and shrubs dispersed throughout the landscape (10 to 40 percent of the total area), or within 1 mile of sharp-tailed grouse nesting/brood rearing habitats

Change in the extent of grassland habitat from circa1850 to 1999 is illustrated at the 6th – level HUC in Figure_34 (NHI 2003). Red color shades indicate negative change while blue color shades indicate positive change. Clearly, interior grassland habitats have decreased significantly throughout the Ecoregion due primarily to conversion to agricultural crops.

Although the data are displayed at the 6th – level HUC, it does not necessarily mean that the entire hydrologic unit was historically or is currently comprised entirely of interior grasslands. The data simply indicate that grasslands and associated change occurred somewhere within a particular hydrologic unit.

The data displayed in Figure_34 can be used by subbasin planners to identify and prioritize conservation and restoration areas and strategies. For example, planners may develop a hierarchical approach to protecting interior grassland habitats where hydrologic units that have exhibited positive change receive a higher initial prioritization than those that have experienced a negative change. Ecoregion planners could then cross-link this information with other data such as ECA and GAP management-protection status to develop comprehensive strategies to identify and prioritize critical areas and potential protection actions.

4.1.7.4 Eastside (Interior) Riparian Wetlands

4.1.7.4.1 Historic

Prior to 1850, riparian habitats were found at all elevations and on all stream gradients; they were the lifeblood for most wildlife species with up to 80 percent of all wildlife species dependent upon these areas at some time in their lifecycle (Thomas 1979). Many riparian

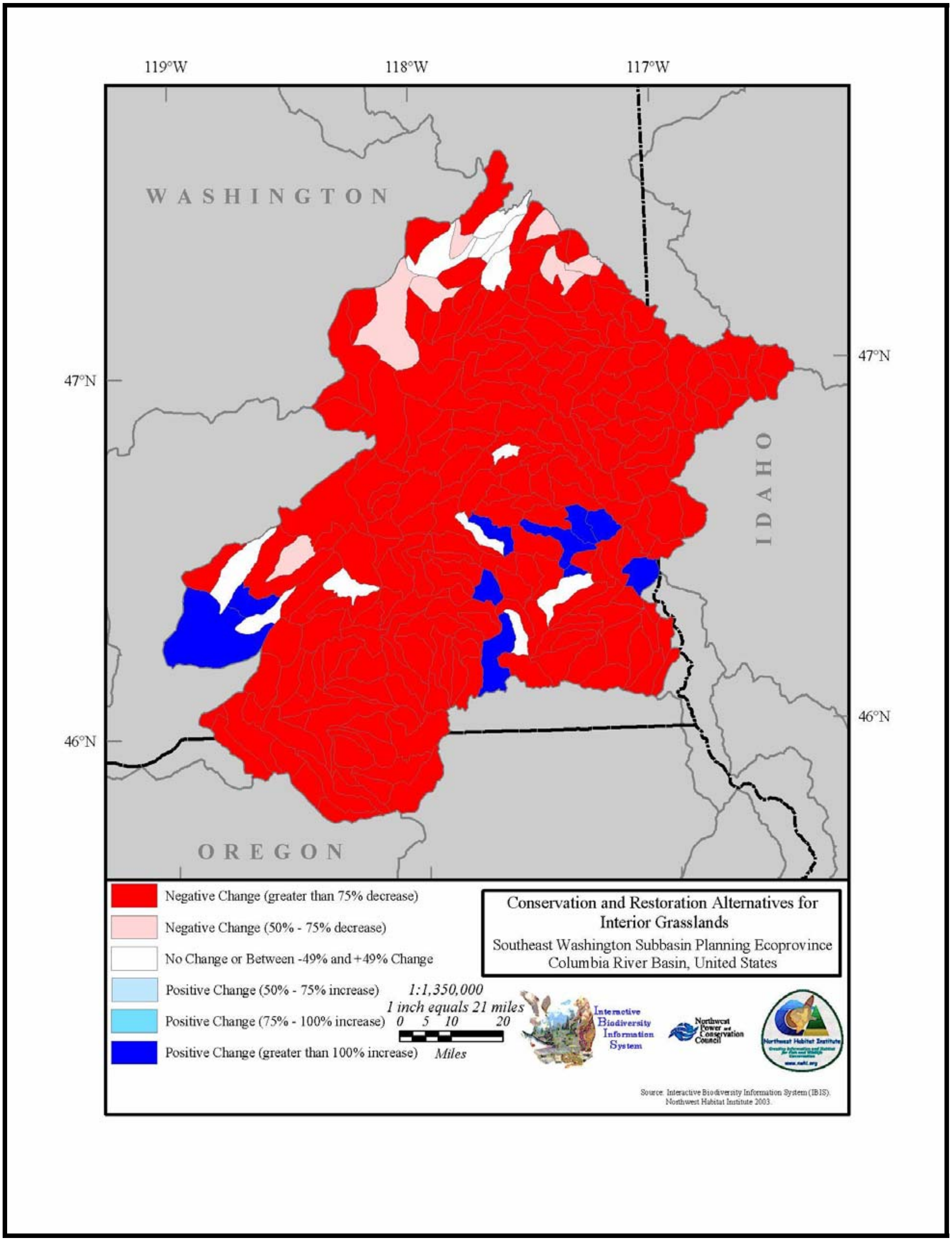

Figure 34. Interior grassland conservation and restoration strategies (NHI 2003).

habitats were maintained by beaver activity, which was prominent throughout the west. Beaver-dammed streams created pools that harbored fish and other species; their dams also reduced flooding and diversified and broadened riparian habitat. The other important ecological process which affected riparian areas was natural flooding that redistributed sediments and established new sites for riparian vegetation to become established.

Riparian vegetation was restricted in the arid Intermountain West, but was nonetheless fairly diverse. It was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly or in some combination by grass-forbs, shrub thickets, and mature forests with tall deciduous trees. Common shrubs and trees in riparian zones included several species of willows, red-osier dogwood (*Cornus stolonifera*), hackberry, mountain alder (*Alnus tenuifolia*), Woods' rose, snowberry, currant (*Ribes nigrum*), black cottonwood, water birch (*Betula occidentalis*), paper birch (*Betula papyrifera*), aspen, and peachleaf willow (*Salix amygdaloides*). Herbaceous understories were very diverse, but typically included several species of sedges along with many dicot species.

Riparian areas have been extensively impacted within the Columbia Plateau such that undisturbed riparian systems are rare (Knutson and Naef 1997). Impacts have been greatest at low elevations and in valleys where agricultural conversion, altered stream channel morphology, and water withdrawal have played significant roles in changing the character of streams and associated riparian areas. Losses in lower elevations include large areas once dominated by cottonwoods that contributed considerable structure to riparian habitats. In higher elevations, stream degradation occurred with the trapping of beaver in the early 1800s, which began the gradual unraveling of stream function that was greatly accelerated with the introduction of livestock grazing. Woody vegetation has been extensively suppressed by grazing in some areas, many of which continue to be grazed. Herbaceous vegetation has also been highly altered with the introduction of Kentucky bluegrass that has spread to many riparian areas, forming a sod at the exclusion of other herbaceous species. The implications of riparian area degradation and alteration are wide ranging for bird populations that utilize these habitats for nesting, foraging and resting. Secondary effects which have impacted insect fauna have reduced or altered potential foods for birds as well.

Within the past 100 years, an estimated 95 percent of this habitat has been altered, degraded, or destroyed by a wide range of human activities including river channelization, unmanaged livestock grazing, clearing for agriculture, water impoundments, urbanization, timber harvest, exotic plant invasion, recreational impacts, groundwater pumping, and fire (Krueper, n.d.). Together, these activities have dramatically altered the structural and functional integrity of western riparian habitats (Johnson *et al.* 1977; Dobyns 1981; Bock *et al.* 1993; Krueper 1993; Fleischner 1994; Horning 1994; Ohmart 1994, 1995; Cooperrider and Wilcove 1995; Krueper 1996). At present, natural riparian communities persist only as isolated remnants of once vast, interconnected webs of rivers, streams, marshes, and vegetated washes.

Quigley and Arbelbide (1997) concluded that in the Inland Pacific Northwest the cottonwood-willow cover type covers significantly less in area now than before 1900. The authors concluded that although riparian shrubland occupied only 2 percent of the landscape, they estimated it to have declined to 0.5 percent. Approximately 40 percent of riparian shrublands occurred above 3,280 feet in elevation prior to 1900; nearly 80 percent is found currently above that elevation. This change reflects losses to agricultural, road, and hydroelectric development and other flood control activities. Current riparian shrublands contain many exotic plant species and generally are less productive than historically. Quigley and Arbelbide (1997) found that riparian woodland was always rare and the change in extent from the past is substantial.

The NHI riparian habitat data are incomplete; therefore, riparian wetland habitats are not well represented on NHI maps. Accurate habitat type maps, especially those detailing riparian wetland habitats, are needed to improve assessment quality and support management strategies and actions. Subbasin wildlife managers, however, believe that significant physical and functional losses have occurred to these important riparian habitats from hydroelectric facility construction and inundation, agricultural development, and livestock grazing. Changes in the distribution of riparian habitat from circa 1850 (historic) to 1999 (current) are illustrated in Figure_35 and Figure_36.

4.1.7.4.2 Current

General:

Riparian and wetland habitats dominated by woody plants are found throughout eastern Washington and eastern Oregon. Mountain alder-willow riparian shrublands are major habitats in the forested zones of eastern Washington and eastern Oregon. Eastside lowland willow and other riparian shrublands are the major riparian types throughout eastern Washington and Oregon at lower elevations. Black cottonwood riparian habitats occur throughout eastern Washington and Oregon at low to mid 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.

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 montane or valley streams. The most typical stand is limited to 100 - 200 feet from streams. Riparian forests also appear on sites subject to temporary flooding during spring runoff. Irrigation of streamsides and toe slopes 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. Riparian wetland habitats are found from 100 to 9,500 feet in elevation.

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.

Riparian wetland habitat structure includes shrublands, woodlands, and forest communities. Stands are closed to open canopies and often are multi-layered. 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 feet], 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.

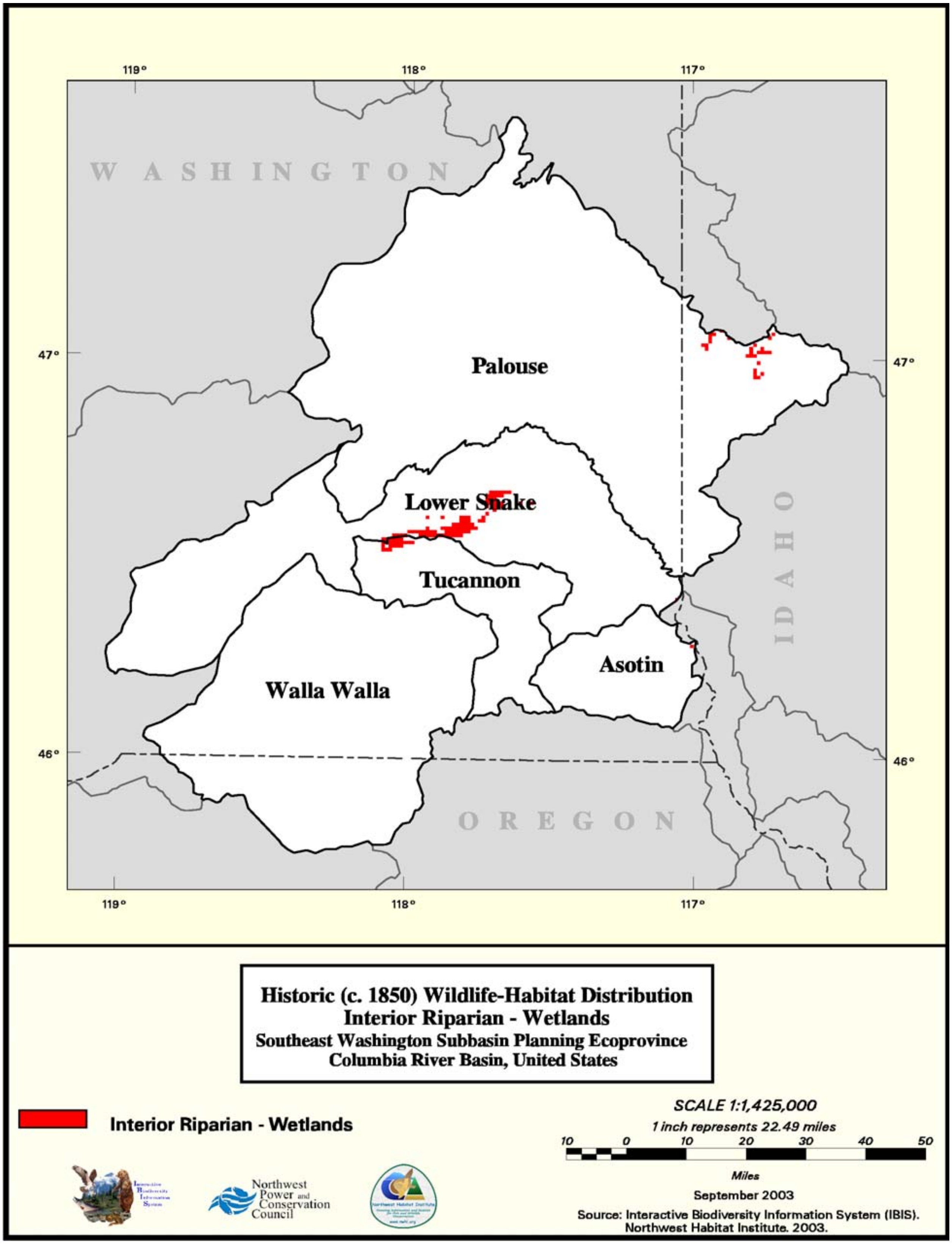

Figure 35. Historic eastside (interior) riparian wetland distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Figure 36. Current eastside (interior) riparian wetland distribution in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Vegetation:
Information found in the NHI (2003) database suggests that black cottonwood, quaking aspen, white alder, peachleaf willow and paper birch are dominant and characteristic tall deciduous trees. Water birch, shining willow (*Salix lucida* ssp. *caudata*) and, rarely, mountain alder 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 and Douglas-fir that characterize conifer-riparian habitat in portions of the shrubsteppe zones.

A wide variety of shrubs is found in association with forest/woodland versions of this habitat. Red-osier dogwood, mountain alder, gooseberry (*Ribes* spp.), rose (*Rosa* spp.), common snowberry and Drummonds willow (*Salix drummondii*) are important shrubs in this habitat. Bog birch (*B. nana*) and Douglas spirea (*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, water birch, shining willow, and netleaf hackberry.

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 co-dominant at many sites. Chokecherry, water birch, serviceberry (*Amelanchier alnifolia*), black hawthorn, and red-osier dogwood can also be co-dominant to dominant. Shorter shrubs, Woods' rose, spirea, snowberry and gooseberry are usually present in the undergrowth.

Ashley (unpublished data, 2003) reported that mock orange was the dominant shrub and black cottonwood the dominant deciduous tree species on ungrazed riparian areas surveyed in the Asotin subbasin. Representative shrub and tree transect results are summarized for shrubs (woody vegetation less than 16 feet tall) in Table_21 and for trees in Table_22. These results are likely typical for ungrazed riparian areas throughout much of the Ecoregion.

Structurally, the shrub layer is comprised of two mean height classes, including the lower layer at 2.5 feet and the upper layer at 4.7 feet . Overall mean cover is just over 47 percent. In contrast, tree layer height ranges from 30 to 55 feet with a mean height of 39.3 feet. Mean tree cover is 45 percent. If unshaded areas over open water are excluded, mean woody vegetation cover would exceed 75 percent along ungrazed riparian corridors.

Mock orange was the dominant shrub tallied in riparian habitats that were moderately grazed while cottonwood trees were conspicuously absent in most areas. Representative shrub and tree transect results are summarized for shrubs (woody vegetation less than 16 feet tall) in Table_23 and for trees in Table_24. These results are likely typical for moderately grazed riparian areas throughout much of the Ecoregion (Ashley, unpublished data, 2003).

The primary structural difference between ungrazed and moderately grazed riparian habitat is the lack of multi-story canopies. The shrub layer is comprised of one mean height class (3.9 feet) compared to two height classes on ungrazed riparian areas, 2.5 feet for the lower canopy, and 4.7 feet for the upper shrub canopy.

Table 21. Shrub composition, percent cover, and mean height on ungrazed riparian habitat (Ashley, unpublished data, 2003).

500 POINTS NEEDED 500 POINTS ENTERED

Species	N	% CC	Mean layer species height Layer 1	Layer 2	Layer 3	Layer 4	
Snowberry	77	15.4%	35.36	22.73	0.00	0.00	.1 foot
Alder	30	6.0%	78.67	0.00	0.00	0.00	.1 foot
Rose	17	3.4%	31.82	0.00	0.00	0.00	.1 foot
Currant	3	0.6%	13.00	38.00	0.00	0.00	.1 foot
Mockorange	93	18.6%	65.57	35.00	0.00	0.00	.1 foot
Serviceberry	5	1.0%	31.00	23.00	0.00	0.00	.1 foot
Cottonwood	13	2.6%	22.58	14.00	0.00	0.00	.1 foot
Locust	4	0.8%	81.00	0.00	0.00	0.00	.1 foot
Hawthorn	3	0.6%	69.00	0.00	0.00	0.00	.1 foot
Ninbark	10	2.0%	40.00	16.00	0.00	0.00	.1 foot
Transect Layer Mean Height			46.80	24.79	0.00	0.00	.1 foot

51.0%	COMBINED Canopy Cover
52.80%	BARE POINTS
47.20%	POINTS have 1 species
3.80%	POINTS have 2 species
NO	POINTS have 3 species
NO	POINTS have 4 species

Table 22 Tree composition, percent cover, and mean height on ungrazed riparian habitat (Ashley, unpublished data, 2003).

Height unit of measure:

100 POINTS NEEDED 100 POINTS ENTERED

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"
Ponderosa Pine	1	1.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Cottonwood	20	20.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Water Birch	3	3.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Alder	15	15.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Locust	5	5.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Willow	1	1.0%	<4	0	0.0%	0	0.0%	0	0.0%	0

DBH DISTRIBUTION	N	%
Small (<4")	0	0.0%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	0	0.0%
Very Large (>20")	0	0.0%
DBH not taken	45	100.0%

Overall tree height	
MEAN	39.3
MODE	40
MAX	55
MIN	30
ST.DEV	8.86
TOTAL CC	45.00%

Overall mean shrub cover is just over 23.4 percent – half of the cover present on ungrazed riparian areas. In contrast, tree layer height ranges from 40 to 65 feet with a mean height of 50 feet. Mean tree cover is almost 41 percent compared to 45 percent on ungrazed riparian sites. Alder and waterbirch were co-dominant deciduous species while conifers, including ponderosa pine, Douglas-fir, and grand fir, were also present.

Overgrazed riparian habitats generally lacked a diverse low shrub understory and were infested with noxious weeds. Shrubs, if present, consisted of unpalatable species such as hawthorne, mock orange, and rose. Trees were either not present, or were comprised of mature individuals depending on the site (Ashley, unpublished data, 2003). As with all vegetation, abiotic factors such as precipitation, hydrology, soil type and soil depth impact both the type of plant community that is present, its resilience, and the plant community's ability to recover from disturbance factors.

Table 23 Shrub composition, percent cover, and mean height on moderately grazed riparian habitat (Ashley, unpublished data, 2003).

Shrub Intercept Data: 500 POINTS NEEDED 500 POINTS ENTERED

Species	N	% CC	Mean height	s	%cc s	y	%cc y	m	%cc m	d	%cc d
Alder	11	2.2%	48.1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Currant	2	0.4%	36.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Mock Orange	72	14.4%	37.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Ocean Spray	9	1.8%	70.8	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Rose	7	1.4%	18.7	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Water birch	4	0.8%	61.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Snowberry	11	2.2%	7.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grand fir	0	0.0%		0	n/a	0	n/a	0	n/a	0	n/a
Doug Fir	0	0.0%		0	n/a	0	n/a	0	n/a	0	n/a
Willow	1	0.2%	0.0	0	0.0%	0	0.0%	0	0.0%	0	0.0%

AGE DISTRIBUTION	N	%
Seedling	0	
Young	0	
Mature	0	
Decadent	0	
Very Decadent	0	
Dead	0	

Overall Height	
MEAN	39.4
MODE	80.0
MAX	150.0
MIN	1.0
ST.DEV	27.0
TOTAL CC	23.4%

AGE KEY

Symbol	Meaning
s	seedling
y	young
m	mature
d	decadent
vd	very decadent
dd	dead

Table 24 Tree composition, percent cover, and mean height on moderately grazed riparian habitat (Ashley, unpublished data, 2003).

120 POINTS NEEDED 120 POINTS ENTERED

Species	N	% CC	Mode DBH	<4"	%CC	4" to 6"	%CC	6" to 10"	%CC	10" to 20"
Ponderosa	5	4.2%	<4	0	0.0%	0	0.0%	0	0.0%	0
Alder	21	17.5%	<4	0	0.0%	0	0.0%	0	0.0%	0
Water Birch	18	15.0%	<4	0	0.0%	0	0.0%	0	0.0%	0
Grand Fir	3	2.5%	<4	0	0.0%	0	0.0%	0	0.0%	0
Douglas Fir	2	1.7%	<4	0	0.0%	0	0.0%	0	0.0%	0

DBH DISTRIBUTION	N	%
Small (<4")	0	0.0%
Medium (4" - 6")	0	0.0%
Medium large (6" - 10")	0	0.0%
Large (10" - 20")	0	0.0%
Very Large (>20")	0	0.0%
DBH not taken	49	100.0%

Overall tree height	
MEAN	50.0
MODE	40
MAX	65
MIN	40
ST.DEV	9.35
TOTAL CC	40.83%

Transect protocols called for “zig-zagging” across stream corridors in order to measure the extant riparian vegetation and to document canopy closure over open water. Future canopy closure data will be compared to instream temperature data to determine if a correlation between the two measurements can be made.

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 can be abundant where riparian areas have been historically heavily grazed. 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 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*).

Disturbance:
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. Beavers crop younger cottonwood and willows and frequently dam side channels. These forests and woodlands require various flooding regimes and specific substrate conditions for reestablishment. Livestock 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.

Conservation Status of Eastside (Interior) Riparian-Wetlands:
Specific conservation status of riparian wetlands is unknown, but assumed to be the same as the protection status afforded to adjacent vegetation zones.

Management and Anthropogenic Impacts:
Management effects and land use on woody riparian vegetation can be obvious or more subtle. For example, removal of beavers from a watershed, removal of large woody debris, or construction of a weir dam for fish habitat are subtle effects of land use changes in riparian wetland habitats. 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 as well. Knutson and Naef (1997) described the potential effects of various land uses on riparian habitats; for example, forest practices can alter riparian area microclimates and reduce large woody debris (Table_25).

Table 25. Summary of potential effects of various land uses on riparian habitat elements needed by fish and wildlife (Knutson and Naef 1997).

Potential Changes in Riparian Elements Needed by Fish and Wildlife	Land Use						
	Forest Practices	**Agriculture**	**Unmanaged Grazing**	**Urban-ization**	**Dams**	**Recreation**	**Roads**
Riparian Habitat							
Altered microclimate	X	X	X	X		X	X
Reduction of large woody debris	X	X	X	X	X	X	X
Habitat loss/fragmentation	X	X	X	X	X	X	X
Removal of riparian vegetation	X	X	X	X	X	X	X
Reduction of vegetation regeneration	X	X	X	X	X	X	X
Soil compaction/ deformation	X	X	X	X		X	X
Loss of habitat connectivity	X	X	X	X		X	X
Reduction of structural and functional diversity	X	X	X	X		X	X
Stream Banks and Channel							
Stream channel scouring	X	X	X	X		X	X
Increased stream bank erosion	X	X	X	X	X	X	X
Stream channel changes (e.g., width and depth)	X	X	X	X	X	X	X
Stream channelization (straightening)	X	X		X			
Loss of fish passage	X	X	X	X	X		X

Potential Changes in Riparian Elements Needed by Fish and Wildlife	Land Use						
	Forest Practices	Agriculture	Unmanaged Grazing	Urban-ization	Dams	Recreation	Roads
Loss of large woody debris	X	X	X	X	X	X	X
Reduction of structural and functional diversity	X	X	X	X	X		X
Hydrology and Water Quality							
Changes in basin hydrology	X	X		X	X		X
Reduced water velocity	X	X	X	X	X		
Increased surface water flows	X	X	X	X		X	X
Reduction of water storage capacity	X	X	X	X			X
Water withdrawal		X		X	X	X	
Increased sedimentation	X	X	X	X	X	X	X
Increased stream temperatures	X	X	X	X	X	X	X
Water contamination	X	X	X	X		X	X

Status and Trends:
Quigley and Arbelbide (1997) concluded that in the Inland Pacific Northwest, the cottonwood-willow cover type covers significantly less in area now than before 1900. 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 feet in elevation prior to1900; currently, nearly 80 percent is found above that elevation. This change reflects losses to agricultural development, road construction, dams and other flood control activities. Current riparian shrublands contain many exotic plant species and generally are less productive than historically. Quigley and Arbelbide (1997) found that riparian woodland was always rare and the change in extent from the past is substantial.

Natural systems evolve and become adapted to a particular rate of natural disturbances over long periods. Land uses alter stream channel processes and disturbance regimes that affect aquatic and riparian habitat (Montgomery and Buffington 1993). Anthropogenic-induced disturbances are often of greater magnitude and/or frequency compared to natural disturbances. These higher rates may reduce the ability of riparian and stream systems and the fish and wildlife populations to sustain themselves at the same productive level as in areas with natural rates of disturbance.

Other characteristics also make riparian habitats vulnerable to degradation by human-induced disturbances. Their small size, topographic location, and linear shape make them prone to disturbances when adjacent uplands are altered. The unique microclimate of riparian and associated aquatic areas supports some vegetation, fish, and wildlife that have relatively narrow environmental tolerances. This microclimate is easily affected by vegetation removal within or adjacent to the riparian area, thereby changing the habitat suitability for sensitive species (Thomas *et al.* 1979; O'Connell *et al.* 1993).

4.1.7.4.3 Recommended Future Condition

At the Ecoregion scale, wildlife managers focused on riverine riparian habitats due to its prevalence throughout the Ecoregion, close association with salmonid habitat requirements, and relationship to water quality issues. Subbasin planners have the option to address lacustrine and palustrine wetland habitats at the local level.

Subbasin planners selected the yellow warber (*Dendroica petechia*)*,* American beaver (*Castor canadensis*)*,* and great blue heron (*Ardea herodias*) to represent the range of habitat conditions required by wildlife species (Table_31) that utilize riparian wetland habitat. These wildlife species may also serve as potential performance measures to monitor and evaluate the results of implemementing future management strategies and actions in riparian habitats. Species accounts are located in Appendix F.

Current riparian/riverine conditions within the Ecoregion range from optimal to poor with most falling below "fair" condition (H. Ferguson, WDFW, personal communication, 2003). As a result, wildlife managers have a wide array of conditions to consider. Recognizing the variation between existing riparian/riverine habitats and the dynamic nature of this habitat type, recommended conditions for riparian/riverine habitats focus on the following habitat and anthropogenic attributes:

1. The presence/height of native hydrophytic shrubs and trees
2. Shrub/tree canopy structure, tree species and diameter (DBH)
3. Distance between roosting and foraging habitats
4. Human disturbance

Ecoregion planners recommend the following ranges of conditions for the specific riparian/riverine habitat attributes described below.

1. Forty to 60 percent tree canopy closure (cottonwood and other hardwood species)
2. Multi-structure/age tree canopy (includes trees less than 6 inches in diameter and mature/decadent trees)
3. Woody vegetation within 328 feet of the shoreline
4. Tree groves greater than 1 acre within 800 feet of water (where applicable)
5. Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs)
6. Multi-structured shrub canopy greater than 3 feet in height
7. Limited to no disturbance within 800 feet of habitat type

Subbasin planners will review the conditions described above to plan and, where appropriate, guide future protection and enhancement actions in riparian/riverine habitats. Specific desired future conditions; however, will be identified and developed within the context of individual management plans at the subbasin level.

Change in extent of the riparian wetland habitat type from circa 1850 to 1999 is not included because of inaccurate NHI (2003) data products.

4.1.7.5 Agriculture

Agricultural habitat varies substantially in composition among the cover types it includes. Cultivated cropland includes at least 50 species of annual and perennial plants in Oregon and Washington, and hundreds of varieties of vegetable and grain crops ranging from carrots, onions, and peas to 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.

Improved pastures are used to produce perennial herbaceous plants for grass seed and hay. Alfalfa and several species of fescue and bluegrass, orchardgrass (*Dactylis glomerata*), and timothy (*Phleum pratensis*) are commonly seeded in improved pastures. Grass seed fields are single-species stands, whereas pastures maintained for hay are typically composed of several species.

Improved pasture is one of the most common agricultural uses in the Ecoregion and is produced with and without irrigation. Unimproved pastures are predominantly grassland sites often in 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 CRP sites. Grasses commonly planted on CRP sites include crested wheatgrass (*Agropyron cristatum*), tall fescue (*F. arundinacea*), perennial bromes (*Bromus* spp.) and wheatgrasses.

Intensively grazed rangelands have been seeded to intermediate wheatgrass (*Elytrigia intermedia*), crested wheatgrass to boost forage production , or are dominated by increaser exotics such as Kentucky wheatgrass or tall oatgrass (*Arrhenatherum elatius*). 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 including tansy ragwort (*Senecio jacobea*), thistle (*Cirsium* spp.), Himalaya blackberry (*Rubus discolor*), and Scotch broom (*Cytisus scoparius*) with patches of native black hawthorn, snowberry, spirea, poison oak (*Toxicodendron diversilobum*), and various tree species, depending on seed source and environment.

Because agriculture is not a focal wildlife habitat type and there is little opportunity to effect change in agricultural land use at the landscape scale, Ecoregion and subbasin planners did not conduct a full-scale analysis of agricultural condition. However, agricultural lands converted to CRP can significantly contribute toward benefits to wildlife habitat. The extent of agricultural areas prior to 1850 and today (including CRP lands) is illustrated in Figure_37 and Figure_38.

4.2 Ecoregional Conservation Assessment by Vegetation Zone

Ecoregion Conservation Assessment status of vegetation zones within the Ecoregion and adjacent provinces is illustrated in Figure_39. Lands identified as ECA Class 1 are located in the Palouse steppe vegetation zone (Palouse subbasin) and in the canyon grassland steppe, central arid steppe, and wheatgrass/fescue steppe vegetation zones within the Lower Snake subbasin.

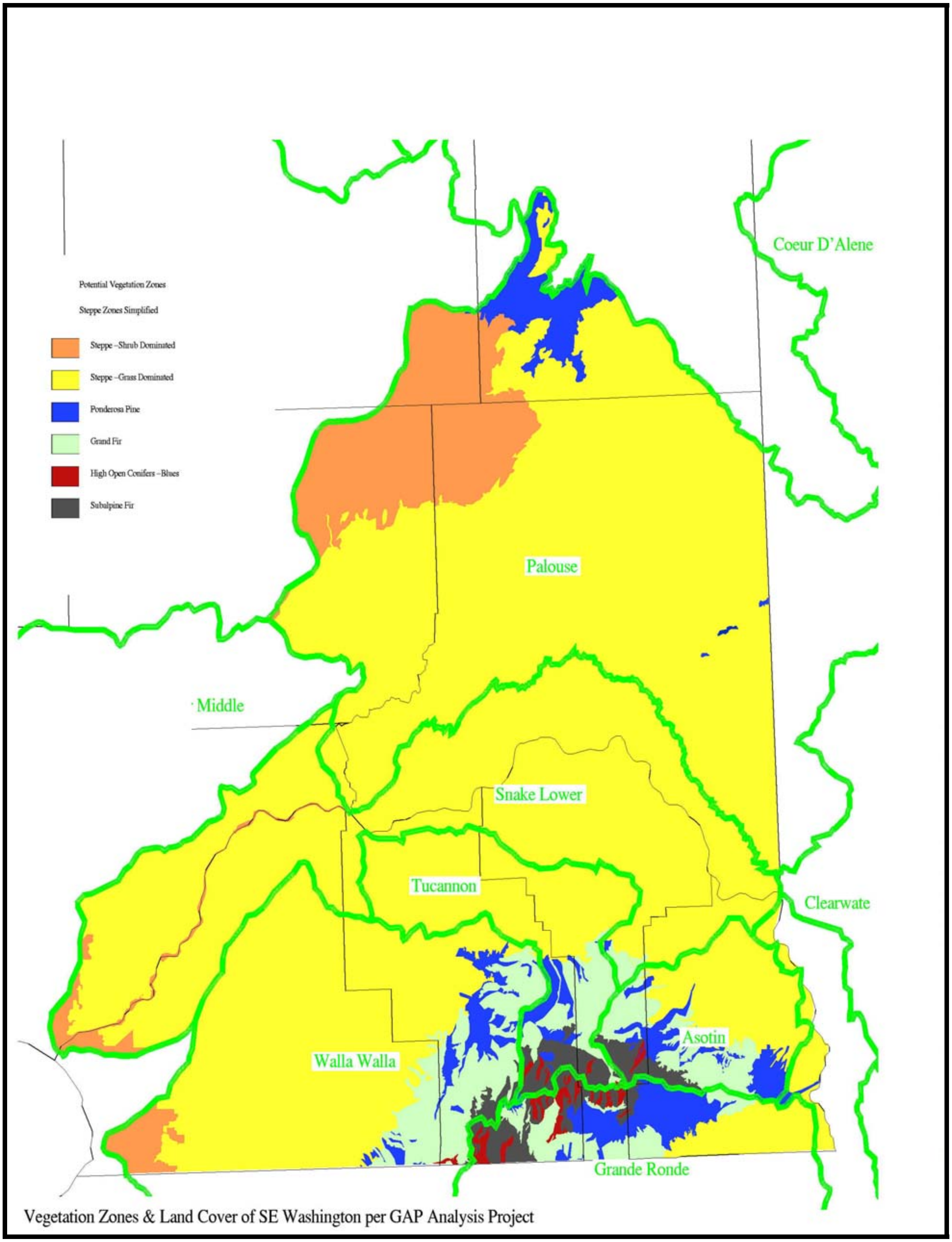

Figure 37. Pre-agricultural vegetation zones of the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

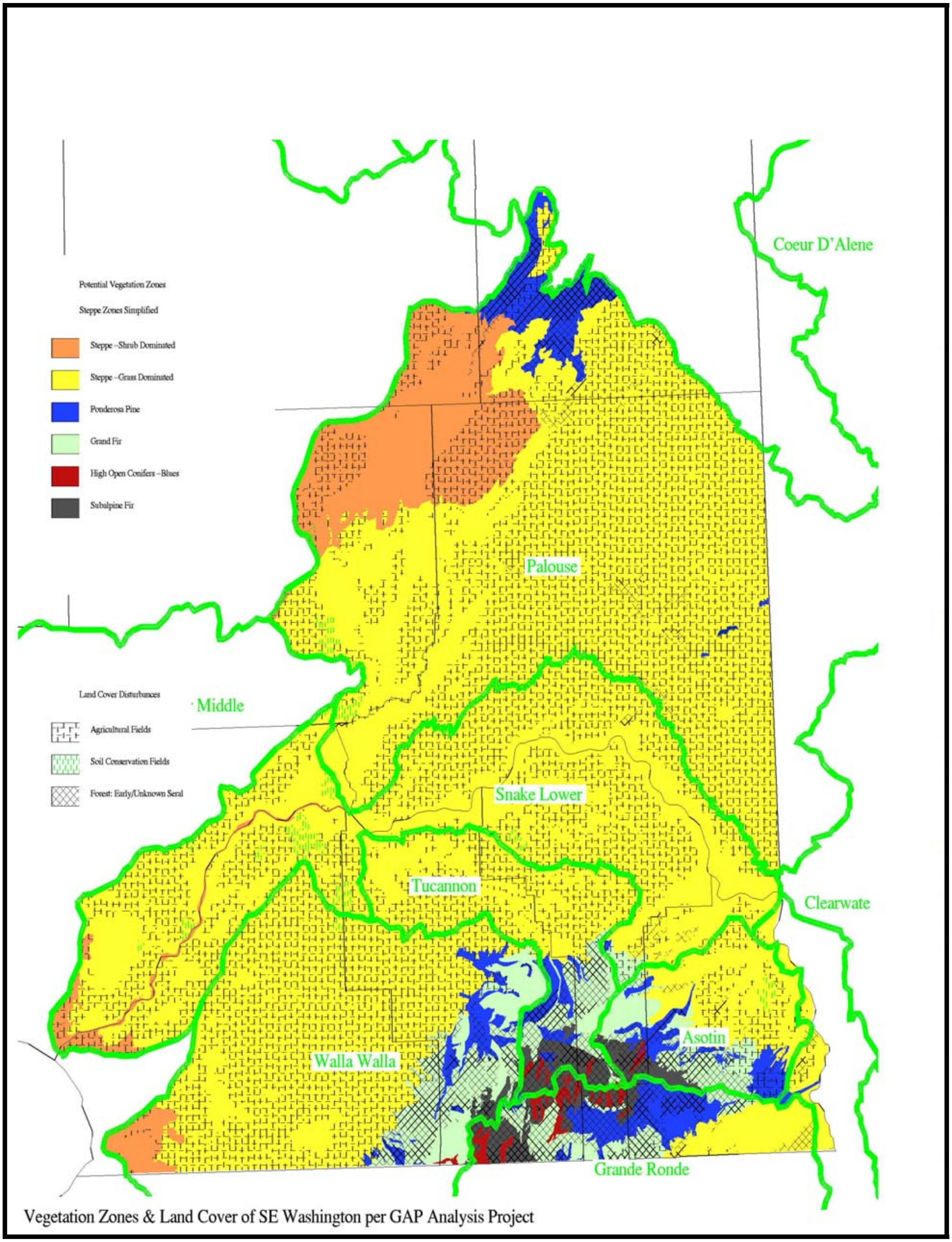

Figure 38. Post-agricultural vegetation zones of the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

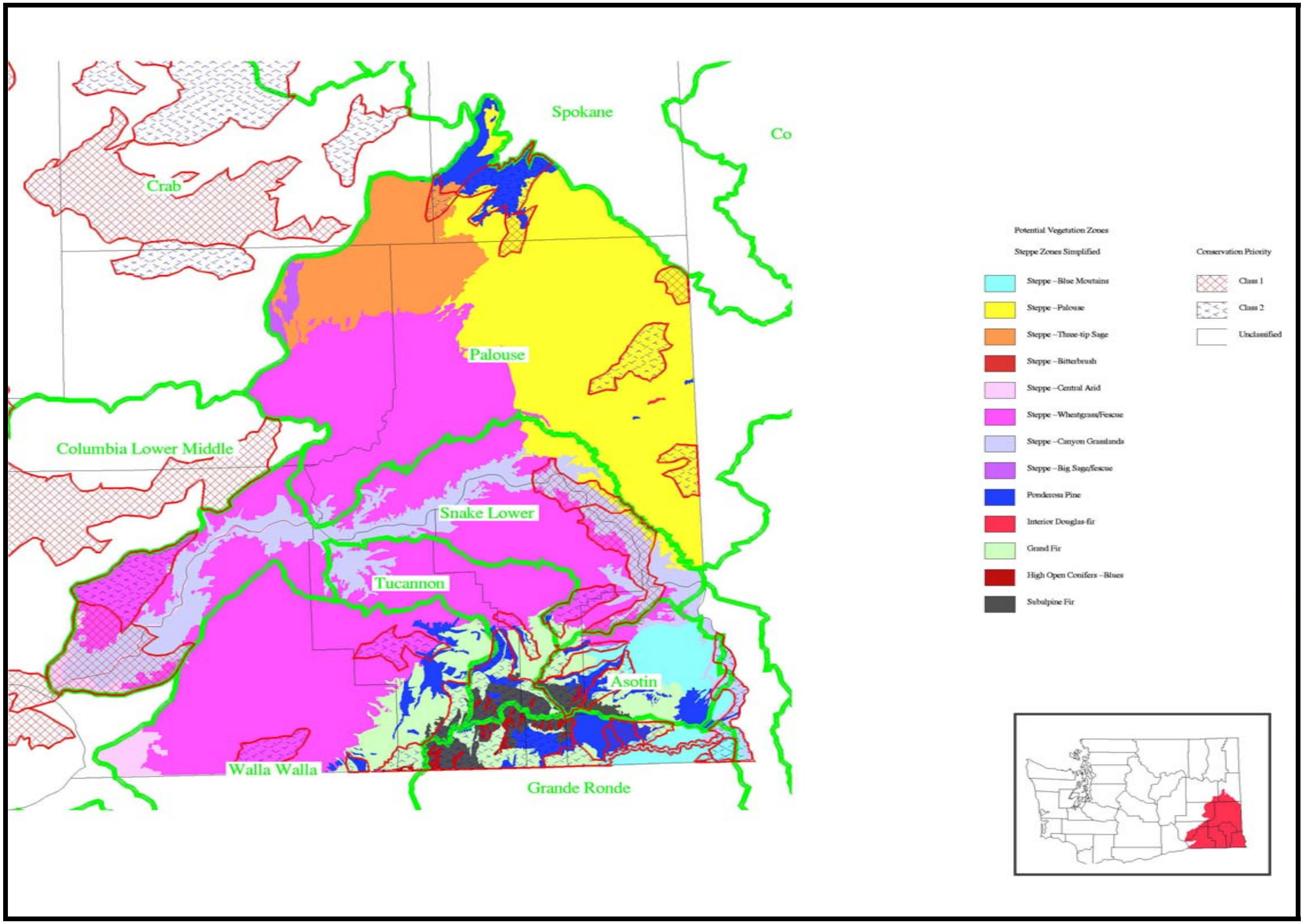

Figure 39. ECA land classes in the Southeast Washington Subbasin Planning Ecoregion and adjacent areas in Washington (Cassidy 1997).

Ecoregion Conservation Assessment Class 1 lands within the Palouse steppe vegetation zone (Palouse subbasin) are currently agriculture except for a small area in the northern end of the subbasin near the Turnbull National Wildlife Refuge. Similarly, lands within the central arid steppe, and wheatgrass/fescue steppe vegetation zones are primarily agriculture. The largest parcel of ECA Class 1 lands within the Ecoregion not under agricultural production lies within the canyon grassland steppe vegetation zone in the Lower Snake subbasin Figure_39.

Combining ECA, GAP and NHI data, vegetation zone information, and land ownership data shows the following:

1. ECA Class 1 lands overlap approximately 7,383 acres of high protection status and 8,443 acres of medium protection status wheatgrass/ fescue steppe habitat currently owned and managed by BLM within the Lower Snake subbasin (Figure_9).
2. No overlap exists between ECA Class 1 lands and high/medium protection status areas in the Palouse subbasin or any other area, or vegetation zone within the Ecoregion Figure_7 and Figure_39.

4.3 Primary Factors Impacting Focal Habitats and Wildlife Species

The principal post-settlement conservation issues affecting focal habitats and wildlife populations include habitat loss and fragmentation resulting from conversion to agriculture, habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes. Anthropogenic changes in shrub and grass dominated communities have been especially severe in the State of Washington, where over half the native shrubsteppe has been converted to agricultural lands (Dobler *et al.* 1996). Similarly, little remains of the grasslands that once dominated the Ecoregion.

Unlike forest communities that can regenerate after clearcutting, shrubsteppe and grasslands that have been converted to agricultural crops are unlikely to return to native plant communities even if left idle for extended periods, because upper soil layers (horizons) and associated micro-biotic organisms have largely disappeared due to water and wind erosion and tillage practices. Furthermore, a long history of grazing, fire, and invasion by exotic vegetation has altered the composition of plant communities within much of the extant shrubsteppe and grassland habitat that remains within the Ecoregion (Quigley and Arbelbide 1997; Knick 1999).

The loss of once extensive grassland and shrubsteppe communities has substantially reduced the habitat available to a wide range of habitat dependent obligate wildlife species, including several birds found only in these community types (Quigley and Arbelbide 1997; Saab and Rich 1997). Sage sparrow, Brewer's sparrow, sage thrasher, and sage grouse are considered shrubsteppe obligates, while numerous other species such as grasshopper sparrow and sharp-tailed grouse are associated primarily with grassland-steppe vegetation. In a recent analysis of birds at risk within the interior Columbia Basin, the majority of species identified as high management concern were shrubsteppe/grassland species. Moreover, according to the BBS, over half these species have experienced long-term population declines (Saab and Rich 1997).

Ecoregion planners reviewed the subbasin summaries (NPPC 2001a-e) for information on factors impacting focal habitats and limiting wildlife populations and abundance. Technical experts involved in providing information for the subbasin summaries identified eight habitat or wildlife-related limiting factors, including mismanaged livestock grazing, agricultural conversion, exotic vegetation, fire suppression, road development, timber harvest, hydropower development, and urban development. In the Walla Walla subbasin and adjoining provinces, mining is a factor that impacts habitats and/or limits wildlife populations.

Livestock grazing, agriculture, and exotic vegetation were identified in all five subbasin summaries as primary limiting factors. Hydropower development and timber harvest were identified in four subbasin summaries as major limiting factors, while fire suppression, road and urban development were listed in three summaries (Table 26). Clearly, grazing, agriculture, and exotic vegetation are common limiting factors that are pervasive throughout the entire Ecoregion.

4.3.1 Livestock Grazing

The legacy of livestock grazing throughout the entire Columbia Plateau, including the Ecoregion, has had widespread and severe impacts to vegetation structure and composition. Disturbance plays an important role in determining successional pathways in grassland and shrubsteppe communities (Daubenmire 1970; Smith *et al.* 1995). One of the most severe impacts has been the increased spread of exotic plants. Excessive grazing by livestock can reduce the abundance of some native plants and allow exotic species to dominate vegetation communities (Branson 1985). The effects of livestock grazing on grassland and shrubsteppe vegetation can influence use of sites by birds and other wildlife species, although the direction of influence (positive or negative) may vary (Saab *et al.* 1995).

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. In recent years, USDA programs have supported conversion of agricultural fields to modified grasslands through CRP; however, in most cases these modified grasslands lack floristic and structural diversity.

Grasslands and grazing animals have coexisted for millions of years. Large migratory herbivores, like the bison, are integral to the functioning of grassland ecosystems. Through grazing, these animals stimulate regrowth of grasses and remove older, less productive plant tissue. Thinning of older plant tissues allows increased light to reach younger tissues, which promotes growth, increased soil moisture, and improved water-use efficiency of grass plants (Frank *et al.* 1998).

Grazing by domestic livestock can replicate many of these beneficial effects, but the herding and grazing regimes used to manage livestock can also harm grasslands by concentrating their impacts. Given the advantages of veterinary care, predator control, and water and feed supplements, livestock are often present in greater numbers than wild herbivores and can put higher demands on the ecosystem. In addition, herds of domestic cattle, sheep, and goats do not replicate the grazing patterns of herds of wild grazers. Use of water pumps and barbed wire fences has lead to more sedentary and often more intense use of grasslands by domestic animals (Frank *et al.* 1998 in McNaughten 1993). Grazing animals in high densities can destroy vegetation, change the balance of plant species, reduce biodiversity, compact soil and accelerate soil erosion, and impede water retention, depending on the number and breed of livestock and their grazing pattern (Evans 1998:263).

Livestock currently graze much of the remaining interior grassland habitat in the Ecoregion. 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 (Tisdale 1986). Evidently, these drier native bunchgrass grasslands changed irreversibly to persistent introduced annual grasses and forbs. In an effort to increase forage production, some native bunchgrass plant communities, and shrubsteppe habitats were either inter-seeded or converted to intermediate wheatgrass, or more commonly, crested

Table 26. Limiting factors analysis for the Southeast Washington Subbasin Planning Ecoregion (NPPC 2001a-e).

Subbasin	**Limiting Factor**									
	Residential Development	**Fire Suppression**	**Livestock Grazing**	**Road Development**	**Hydropower Development**	**Exotic Vegetation**	**Agriculture**	**Mining**	**Timber Harvest**	**Number of Limiting Factors Identified in Subbasin**
Asotin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	**8**
Tucannon	No	No	Yes	No	No	Yes	Yes	No	Yes	**4**
Lower Snake	No	Yes	Yes	No	Yes	Yes	Yes	No	No	**5**
Palouse	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	**7**
Walla Walla	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**9**
Number of Subbasins Limiting Factor Identified	**3**	**3**	**5**	**3**	**4**	**5**	**5**	**1**	**4**	

wheatgrass, further reducing the floristic quality and the amount of native habitats.

One of the most visible and useful indicators of degradation of grazing lands is soil erosion. High densities of livestock or poor management of herds diminish vegetative cover and contribute to erosion. This eventually will reduce the productivity of the grassland, although some areas with deep soils can withstand high rates of erosion.

4.3.2 Agriculture

Throughout the Ecoregion and eastern Washington, conversion of grassland and shrubsteppe communities to agricultural purposes has resulted in a fragmented landscape with few extensive tracts of grassland or shrubsteppe remaining (Dobler *et al.* 1996).

Agricultural land uses in the Ecoregion include dry land wheat farms, irrigated agricultural row crop production, and irrigated agriculture associated with livestock production (alfalfa and hay). Agriculture conversions concentrated in low elevation valleys have significantly affected valley bottom grasslands, shrublands, and cottonwood dominated riparian areas. Agricultural development has altered or destroyed vast amounts of native grassland and shrubsteppe habitat in the lowlands, and fragmented riparian habitat. Agricultural operations have also increased sediment loads and introduced herbicides and pesticides into streams.

Similarly, conversion of xeric hillsides and benches has eliminated or severally altered much of the once abundant grassland habitat within the Ecoregion. Conversion of any wildlife habitat type to agriculture adversely affects wildlife in two ways: native habitat in most instances is permanently lost, and remaining habitat is isolated and embedded in a highly fragmented landscape of multiple land uses.

Although the magnitude of agricultural conversion of Washington's interior grasslands and shrubsteppe is impressive, its effect on wildlife is magnified by extreme fragmentation of the remaining habitats. Species tend to evolve in concert with their surroundings, and for interior grassland and shrubsteppe dependent wildlife, this means that species adapted to expansive landscapes of steppe and shrubsteppe communities. When landscapes are fragmented by conversion to land-use types that are different from what occurred naturally, wildlife dependent upon the remaining remnant native habitat may be subjected to adverse population pressures, including:

- isolation of breeding/meta populations;
- competition from similar species associated with other, now adjacent, habitats;
- increased predation by predators;
- increased nest loss through parasitism by brown-headed cowbirds;
- creation of population sinks; and
- increased conflict between wildlife species and agricultural interests (e.g., crop depredation by elk and deer).

In addition, fragmentation of previously extensive landscapes can influence the distribution and abundance of birds through redistribution of habitat types and through the pattern of habitat fragmentation, including characteristics such as decreased patch area and increased habitat edge (Ambuel and Temple 1983; Wilcove *et al.* 1986; Robbins *et al.* 1989; Bolger *et al.* 1991, 1997). Fragmentation also can reduce avian productivity through increased rates of nest predation (Gates and Gysel 1978; Wilcove 1985), increased nest parasitism (Brittingham and Temple 1983; Robinson *et al.* 1995), and reduced pairing success of males (Gibbs and Faaborg 1990; Villard *et al.* 1993; Hagan *et al.* 1996).

It is unknown to what extent these population pressures affect birds and other wildlife species in fragmented grassland and shrubsteppe environments, although a recent study from Idaho (Knick and Rotenberry 1995) suggests that landscape characteristics influence site-selection by some shrubsteppe birds. Most research on fragmentation effects on birds has occurred in the forests and grasslands of eastern and central North America, where conversion to agriculture and suburban/urban development has created a landscape quite different from that which existed previously. The potential for fragmentation to adversely affect shrubsteppe wildlife in Washington warrants further research.

Even though the conversion of native habitats to agriculture severely impacted native wildlife species such as sharp-tailed grouse, agriculture did provide new habitat niches that were quickly filled with introduced species such as the ring-necked pheasant (*Phasianus colchicus*) chukar (*Alectoris chukar*), and the gray partridge (*Perdix perdix*). Moreover, native ungulate populations took advantage of new food sources provided by croplands and either expanded their range or increased in number (J. Benson, WDFW, personal communication, 1999). Wildlife species and populations that could adapt to or thrive on “edge” habitats increased with the introduction of agriculture until the advent of “clean farming” practices and monoculture cropping systems.

4.3.3 Exotic Vegetation

The number and abundance of introduced species is an indicator of biodiversity condition. At the Ecoregional scale, the growing threat of invasive species in grasslands and other habitat types may bode ill for carbon storage. For example, recent experiments suggest that crested wheatgrass, a shallow-rooted grass introduced to North American prairies from North Asia to improve cattle forage, stores less carbon than native perennial prairie grasses with their extensive root systems (Christian and Wilson 1999:2397). Locally, noxious weeds, primarily yellow starthistle, spotted and diffuse knapweed, rush skeleton weed, leafy spurge and introduced annual grasses, are pervasive and have taken over thousands of acres of wildlife habitat.

Yellow starthistle displaces native plant species and reduces plant diversity (Lacey *et al.* 1974), and when it occurs in solid stands can drastically reduce forage production for wildlife. Birds, wildlife, humans, domestic animals, and vehicles may transport the seeds. A single plant may produce up to 150,000 seeds. Approximately 90 percent of the seed falls within 2 feet of the parent plant (Roche 1991). Of these seeds, 95 percent are viable, and 10 percent can remain viable for 10 years (Callihan *et al.* 1993). Yellow starthistle is deep-rooted, grows more rapidly than most perennial grasses, and will grow twice as fast as annual grasses (Sheley and Larson 1995). Yellow starthistle can accelerate soil erosion and surface runoff (Lacey *et al.* 1989) that eventually flows into salmonid bearing streams within the Ecoregion.

Knapweeds are members of the Asteraceae family and are problematic within the Ecoregion. Spotted knapweed is a deep tap-rooted perennial that lives up to nine years (Boggs and Story 1987). Seeds germinate in the spring and fall when moisture and temperatures are suitable (Watson and Renney 1974). Wind, humans, animals, and vehicles spread knapweed seeds. Spotted knapweed is also able to extend lateral shoots below the soil surface to form rosettes next to the parent plant (Watson and Renney 1974).

Watson and Renney (1974) found that spotted knapweed decreased bluebunch wheatgrass by 88 percent. Elk use was reduced by 98 percent on range dominated by spotted knapweed compared to bluebunch-dominated sites (Hakim 1979). Similarly, diffuse knapweed reduces the biodiversity of plant populations, increases soil erosion (Sheley *et al.* 1997), threatens Natural Area Preserves (Schuller 1992) and replaces wildlife forage on range and pasture.

Rush skeletonweed is also in the Asteraceae family. It can be a perennial, a biennial, or a short-lived perennial, depending on its location. Seed production ranges from 15,000 to 20,000 seeds. The seeds are adapted to wind dispersal but are also spread by water and animals. Rush skeletonweed can also spread by its roots. Rush skeletonweed reduces forage for wildlife. Its extensive root system enables it to compete for the moisture and nutrients that grasses need to flourish.

Leafy spurge is a perennial belonging to the Spurge family. The root system can penetrate the soil 8 to 10 feet and will spread horizontally, enabling plant colonies to increase in size to out-compete more desirable native vegetation for space, nutrients, water, and sunlight. The seeds are in a capsule and, when dry, the plant can project the seeds as far as15 feet. Seeds may be viable in the soil up to 8 years. Like most weed species, leafy spurge is spread by vehicles, mammals, and birds. Leafy spurge root sap gives off a substance that inhibits the growth of grasses and reduces forage for wildlife.

Annual grasses such as cheatgrass, bulbous bluegrass, medusahead, and others have become naturalized throughout the Ecoregion and have either completely displaced or compete heavily with native grasses and forbs in most areas. Although annual grasses can be potential forage for big game and some bird species, they severely impact native plant communities and can add significantly to the fire fuel load, resulting in hotter wildfires that increase damage to native vegetation.

4.3.4 Fire

In Ecoregion forest habitats, fire suppression has resulted in the loss of climax forest communities and, in some instances, wildlife species diversity by allowing the spread of shade tolerant species such as Douglas-fir and grand fir. Prior to fire suppression, wildfires kept shade-tolerant species from encroaching on established forest communities. The lack of fire within the ecosystem has resulted in significant changes to the forest community to the detriment of some wildlife species. Changes in forest habitat components have reduced habitat availability, quality, and utilization for wildlife species dependent on timbered habitats.

Fire is a natural occurrence in most grassland ecosystems and has been one of the primary tools humans have used to manage grasslands. Fire prevents woody vegetation from encroaching, removes dry vegetation, and recycles nutrients. Conversely, fire suppression allows shrubs and trees to encroach on areas once devoid of woody vegetation and/or promotes decadence in undisturbed native grass communities. Although fire can benefit grasslands, it can be harmful too—particularly when fires become much more frequent than is natural. If too frequent, fire can remove plant cover and increase soil erosion (Ehrlich *et al.* 1997:201) and can promote the spread of annual grasses to the detriment of native plants (Whisenant 1990). Fires also release atmospheric pollutants.

Fires covering large areas of shrubsteppe habitat can eliminate shrubs and their seed sources and create grassland habitat to the detriment of sagebrush-dependent wildlife species such as sage grouse. Fires that follow heavy grazing or repeated early season fires can result in annual grasslands of cheatgrass, medusahead, knapweed, and/or yellow starthistle.

4.3.5 Road Development

The transportation system within the Ecoregion is a potential limiting factor to wildlife populations. Road densities and placement can have a negative impact on elk use of important habitat (Perry and Overly 1977). More than 65 species of terrestrial vertebrates in the Columbia River Basin have been identified as being negatively affected by road-associated factors (Wisdom *et al.* 2000), which can negatively affect terrestrial vertebrate habitats and populations as well as water quality and fish populations.

Habitat fragmentation due to road construction and improper culvert placement has also prevented migration of fish and amphibian species within and/or between some subbasin tributaries. Increasing road densities can reduce big game habitat effectiveness or increase vulnerability to harvest. Motorized access facilitates firewood cutting and commercial harvest, which can reduce the suitability of habitats surrounding roads for species that depend on large trees, snags, or logs (USFS 2000). Roads also aid the spread of noxious weeds.

4.3.6 Hydropower Development

Prior to hydropower construction, alluvial soils associated with the Snake River valley provided a rich medium for riparian vegetation and cultivated crops. Thin bands of trees and shrubs were common along the shoreline. This riparian band expanded where tributaries or springs entered the river and extended up canyon sides in draws where there was sufficient moisture. The flat terraces along the river were primarily in agriculture production. Drier areas within the floodplain and along canyon slopes supported sagebrush, rabbitbrush and grasses. Over 50 islands were also interspersed within the river along with sand and gravel bars (USFWS *et al*. 1991).

Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams were authorized by Congress in 1945 and were completed in 1962, 1969, 1970, and 1975 respectively (USFWS et al. 1991). As a result, approximately 140 miles of once free flowing river were impounded and thousands of acres of riparian and shrubsteppe habitat were inundated and permanently lost severely impacting wildlife species associated with those habitats. Lewke (1975) estimated that the loss of riparian habitat caused by the impoundment of Lower Granite Dam alone resulted in a loss of habitat for 11,000 summer and 17,000 winter birds. There has been some recovery, but the carrying capacity for wildlife in the area has been undeniably lowered. The amount of habitat and associated habitat units (HUs) lost on the lower Snake River due to hydropower development are shown in Table 27 and Table 28.

Table 27. Habitat type, acres, and habitat units lost due to hydropower development on the lower Snake River (USFWS *et al.* 1991).

Habitat Type	Acres
Agriculture	6,035
Forbland	799
Woody Riparian	2,279
Grass/shrubsteppe	8,080
Riverine	19,464
TOTAL	**36,657**

Table 28. Habitat units lost due to hydropower development on the lower Snake River (NPPC 2000).

Loss Assessment Species	HUs
Downy Woodpecker	365
Song Sparrow	288
Yellow Warbler	927
California Quail	20,508
Ring-necked Pheasant	2,647
Canada Goose	2,040
TOTAL	**26,775**

Since most of the rich floodplain alluvial soils are now inundated, little agricultural land remains. The same is true for much of the remaining shoreline where most of the remaining riparian vegetation is associated with tributaries and mesic canyon draws. Over 40 percent of the reservoir shoreline is riprapped, which precludes revegetation of riparian plant communities. Furthermore, much of the remaining shoreline is comprised of steep cutbanks due to wave action. Since impoundment, the recovery of riparian habitat has been slow due to shallow soils along the banks of the reservoir in comparison to soils formed in a natural riparian ecosystem. In contrast, however, emergent wetlands appear to be increasing in size over time as a result of sedimentation in reservoir backwater areas (USFWS *et al.* 1991).

Hydropower development on the lower 140 miles of the Snake River provided water to convert shrubsteppe habitat to irrigated croplands, orchards, vineyards, and pulp tree plantations. In addition, lower Snake River reservoirs provide a major water transportation route for farm commodities and other goods. Barge traffic on the lower Snake River produces wave action throughout the length of the system. Along with barge traffic comes the continuous maintenance (i.e., dredging) of the channel due to sedimentation.

4.3.7 Development and Urbanization

In addition to grazing and agriculture, there have been permanent losses of habitats due to urban and rural residential growth. Urban sprawl is a concern for resource managers as indicated by the growing number of ranchettes, subdivisions, subdivided cropland, and floodplain encroachment. Areas of development often occur near wooded areas, lakes, or streams. The increasing number of dwellings poses a threat to water quality due to the increased amount and dispersion of potential nutrient sources immediately adjacent to waterways.

4.3.8 Railroad System

The railroad runs along the entire length of the lower Snake River corridor. The railroad presents a number of issues that are limiting to wildlife populations. Direct loss of wildlife along the rail system is unavoidable. Fires set by the operation of the rail system are a common problem, which can also lead to the direct loss of wildlife through physical loss of habitat and through influencing habitat succession and seral stages. Indirect losses to wildlife and riparian habitats attributed to the rail system are primarily caused by the placement of rock riprap along much of the railway to reduce erosion to track beds from wave action along the reservoirs.

4.3.9 Summary of Factors Affecting Focal Habitats and Wildlife Species

4.3.9.1 Ponderosa Pine

- Timber harvesting, particularly at low elevations, has reduced the amount of old growth forest and associated large diameter trees and snags.

- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. There is a high risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.
- Fragmentation of remaining tracts has negatively impacted species with large area requirements.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.
- The timing (spring/summer versus fall) of restoration/silviculture practices such as mowing, thinning, and burning of understory removal may be especially detrimental to single-clutch species.
- Spraying insects that are detrimental to forest health may have negative ramifications on lepidopterans and non-target avian species.

4.3.9.2 Shrubsteppe/Grasslands

- Extensive permanent habitat conversions of shrubsteppe/grassland habitats (e.g., approximately 60 percent of shrubsteppe in Washington [Dobler *et al.* 1996]) to other uses (e.g., agriculture, urbanization).
- Fragmentation of remaining tracts of moderate to good quality shrubsteppe habitat.
- Degradation of habitat from intensive grazing and invasion of exotic plant species, particularly annual grasses such as cheatgrass and woody vegetation such as Russian olive.
- Degradation and loss of properly functioning shrubsteppe/grassland ecosystems resulting from the encroachment of urban and residential development and conversion to agriculture. Best sites for healthy sagebrush communities (deep soils, relatively mesic conditions) are also best for agricultural productivity; thus, past losses and potential future losses are great. Most of the remaining shrubsteppe in Washington is in private ownership with little long-term protection (57 percent).
- Loss of big sagebrush communities to brush control (may not be detrimental relative to interior grassland habitats).
- Conversion of CRP lands back to cropland.
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
- High density of nest parasites (brown-headed cowbird) and domestic predators (cats) may be present in altered landscapes, particularly those in proximity to agricultural and residential areas subject to high levels of human disturbance.
- Agricultural practices cause direct or indirect mortality and/or reduce wildlife productivity. There are a substantial number of obligate and semi-obligate avian and mammal species; thus, threats to the habitat jeopardize the persistence of these species.
- Fire management, either suppression or over-use.
- Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.

4.3.9.3 Eastside (Interior) Riparian Wetlands

- Loss of habitat due to numerous factors including recreational developments, inundation from impoundments, cutting and spraying of riparian vegetation for eased access to water courses, gravel mining, etc.
- Habitat alteration from 1) hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduced stream flows and reduction of overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and 2) stream bank stabilization which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation.
- Habitat degradation from livestock grazing which can widen channels, raise water temperatures, and reduce understory cover.
- Habitat degradation from conversion of native riparian shrub and herbaceous vegetation to invasive exotics such as reed canarygrass, purple loosestrife, perennial pepperweed, salt cedar, indigo bush, and Russian olive.
- Fragmentation and loss of large tracts necessary for area-sensitive species such as yellow-billed cuckoo.
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.
- High energetic costs associated with high rates of competitive interactions with European starlings for cavities may reduce reproductive success of cavity-nesting species such as Lewis' woodpecker, downy woodpecker, and tree swallow, even when outcome of the competition is successful for these species.
- Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas.

The World Resources Institute (WRI) summarized a variety of human-induced pressures that affect global ecosystems (Table_29) A corresponding analogy may be drawn for the Ecoregion in that the principal pressure on resources in some areas of the Ecoregion is simple overuse—too much logging, grazing, or recreational/residential development. Overuse not only depletes the plants and wildlife that inhabit the Ecoregion, but also can fragment wildlife habitats and disrupt their integrity—all factors that diminish their productive capacity. Outright conversion of forests, shrubsteppe, and wetlands to agriculture or other uses is another principal pressure reshaping terrestrial habitat in the Ecoregion.

4.4 Summary of Focal Habitats and Species Relationships

Relationships between focal habitats and focal species assemblages are summarized in Figure_40. Changes in the extent and quality of Ecoregion focal habitat conditions were examined to identify and understand the magnitude of change that occurred in focal habitats and associated wildlife populations since European settlement (circa 1850). Ecoregion planners documented current habitat conditions and reviewed habitat attributes and life requisites for each wildlife species assemblage. A comparison of current habitat conditions and focal species habitat needs led to development of a range of recommended future conditions for each focal habitat type.

Table 29. Primary human-induced pressures on ecosystems (WRI 2000:19).

Ecosystem	Pressures	Causes
Agroecosystems	■ Conversion of farmland to urban and industrial uses ■ Water pollution from nutrient runoff and siltation ■ Water scarcity from irrigation ■ Degradation of soil from erosion, shifting cultivation, or nutrient depletion ■ Changing weather patterns	■ Population growth ■ Increasing demand for food and industrial goods ■ Urbanization ■ Government policies subsidizing agricultural inputs (water, research, transport) and irrigation ■ Poverty and insecure tenure ■ Climate change
Forest Ecosystems	■ Conversion or fragmentation resulting from agricultural or urban uses ■ Deforestation resulting in loss of biodiversity, release of stored carbon, air and water pollution ■ Acid rain from industrial pollution ■ Invasion of nonnative species ■ Overextraction of water for agricultural, urban, and industrial uses	■ Population growth ■ Increasing demand for timber, pulp, and other fiber ■ Government subsidies for timber extraction and logging roads ■ Inadequate valuation of costs of industrial air pollution ■ Poverty and insecure tenure
Freshwater Systems	■ Overextraction of water for agricultural, urban, and industrial uses ■ Overexploitation of inland fisheries ■ Building dams for irrigation, hydropower, and flood control ■ Water pollution from agricultural, urban, and industrial uses ■ Invasion of nonnative species	■ Population growth ■ Widespread water scarcity and naturally uneven distribution of water resources ■ Government subsidies of water use ■ Inadequate valuation of costs of water pollution ■ Poverty and insecure tenure ■ Growing demand for hydropower
Grassland Ecosystems	■ Conversion or fragmentation owing to agricultural or urban uses ■ Induced grassland fires resulting in loss of biodiversity, release of stored carbon, and air pollution ■ Soil degradation and water pollution from livestock herds ■ Overexploitation of game animals	■ Population growth ■ Increasing demand for agricultural products, especially meat ■ Inadequate information about ecosystem conditions ■ Poverty and insecure tenure

5.0 Biological Features

5.1 Focal Wildlife Species Selection and Rationale

Lambeck (1997) defined focal species as a suite of species whose requirements for persistence define the habitat attributes that must be present if a landscape is to meet the requirements for all species that occur there. The key characteristic of a focal species is that its status and trend provide insights to the integrity of the larger ecological system to which it belongs (USFS 2000).

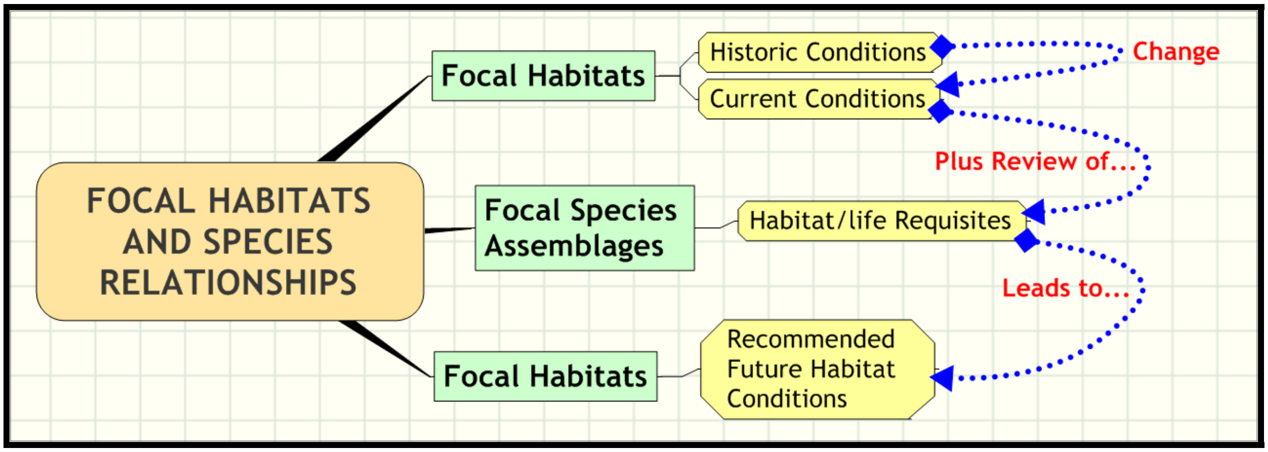

Figure 40. Focal habitats and species assemblage relationships.

Subbasin planners refer to these species as "focal species" because they are the focus for describing desired habitat conditions and attributes and needed management strategies and/or actions. The rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the Ecoregion also impact wildlife species (see section 4.3), hence, the decision by Ecoregion planners to focus on focal habitats with focal species in a supporting role.

Ecoregion planners consider focal species life requisites representative of habitat conditions or features that are important within a properly functioning focal habitat type. In some instances, extirpated or nearly extirpated species such as sharp-tailed grouse were included as focal species if subbasin planners believed they could potentially be reestablished and/or are highly indicative of some desirable habitat condition.

Ecoregion and subbasin planners identified a focal species assemblage, (species that inhabitat the same habitat type and require similar habitat attributes) for each focal habitat type (Table_31) and combined life requisite habitat attributes for each species assemblage within each focal habitat to form a recommended range of management conditions. Wildlife habitat managers will use the recommended range of habitat conditions to identify and prioritize future habitat acquisition, protection, and management strategies and to develop specific habitat management actions for focal habitats. Recommended future habitat conditions based on the life requisite needs of focal wildlife species assemblages for each focal habitat are summarized below.

5.1.1 Ponderosa Pine

Condition 1 – mature ponderosa pine forest: The white-headed woodpecker represents species that require large patches (greater than 350 acres) of open mature old growth ponderosa pine stands with canopy closures between 10 and 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH).

Condition 2 – multiple canopy ponderosa pine mosaic: Flammulated owls represent wildife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner *et al.* 1990), two-layered canopies, tree density of 508 trees/acre (9-foot spacing), basal area of 250 feet^2/acre (McCallum 1994b), and snags greater than 20 inches DBH 3-39 feet tall (Zeiner *et al.* 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

Condition 3 – Dense canopy closure ponderosa pine forest: Rocky Mountain elk were selected to characterize ponderosa pine habitat that is greater than 70 percent canopy closure and 40 feet in height.

5.1.2 Shrubsteppe

Condition 1 – Sagebrush dominated shrubsteppe habitat: The sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush-dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat (Knock and Rotenberry 1995; Paige and Ritter 1999; Vander Haegen *et al.*, 2000). Suitable habitat includes 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover.

Similarly, the Brewer's sparrow was selected to represent wildlife species that require sagebrush-dominated sites, but prefer a patchy distribution of sagebrush clumps 10 to 30 percent cover (Altman and Holmes 2000), lower sagebrush height (between 20 and 28 inches), (Wiens and Rotenberry 1981), native grass cover 10 to 20 percent (Dobler 1994), non-native herbaceous cover less than 10 percent, and bare ground greater than 20 percent (Altman and Holmes 2000).

Condition 2 – Diverse shrubsteppe habitat: Mule deer were selected to represent species that require diverse, dense (30 to 60 percent shrub cover less than 5 feet tall) shrubsteppe habitats comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld *et al.* 1973; Sheehy 1975; Jackson 1990; Ashley *et al.* 1999) with a palatable herbaceous understory exceeding 30 percent cover (Ashley *et al.* 1999).

5.1.3 Eastside (Interior) Grasslands

Grasshopper sparrow and sharp-tailed grouse were selected to represent interior grassland wildlife species. The range of conditions recommended for interior grassland habitat includes:

- Native bunchgrasses greater than 40 percent cover;
- Native forbs 10 to 30 percent cover;
- Herbaceous vegetation height greater than10 inches;
- Visual obstruction readings (VOR) at least 6 inches;
- Native non-deciduous shrubs less than 10 percent cover;
- Exotic vegetation/noxious weeds less than 10 percent cover; and
- Multi-structured fruit/bud/catkin producing deciduous trees and shrubs (macrophyllus draws and riparian sites) dispersed throughout the landscape (10 to 40 percent of the total area), or within 1 mile of sharp-tailed grouse nesting/broodrearing habitats.

5.1.4 Eastside (Interior) Riparian Wetlands

The yellow warbler, beaver, and great blue heron represent wildlife species associated with riverine habitats. Ecoregion planners recommend the following range of conditions for the specific riparian/riverine habitat attributes described below.

- Forty to 60 percent tree canopy closure (cottonwood and other hardwood species);
- Multi-structure/age tree canopy (includes trees less than 6 inches in diameter and mature/decadent trees);
- Woody vegetation within 328 feet of shoreline;
- Tree groves greater than 1 acre within 800 feet of water (where applicable);

- Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs);
- Multi-structured shrub canopy greater than 3 feet in height; and
- Limited to no disturbance within 800 feet of habitat type.

Ecoregion and subbasin planners emphasize ecosystem management through the use of focal habitat types while including components of single-species, guild, or indicator species assemblages. This approach is based on the assumption that a conservation strategy that emphasizes focal habitats at the ecoregion scale is more desirable than one that emphasizes individual species.

By combining the “course filter” (focal habitats) with the “fine filter” (focal wildlife species assemblage) approach, Ecoregion planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for wildlife. This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. Although conservation and management is directed towards focal species, establishment of conditions favorable to focal species will also benefit a wider group of species with similar habitat requirements.

Focal species can also serve as performance measures to evaluate ecological sustainability, species and ecosystem diversity, and results of management actions (USFS 2000). Monitoring of habitat attributes and focal species will provide a means of tracking progress towards conservation. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in this approach.

Subbasin planners selected focal wildlife species using a combination of factors, including:

- primary association with focal habitats for breeding;
- specialist species that are obligate or highly associated with key habitat elements/conditions important in functioning ecosystems;
- declining population trends or reduction in their historic breeding range (may include extirpated species);
- special management concern or conservation status such as threatened, endangered, species of concern and management indicator species; and
- professional knowledge on species of local interest.

A total of nine bird species and three mammalian species were chosen as focal or indicator species to represent four priority habitats in the Ecoregion (Table_30). Focal species selection rationale and important habitat attributes are described in further detail in Table_31.

5.2 Focal Species Information

This section contains abbreviated information on focal species. The reader is encouraged to review additional focal species life history information included in Appendix_F (some life history information such as historic distribution and historic and current population status may not be available for all focal species).

Table 30. Focal species selection matrix for the Southeast Washington Subbasin Planning Ecoregion.

Common Name	Focal Habitat[1]	Status[2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
White-headed woodpecker	Ponderosa pine	n/a	C	Yes	Yes	Yes	No
Flammulated owl		n/a	C	Yes	Yes	Yes	No
Rocky Mountain elk		n/a	n/a	Yes	Yes	No	Yes
Sage sparrow	Shrubsteppe	n/a	C	Yes	Yes	Yes	No
Sage thrasher		n/a	C	Yes	Yes	Yes	No
Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
Mule deer		n/a	n/a	Yes	Yes	No	Yes
Yellow warbler	Eastside (Interior) Riparian Wetland	n/a	n/a	Yes	No	Yes	No
American beaver		n/a	n/a	Yes	No	No	Yes
Great blue heron		n/a	n/a	Yes	Yes	No	No
Grasshopper sparrow	Eastside (Interior) Grassland	n/a	n/a	Yes	No	Yes	No
Sharp-tailed grouse		SC	T	Yes	Yes	Yes	No

[1] SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine
[2] C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

5.2.1 Ponderosa Pine Focal Species Information

5.2.1.1 White-headed Woodpecker

5.2.1.1.1 General Habitat Requirements

White-headed woodpeckers prefer a conifer forest with a relatively open canopy (50 – 70 percent cover) and an availability of snags and stumps for nesting. These birds prefer to build nests in trees with large diameters with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present. In general, open ponderosa pine stands with canopy closures between 30 and 50 percent are preferred. The openness, however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989).

Highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. They are uncommon or absent in monospecific ponderosa pine forests and stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine). Additional habitat attribute information can be viewed in Table 31.

5.2.1.1.2 Limiting Factors

Logging has removed much of the old growth cone producing pines that provide winter food and large snags for nesting throughout this species' range. The impact from the decrease in old growth cone producing pines is even more significant in areas where no alternate pine species exist for the white-headed woodpecker to utilize.

Fire suppression has altered the stand structure in many of the forests. Lack of fire has allowed dense stands of immature ponderosa pine as well as the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads resulting in more severe stand replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These

Table 31. Focal species selection rationale and habitat attributes for the Southeast Washington Subbasin Planning Ecoregion.

		Key Habitat Relationsips				
Focal Species	**Focal Habitat**	**Conservation Focus**	**Habitat Attribute (Vegetative Structure)**	**Comments**	**Life Requisite**	**Reason for Selection**
White-headed woodpecker	Ponderosa pine	large patches of old growth forest with large trees and snags	> 10 trees/ac > 21" DBH w/ > 2 trees > 31" DBH	large high-cut stumps; patch size smaller for old-growth forest; need > 350 ac or > 700 ac	Reproduction	Obligate for large patches of healthy old-growth Ponderosa pine forest; WA Priority Species
			10-50 percent canopy closure			
			> 1.4 snags/ac > 8" DBH w/ > 50 percent > 25"			
Flammulated owl	Ponderosa pine	interspersion; grassy openings and dense thickets	> 10 snags / 40 ha > 30 cm DBH and 1.8m tall	thicket patches for roosting; grassy openings for foraging	Food	Indicator of healthy landscape mosaic in Ponderosa pine and Ponderosa pine /Douglas-fir forest; WA Priority Species
			> 20 trees/ha > 21" DBH			
			at least 1 dense, brushy thicket and grassy opening			
Rocky Mountain Elk	Ponderosa pine	Mature ponderosa pine forest	canopy closure ≥ 70 percent and > coniferous trees 40 feet tall		Thermal Cover	WA Priority Species
			sagebrush height > 50 cm			
			herbaceous cover > 10 percent			
			open ground > 10 percent			
Sage thrasher	Shrubsteppe	Sagebrush height	sagebrush cover 5-20 percent	not area-sensitive (need > 40 ac); not impacted by cowbirds; high moisture sites w/ tall shrubs	Food, Reproduction	Indicator of healthy, tall sagebrush dominated shrubsteppe habitat; WA Priority Species
			sagebrush height > 80 cm			
			herbaceous cover 5-20 percent			
			other shrub cover > 10 percent			

Key Habitat Relationsips						
Focal Species	**Focal Habitat**	**Conservation Focus**	**Habitat Attribute (Vegetative Structure)**	**Comments**	**Life Requisite**	**Reason for Selection**
			non-native herbaceous cover < 10 percent			
Brewer's sparrow	Shrubsteppe	sagebrush cover	sagebrush cover > 10 to 30 percent		Food, Reproduction	Indicator of healthy sagebrush dominated or mixed shrubsteppe habitat w/ native herbaceous cover
			mean sagebrush height > 64 cm			
			herbaceous cover > 10 percent			
			open ground > 20 percent			
			non-native herbaceous cover < 10 percent			
Mule deer	Shrubsteppe	big sagebrush, antelope bitterbrush	30-60 percent canopy cover of preferred shrubs < 5 ft (1.5m).		Food	Indicator of healthy diverse shrub layer in shrubsteppe habitat; WA Priority Species
			number of preferred shrub species > 3			
			mean height of shrubs > 3 feet (1m)			
			30-70 percent canopy cover of all shrubs < 5 feet(1.5m)			
			herbaceous cover > 30%			
Yellow warbler	Eastside (Interior) Riparian Wetland	native deciduous hydrophytic shrub species	60 to 80 percent deciduous shrub cover (>50% comprised of hydrophytic shrubs), shrub height > 3 feet (1m),	highly vulnerable to cowbird parasitism; grazing reduces understory structure	Reproduction	Represents species which reproduce in riparian shrub habitat and make extensive use of adjacent wetlands.
American Beaver	Eastside (Interior) Riparian	canopy closure/structure	40-60 percent tree/shrub canopy closure		Food	Indicator of healthy regenerating cottonwood stands; important habitat manipulator

Key Habitat Relationsips						
Focal Species	Focal Habitat	Conservation Focus	Habitat Attribute (Vegetative Structure)	Comments	Life Requisite	Reason for Selection
	Wetland					
		tree recruitment	trees < 6" DBH (15cm); shrub height ≥ 6.6 feet (2m)			
		permanent water	stream channel gradient ≤ 6 percent with little to no fluctuation		Water (cover for food and reproductive requirements)	
		shoreline development	woody vegetation ≤ 328 feet (100m) from water		Food	
Great blue heron	Eastside (Interior) Riparian Wetland	human disturbance	grove of trees ≥ 1 acre (0.4 ha) in area over water or ≤ 800 feet (250 m) from water		Food, Reproduction	Indicator of human disturbance; carnivore that forages on a variety of vertebrates in shallow water; cultural significance; WA Priority Species.
			disturbance-free zone around potential nest site of >800 feet (250 m) on land or >500 feet (150 m) on water			
			foraging zone ≥ 300 feet (100 m) from human activities or 150 feet (50 m) from roads			
Grasshopper Sparrow	Eastside (Interior) Grassland	Native grasslands	native bunchgrass cover > 15 percent and comprising > 60 percent of the total grass cover		Food, Reproduction	Indicator of healthy grasslands dominated by native bunchgrasses
			bunchgrass > 10" in height			
			native shrub cover < 10 percent			

			Key Habitat Relationsips			
Focal Species	**Focal Habitat**	**Conservation Focus**	**Habitat Attribute (Vegetative Structure)**	**Comments**	**Life Requisite**	**Reason for Selection**
		Non-native and agricultural grasslands (Conservation Reserve Program)	grass-forb cover > 90 percent			
			shrub cover < 10 percent			
			variable grass heights between 6-18"			
Sharp-tailed grouse	Eastside (Interior) Grassland	Bunchgrass dominated grasslands	mean VOR > 6" (1.5dm)		Reproduction	Indicator of healthy grasslands w/ deciduous trees and shrubs; WA Priority Species
			> 40 percent grass cover			
			> 30 percent forb cover	Needed primarily for brood rearing cover, food, and insect production	Reproduction and brood rearing	
			< 10 percent cover introduced herbaceous cover (noxious weeds and/or highly invasive species such as cheatgrass)			
		Deciduous trees and shrubs	Multi-structure fruit/bud/catkin producing deciduous shrubs (snowberry, rose, waterbirch, aspen, chokecherry, etc.)	Shrubby draws and/or clumps dispersed within grassland habitats	Winter food	

dense stands of immature trees has also led to increased competition for nutrients as well as a slow change from a ponderosa pine climax forest to a Douglas-fir dominated climax forest.

5.2.1.1.3 Current Distribution

White-headed woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California, Nevada and northern Idaho in the United States (Figure 41).

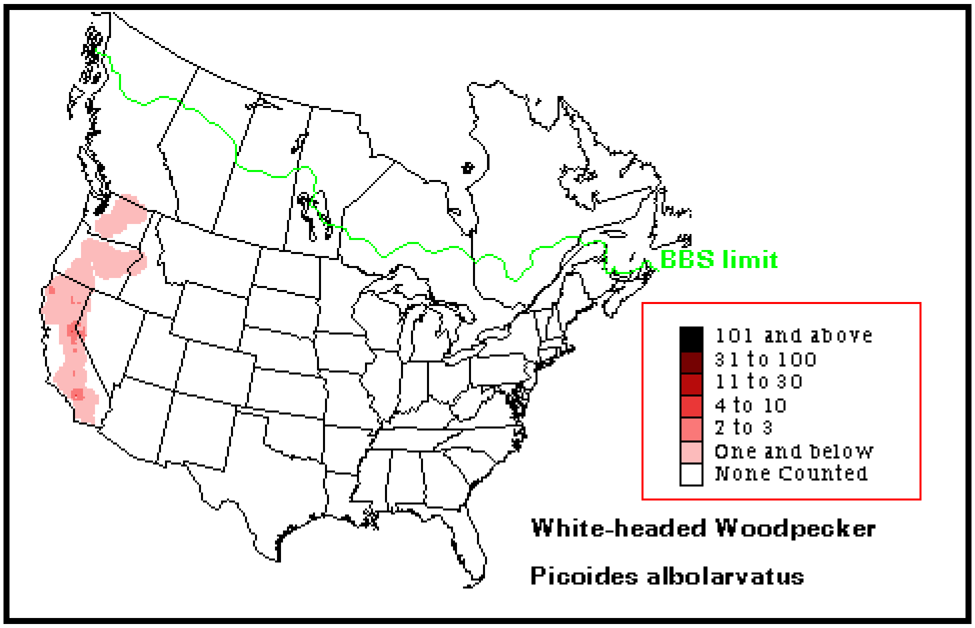

Figure 41. Current distribution/year-round range of white-headed woodpeckers (Sauer *et al.* 2003).

5.2.1.1.4 Population Trend Status

White-headed woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho and rare in British Columbia. However, they are still common in most of their original range in the Sierra Nevada and mountains of southern California.

This species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations. Breeding Bird Survey population trend data are illustrated in Figure 42.

5.2.1.1.5 Structure Condition Associations

Structural conditions associated with white-headed woodpeckers are summarized in Table 32 (NHI 2003). White-headed woodpeckers feed and reproduce (F/R) in and are generally associated (A) with a multitude of structural conditions within the ponderosa pine habitat type. Similarly, white-headed woodpeckers are present (P), but not dependent upon sapling/pole successional forest. According to NHI (2003) data, white-headed woodpeckers are not closely associated (C) with any specific ponderosa pine structural conditions.

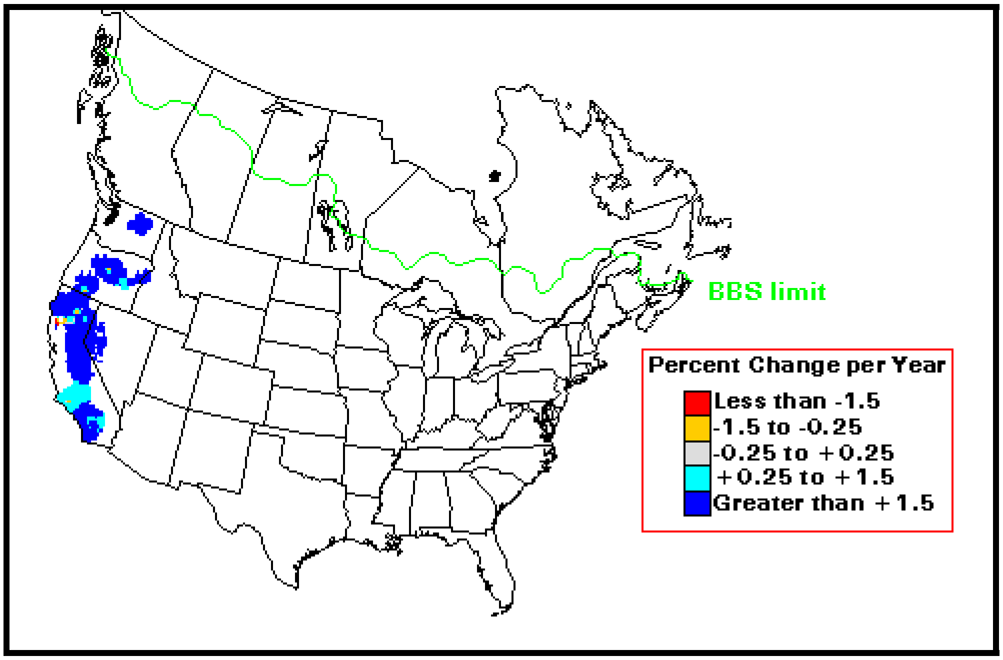

Figure 42. White-headed woodpecker Breeding Bird Survey population trend: 1966-1996 (Sauer *et al.* 2003).

Table 32. White-headed woodpecker structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
White-headed Woodpecker	Ponderosa Pine	Giant Tree-Multi-Story	F/R	A
		Grass/Forb-Closed	F/R	A
		Grass/Forb-Open	F/R	A
		Large Tree-Multi-Story-Closed	F/R	A
		Large Tree-Multi-Story-Moderate	F/R	A
		Large Tree-Multi-Story-Open	F/R	A
		Large Tree-Single Story-Closed	F/R	A
		Large Tree-Single Story-Moderate	F/R	A
		Large Tree-Single Story-Open	F/R	A
		Medium Tree-Multi-Story-Closed	F/R	A
		Medium Tree-Multi-Story-Moderate	F/R	A
		Medium Tree-Multi-Story-Open	F/R	A
		Medium Tree-Single Story-Closed	F/R	A
		Medium Tree-Single Story-Moderate	F/R	A
		Medium Tree-Single Story-Open	F/R	A
		Shrub/Seedling-Closed	F/R	A
		Shrub/Seedling-Open	F/R	A
		Small Tree-Multi-Story-Closed	F/R	A
		Small Tree-Multi-Story-Moderate	F/R	A
		Small Tree-Multi-Story-Open	F/R	A
		Small Tree-Single Story-Closed	F/R	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Small Tree-Single Story-Moderate	F/R	A
		Small Tree-Single Story-Open	F/R	A
		Sapling/Pole-Closed	F/R	P
		Sapling/Pole-Moderate	F/R	P
		Sapling/Pole-Open	F/R	P

5.2.1.2 Flammulated Owl

5.2.1.2.1 General Habitat Requirements

The flammulated owl is a Washington State candidate species. Limited research on the flammulated owl indicates that its demography and life history, coupled with narrow habitat requirements, make it vulnerable to habitat changes. The flammulated owl occurs mostly in mid-level conifer forests that have a significant ponderosa pine component (McCallum 1994b) between elevations of 1,200 to 5,500 feet in the north, and up to 9,000 feet in the southern part of its range in California (Winter 1974).

Flammulated owls are typically found in mature to old, open canopy ponderosa pine, Jeffrey pine (*Pinus jeffreyi*), Douglas-fir, and grand fir (Bull and Anderson 1978; Goggans 1986; Howie and Ritchie 1987; Reynolds and Linkhart 1992; Powers *et al.* 1996). Flammulated owls are a species dependent on large diameter ponderosa pine forests (Hillis *et al.* 2001) and are obligate secondary cavity nesters (McCallum 1994b), requiring large snags in which to roost and nest. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner *et al.* 1990). The owls selectively nest in dead ponderosa pine snags, and prefer nest sites with fewer shrubs in front than behind the cavity entrance, possibly to avoid predation and obstacles to flight. Specific habitat attribute information is located in Table_31.

5.2.1.2.2 Limiting Factors

Logging disturbance and the loss of breeding habitat associated with it has a detrimental effect on the flammulated owls (USDA 1994a). Flammulated owls prefer late seral forests. The main threat to this species is the loss of nesting cavities as these owls cannot create their own nest and rely on existing cavities. Management practices such as intensive forest management, forest stand improvement, and the felling of snags and injured or diseased trees (potential nest sites) for firewood effectively remove most of the cavities suitable for nesting (Reynolds *et al.* 1989). However, the owls will nest in selectively logged stands, as long as they contain residual trees (Reynolds *et al.* 1989).

Wildfire suppression has allowed many ponderosa pine stands to proceed to the more shade resistant fir forest types, which is less suitable habitat for these species (Marshall 1957; Reynolds *et al.* 1989).

Roads and fuelbreaks, often placed on ridgetops, result in removal of snags for safety considerations (hazard tree removal) and firewood can result in the loss of existing and recruitment nest trees.

Pesticides, including aerial spraying of carbaryl insecticides to reduce populations of forest insect pests, may affect the abundance of non-target insects important in the early spring diets of flammulated owls (Reynolds *et al.* 1989). Although flamulated owls rarely take rodents as prey, they could be at risk, like other raptors, of secondary poisoning by anticoagulant rodenticides. Possible harmful doses could cause hemmoraging upon the ingestion of anticoagulants such as Difenacoum, Bromadiolone, or Brodifacoum (Mendenhall and Pank 1980).

5.2.1.2.3 Current Distribution

Flammulated owl distribution is illustrated in Figure_43. Flammulated owls are uncommon breeders east of the Cascades in the ponderosa pine belt from late May to August. There have been occasional records from western Washington, but they are essentially an east side species. Locations where they may sometimes be found include Blewett Pass (straddling Chelan and Kittitas Counties), Colockum Pass area (Kittitas County), and Satus Pass (Klickitat County) (Figure_44).

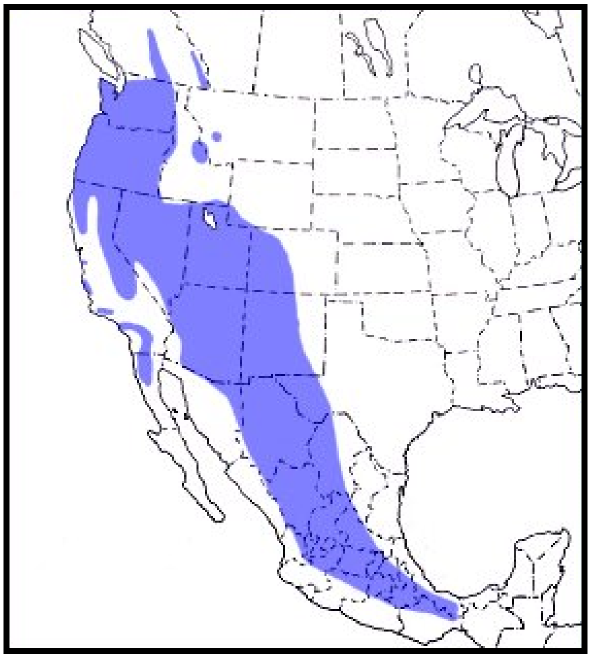

Figure 43. Flammulated owl distribution, North America (Kaufman 1996).

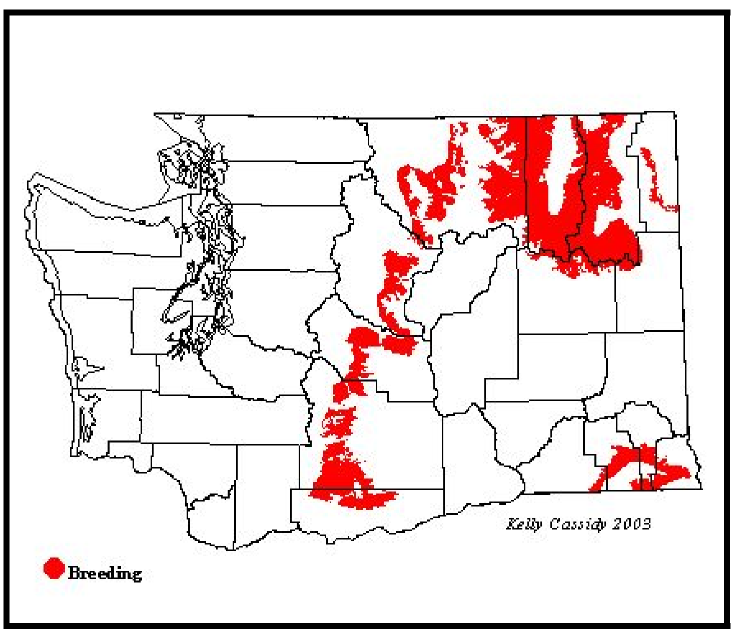

Figure 44. Flammulated owl distribution, Washington (Kaufman 1996).

5.2.1.2.4 Population Trend Status

Flammulated owls are candidates for inclusion on the WDFW endangered species list and are considered a species at risk by the Washington GAP Analysis Project and Audubon-Washington.

Because old-growth ponderosa pine is more rare in the northern Rocky Mountains than it was historically, and little is known about local flammulated owl distribution and habitat use, the USFS has listed the flammulated owl as a sensitive species in the Northern Region (USDA 1994b). It is also listed as a sensitive species by the USFS in the Rocky Mountain, Southwestern, and Intermountain regions, and receives special management consideration in the states of Montana, Idaho, Oregon, and Washington (Verner 1994).

So little is known about flammulated owl populations that even large scale changes in their abundance would probably go unnoticed (Winter 1974). Several studies have noted a decline in flammulated owl populations following timber harvesting (Marshall 1939; Howle and Ritcey 1987). However, more and more nest sightings occur each year, but this is most likely due to the increase in observation efforts.

5.2.1.2.5 Structural Condition Associations

Structural conditions associated with flammulated owl are summarized in Table 33 (NHI 2003). Flammulated owls feed and reproduce (F/R) in and are closely associated (C) with medium to large, multi-story, moderate to closed canopy ponderosa pine forest conditions. Similarly, flammulated owls are associated (A) with medium to large multi-story/open canopy forest and will utilize dense stands of small trees. In contrast, flammulated owls are present (P), but not dependent upon open canopy forest (NHI 2003). Of the three ponderosa pine focal species, flammulated owls are the most structural dependent species.

Table 33. Flammulated owl structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structure Condition (SC)	SC Activity	SC Assoc.
Flammulated Owl	Ponderosa Pine	Large Tree-Multi-Story-Open	F/R	A
		Medium Tree-Multi-Story-Open	F/R	A
		Small Tree-Multi-Story-Closed	F/R	A
		Small Tree-Multi-Story-Moderate	F/R	A
		Giant Tree-Multi-Story	F/R	C
		Large Tree-Multi-Story-Closed	F/R	C
		Large Tree-Multi-Story-Moderate	F/R	C
		Medium Tree-Multi-Story-Closed	F/R	C
		Medium Tree-Multi-Story-Moderate	F/R	C
		Large Tree-Single Story-Closed	F/R	P
		Large Tree-Single Story-Moderate	F/R	P
		Medium Tree-Single Story-Closed	F/R	P
		Medium Tree-Single Story-Moderate	F/R	P
		Small Tree-Multi-Story-Open	F/R	P

5.2.1.3 Rocky Mountain Elk

5.2.1.3.1 General Habitat Requirements

Elk inhabit the foothills and mountainous regions of the Blue Mountains, ranging in elevation from approximately 1,400 feet to over 6,400 feet. Satisfactory cover consists stands of coniferous trees that are greater than 40 feet tall, with a canopy closure of greater than 70 percent. Marginal cover is defined as coniferous trees greater than 10 feet tall with a canopy closure of greater than 40 percent. Leckenby (1984) found that elk use of cover is disproportionately higher in cover areas within 200 yards of cover forage edges. In forage areas, use was greatest with 300 yards of the cover-forage edge. Specific habitat attributes are described in Table_31.

Elk use of optimum habitat is reduced significantly by human activity (Lyndecker 1994). Protection from high levels of anthropogenic disturbance of elk breeding areas, winter ranges, and calving areas is an important management consideration. Several area closures have been implemented on winter ranges and calving areas in the Blue Mountains of Washington.

5.2.1.3.2 Limiting Factors

Myers *et al.* (1999) documented that road densities, silviculture practices (forage:cover ratios, stand composition, edge extent, and opening size), grazing, and noxious weeds influence seasonal elk use of habitat in the eastern Blue Mountains. In addition, elk habitat quality and use have been negatively impacted from long-term fire suppression and development.

Road densities and the use of off-road vehicles on developed trail systems on USFS land result in increased harassment of elk and decreased use by elk in prime habitat areas. This problem is especially acute when roads and trails are constructed through known elk calving areas, high-use summer habitat, and winter ranges. Road and trail closures have been implemented around major elk calving areas. In some areas, however, these closures allow all terrain vehicle use, which is incompatible with WDFW's objective of increasing elk use of these areas. Violations of the closures are an ongoing problem as is uncontrolled firewood cutting. Washington Department of Fish and Wildlife continues to coordinate closely with the USFS to improve habitat effectiveness for elk by reducing road densities and controlling all terrain vehicle use on trails in important elk habitat. Road closures in specific elk game management units (GMU) are described in the elk species account located in Appendix_F.

Silvicultural practices, especially clear cutting adjacent to open roads, has impacted elk habitat in many areas in the Blue Mountains. Clear cuts reduce the amount of security and thermal cover available for elk, and associated road development increases vulnerability. Elk have shown preference for areas with large tracts providing security cover, smaller sized openings, and edge areas (Myers *et. al.*1999). Increased logging, open roads, and uncontrolled firewood cutting have contributed to declining elk use in areas of important summer habitat.

Grazing on privately owned elk habitat in GMU 172 (Mountain View) (Figure_45) has resulted in over grazed range conditions, a condition that dramatically increases the risk of a noxious weed problem. In contrast, USFS lands appear to be in good condition (P. Fowler, WDFW, personal communication, 2003). Habitat conditions on public land in GMU 186 (Grande Ronde) (Figure_45) are fair. Trespass cattle on the Chief Joseph Wildlife Area continue to be an annual nuisance. Grazing permits on the Asotin Wildlife Area have been terminated, with the exception of the Weatherly parcel.

Noxious weeds displace native plant communities used by elk, resulting in a reduction in available elk forage. Washington Department of Fish and WIldlife implemented an aggressive weed control program on its lands within the Ecoregion, and works closely with the USFS to identify and control noxious weeds on USFS lands. Weed control programs on public lands can be compromised by the spread of noxious weeds, such as yellow starthistle, from adjacent private lands.

Fire suppression has reduced long-term habitat effectiveness on National Forest land by reducing the quality of the elk habitat in many areas of the Blue Mountains. The USFS Fire Management Policy will improve habitat conditions for elk through the use of prescribed and

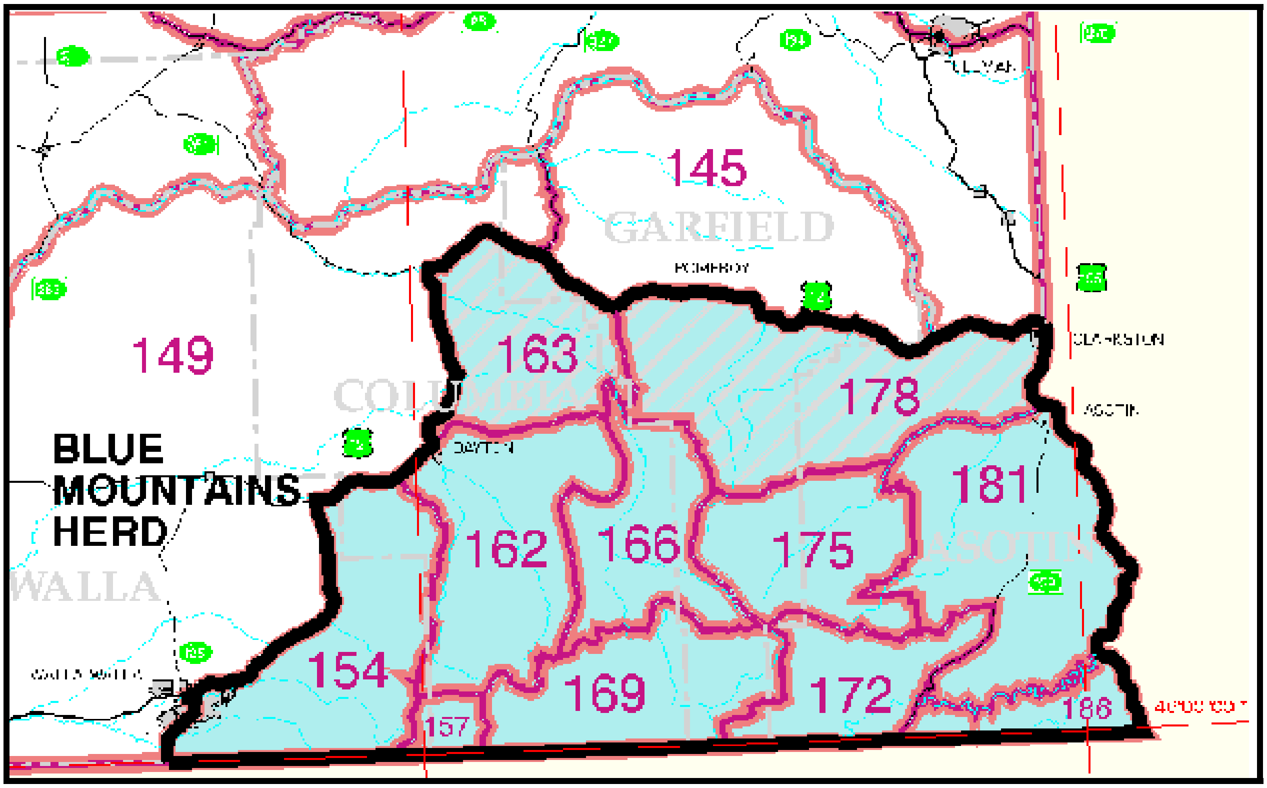

Figure 45. Elk game management units in the Southeast Washington Subbasin Planning Ecoregion, Washington (Fowler 2001).

controlled natural fires. This policy will affect the National Forest lands within the Pomeroy Ranger District (Walla Walla, Tucannon, Asotin subbasins), and will allow fire to maintain habitat conditions in this area.

Development, including the sale and subdivision of large tracts of land, also contributes to the loss of elk habitat in some areas. Habitat conditions, especially in GMU 154 (Figure 45), continue to deteriorate due to subdivision of land into smaller parcels for residential construction.

5.2.1.3.3 Agricultural Damage

Elk damage to crops and fences is a continuing problem on the lowlands of the Blue Mountains elk herd area. The WDFW enforcement program has maintained recent records of damage complaints and claims for damage. Elk damage complaints reported to WDFW in 1995, 1998 and 1999 ranged between 36 and 47. Elk depredation of agricultural crops appears to occur more frequently from April through September. During winters with heavy snowfall, damage to hay stacks may be a problem. Elk also compete with domestic livestock for forage on native rangelands. Conflicts with agriculture have forced WDFW to maintain elk numbers below their potential in some areas within the Ecoregion.

Washington Department of Fish and Wildlife has constructed elk fence to protect agriculture fields from elk damage. In the fall of 1997, one-way gates were placed at strategic points along the fence in GMU 178 (Figure 45) to allow elk that are outside the fence to cross back through, thus eliminating the loss of large numbers of elk trapped outside the fence. These one-way gates appear to be working, allowing elk trapped outside the elk fence in GMU 178 to move back through the fence into GMUs 166 and 175 (Figure 45). To continue to be effective, elk fence construction must receive higher priority in the capital budget and a maintenance schedule must be implemented that allows maintainence of the fence throughout the year. The elk fence should be extended for approximately two miles along its eastern boundary to stop elk from going around the fence during the winter.

In addition to the elk fence, WDFW should prioritize at least $3,000/year for helicopter time to herd elk back inside the fence when necessary. Implementation of the *Blue Mountains Elk Control Plan* (Fowler 2001) has improved WDFW – landowner relations.

Land ownership varies by GMU, but approximately 63 percent of the elk range is on public land, whereas 37 percent is privately owned. Game Management Units 154, 162, 178, and 181 are largely privately owned, and are primarily agricultural and range lands. Most of the area in GMUs 157, 166, 169, 175, and 186 is publicly owned land, managed by the USFS, WDNR, WDFW, and BLM. The Confederated Tribes of the Umatilla Indian Reservation own the 8,100-acre Rainwater Wildlife Area in GMU 162. Game Management Unit 172 is evenly split between public and private land. The Grouse Flats Wildlife Management Area is in GMU 172; the Asotin Wildlife Area is in GMU 175; Chief Joseph Wildlife Area is in GMU 186; and the Wooten Wildlife Area is in GMU 166.

5.2.1.3.4 Historic Distribution

Historically, elk were common throughout the Blue Mountains and Columbia Basin, but were almost extirpated during the late 1800s and early 1900s. To help recover the elk population, farmers, ranchers, and sportsmen's groups in southeast Washington initiated transplants of elk from Yellowstone National Park. Twenty-eight elk were released from Pomeroy in 1911; 50 elk from Walla Walla in 1919; and 26 elk from Dayton 1931 (Urness 1960). The first season for branched-antlered bull elk was held in 1927, and the first either-sex season in 1934 to reduce elk numbers and control damage on private lands in the Charley (Asotin Creek drainage) and Cummings Creek (Tucannon drainage) drainages. The transplants, along with habitat changes that occurred through the mid 1900s allowed the elk population to grow to approximately 6,500 head in Washington (McCorquodale 1985; ODFW 1992).

5.2.1.3.5 Current Distribution

Elk are distributed throughout the foothills and higher elevations of the Blue Mountains. The density of the elk population in the Blue Mountains of Washington varies among the ten GMUs. Major wintering populations occur in GMUs 154, 157, 162, 166, 169, 172, and 175. Smaller populations occur in GMUs 178, 181, and 186. The lowland areas and portions of the foothills are currently in agriculture production and conflicts occur when elk move into these areas.

5.2.1.3.6 Population Status and Distribution by Game Management Unit

In GMU 154 Blue Creek (Walla Walla subbasin), elk migrate into Washington from Oregon during periods of severe weather, which causes the wintering elk population in Washington to fluctuate dramatically. Elk from GMU 157 also winter in GMU 154. The number of elk counted during surveys over the last ten years (1994 – 2003) has ranged from 623 to 1,063, and averaged 843. In 2003, 669 elk counted in GMUs 154 and 157.

The number elk surveyed in GMU 162 (Walla Walla subbasin) over the last ten years has ranged from 591 to 1028, and averaged 782. In 2003, 751 elk were counted in GMU 162. Antlerless permits have been increased dramatically to alleviate agricultural damage problems on private land, and as a result the population on private land is declining.

In GMU 166 (Tucannon subbasin), the number of elk counted over the last ten years has ranged from 369 to 521, and averaged 431. In 2003, 444 elk were counted. Adult bull survival in the Tucannon herd has also declined significantly over the last six years, due to poaching and unregulated hunting.

The elk population north of the Wenaha River in GMU 169 (Grande Ronde subbasin) has declined by approximately 1,500 elk since the 1980s. Surveys conducted in the mid-1980s documented 2,500 elk wintering north of the Wenaha; only 500 elk were estimated (453 elk counted by the Oregon Department of Fish and Wildlife) based on spring surveys in 2003. Several factors may have contributed to the observed decline in elk numbers, including: documented low calf survival for many years; and, harvest of cow elk during antlerless hunts in adjacent units of Oregon and Washington (GMU 172). Changes in the vegetative communities resulting from fire suppression within the Wenaha Wilderness may have reduced the carrying capacity for elk, causing elk to move further south into Oregon to find adequate winter range. Between 1995 and 1999, Oregon reduced and/or eliminated antlerless permits in units that are below management objectives.

The number of elk counted during surveys over the last ten years in GMU 172 (Grande Ronde subbasin) has ranged from 290 to 671, and averaged 425. In 2003, 671 elk were counted in GMU 172. However, the 2003 survey may have been inflated by approximately 250 elk due to intense shed antler hunting activity in GMU 169, which may have re-distributed elk into GMU 172. The population decline that occurred in the mid-1990s was a direct result of low calf survival and cow elk lost to antlerless permits issued for damage control prior to 1995. Since 1995, management action was taken to reduce the loss of cow elk to damage control.

The number of elk counted during surveys over the last ten years in GMU 175 (Asotin subbasin) has ranged from 539 to 791, and averaged 661. In 2003, 701 elk were counted in GMU 175. Low calf survival and the loss of antlerless elk from the population have been identified as factors that negatively impact this elk herd. Adult bull survival in GMU 175 is the lowest (1 adult bull:100 cows compared to an average of 10 adult bulls:100 cows) of any game management unit in the Blue Mountains. Adult bull survival in the Lick Creek herd has never improved, while herds in other game management units have shown significant improvement.

While GMU 178 (Tucannon subbasin) is not managed to encourage elk, poor maintenance of the elk fence and a continuous loss of elk to damage control prior to 1997 contributed significantly to declining elk numbers in adjacent elk units (GMUs 166 and175). The installation of one-way gates in the elk fence has greatly reduced the loss of elk to damage control in this unit.

Neither GMU 181 nor GMU 186 contain major elk populations. Elk numbers in GMU 181 have ranged from 10 to 150 during surveys. The resident elk population in GMU 186 varies between 50 and 150 elk. Elk from Oregon move into GMU 186 during the winter months, increasing the elk population by 250 to 550 elk, depending on the severity of winter conditions.

5.2.1.3.7 Population Trend Status

Elk populations in the Blue Mountains have declined by approximately 1,500-2,000 animals since 1985. Aerial surveys are conducted annually in March to determine herd composition and population trend (Table_34). Since 1995, the elk population has remained fairly stable, ranging from a low of 3,902 to a high of 4,750. The 2003 late winter elk population is estimated at 4,750. Subpopulations in GMU 169, 175, the eastern portion of GMU 166, and GMU 172 are below population management objectives by approximately 1,000 elk. The goal is to increase elk populations that are below management objective in units containing primarily public land, with an overall population management objective of 5,600 elk (WDFW 2001).

Population objectives by GMU are summarized in Table_35. Although bull ratios were either met or exceeded in most game management units, overall population objectives were met or exceeded in only one area (Blue Creek watershed).

Table 34. Elk composition and population trend surveys for the Blue Mountains, 1987 – 2003 (Fowler 2002).

Year	Bulls:100 Cows	Adult Bulls:100 Cows	Calves:100 Cows	Sample Size
1987	7	2	35	2060
1988	6	1	32	2962
1989	5	3	22	4196
1990	8	3	25	3706
1991	11	7	28	4072
1992	16	10	18	3560
1993	13	8	19	4092
1994	14	10	18	3161
1995	17	13	20	3689
1996	14	11	15	3656
1997	13	9	24	3405
1998	11	8	23	3118
1999	13	10	23	3615
2000	12	9	17	3628
2001	10	7	21	3874
2002	13	7	21	3795
2003	12	9	29	3740

Table 35. Elk survey trends and population objectives for Game Management Units in Washington, 1993 – 2000 (Fowler 2002).

GMU	Mean No. Elk Counted 1993 – 2000	Population Objective	Average Bull Ratio 1993 – 2000	Bull Ratio Objective
154-157 Blue Creek	813	800	15	15
162 - Dayton	757	800	14	15
166 - Tucannon	423	700	11	15
169 - Wenaha	476	1,400	24	20
172 - Mountain View	404	700	20	15
175 - Lick Creek	623	1,000	6	15
178 - Peola	N\A	30	—	—
181 - Couse	35	$\leq$50	—	—
186 - Grande Ronde	62	$\leq$150	—	15
TOTAL	3,593	5,600	—	—

In March 2000, 72 elk from the Hanford Site were released in GMU 175 (Asotin subbasin) in an effort to improve productivity and increase the population to management objective levels. Approximately 80 percent of the elk released migrated to the north and west, leaving the unit within three months. As a result, small groups of elk have established themselves in lowland agricultural areas, which may pose a problem in the near future (Fowler 2002).

Low cow elk pregnancy rates (65-68 percent) recorded in the late 1980s contributed significantly towards reduced elk population trends in the Blue Mountains of Washington. Post harvest low bull to cow ratios (2-5 bulls:100 cows) and poor physical condition of cow elk as a result of drought (Fowler 1988) were the dominant contributing factors. In 1989, WDFW implemented a new harvest management strategy allowing the harvest of only spike bull elk, while hunting of branch-antlered bulls was controlled by permit. The goal of this strategy was to increase post-season bull ratios to a minimum of 15 bulls:100 cows and to improve breeding effectiveness by increasing the number of adult bulls in the population (Noyes *et al.* 1996). Within two years, post-season bull ratios increased to 16 bulls:100 cows, and pregnancy rates, documented in 1992-1993, had increased to an average of 90 percent (P. Fowler, WDFW, personal communication, 2003).

Breeding effectiveness improved dramatically as adult bull numbers increased in the elk population. Earlier breeding, smaller harem size, and more intense rutting activity were observed as the number of adult bulls increased (P. Fowler, WDFW, personal communication, 2003). Prior to the increase, average mean conception dates occurred later than normal, September 30 in 1987 and October 9 in 1988, respectively. By 1992-1993, the average conception date for cow elk in the Blue Mountains occurred one to two weeks earlier; September 24, and September 18, respectively (Figure 46). The date of conception is important because calves that are born early have a greater chance of surviving (Thorne *et al.* 1976). Although pregnancy rates, conception dates, and early summer calf ratios have improved to

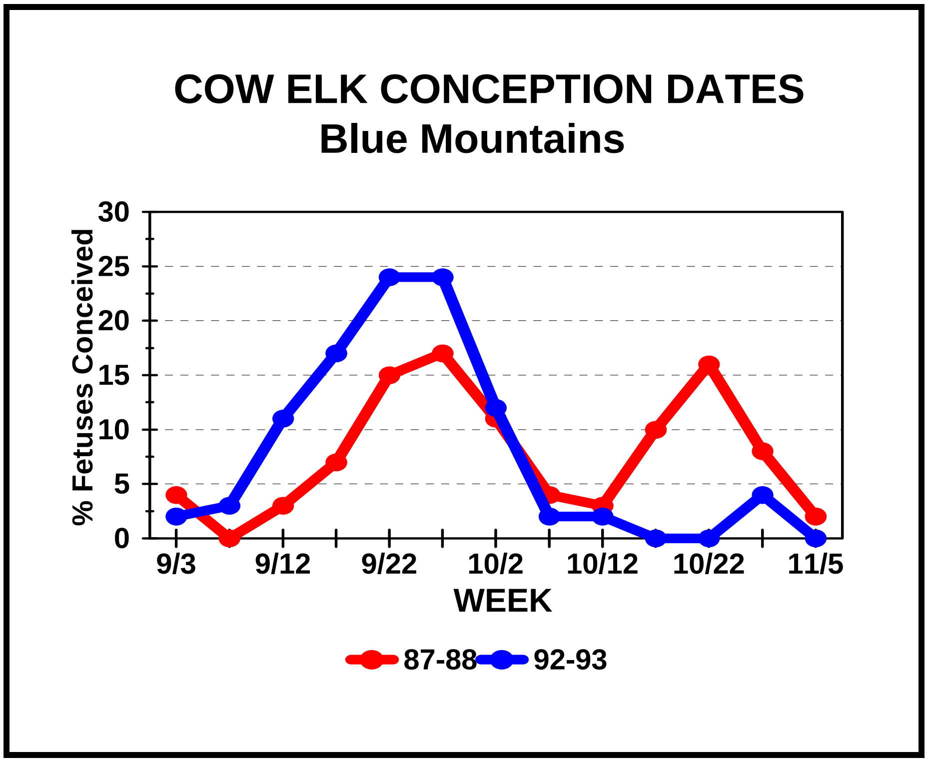

Figure 46. Cow elk conception dates in the Blue Mountains of Washington (Fowler 2001).

50+ calves:100 cows, annual calf survival remains below management objective, mostly due to heavy predation by mountain lions and black bear.

5.2.1.3.8 Structural Condition Associations

Structural conditions associated with Rocky Mountain elk are summarized in Table 36 (NHI 2003). Elk breed (B) in most ponderosa pine structural conditions; however, reproduction (R) (calving) takes place in closed canopy, pole-sapling/small tree structural conditions (NHI 2003). As shown in Table 36, elk are associated (A) with multiple ponderosa pine structural conditions, but are not closely associated with any specific structural condition.

Table 36. Rocky Mountain elk structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Rocky Mountain Elk	Ponderosa Pine	Giant Tree-Multi-Story	B	A
		Grass/Forb-Closed	B	A
		Grass/Forb-Open	B	A
		Large Tree-Multi-Story-Closed	B	A
		Large Tree-Multi-Story-Moderate	B	A
		Large Tree-Multi-Story-Open	B	A
		Large Tree-Single Story-Closed	B	A
		Large Tree-Single Story-Moderate	B	A
		Large Tree-Single Story-Open	B	A
		Medium Tree-Multi-Story-Closed	B	A
		Medium Tree-Multi-Story-Moderate	B	A
		Medium Tree-Multi-Story-Open	B	A
		Medium Tree-Single Story-Closed	B	A
		Medium Tree-Single Story-Moderate	B	A
		Medium Tree-Single Story-Open	B	A
		Sapling/Pole-Closed	R	A
		Sapling/Pole-Moderate	B	A
		Sapling/Pole-Open	B	A
		Shrub/Seedling-Closed	B	A
		Shrub/Seedling-Open	B	A
		Small Tree-Multi-Story-Closed	R	A
		Small Tree-Multi-Story-Moderate	B	A
		Small Tree-Multi-Story-Open	B	A
		Small Tree-Single Story-Closed	R	A
		Small Tree-Single Story-Moderate	B	A
		Small Tree-Single Story-Open	B	A

5.2.1.4 Ponderosa Pine Focal Species Structural Condition Summary

Ponderosa pine structural conditions are summarized by association in Figure 47. As shown, the species assemblage selected to represent this habitat type is generally associated (A) and/or present (P) in most structural conditions and dependent or closely associated (C) with only five structural conditions. This infers that the species assemblage is comprised primarily of “generalist” species with only the flammulated owl exhibiting a close association or link with ponderosa pine structural conditions (making it somewhat of a habitat specialist). Because of the relatively large number of structural conditions associated (A) with Ecoregion ponderosa pine habitat focal species, the presence of viable populations of white-headed woodpeckers, flammulated owls, and elk present within the ponderosa pine habitat type would suggest that the ponderosa pine habitat is functional from a structural condition perspective. M. Denny (WDFW, personal communication, 2003) reports that flammulated owls appear to be relatively common and viable throughout the Blue Mountains. At present, however, local population data for white-headed woodpeckers are unknown and is a data gap.

Furthermore, structural condition summaries can also be used to define the range of recommended structural conditions to manage ponderosa pine forests, identify specific stand elements that require closer scrutiny (along with possibly evaluating additional species that are closely associated (C) with those structural conditions), and guide temporal and spacial ponderosa pine forest management considerations. For example, elk reproduction is associated with small tree multi-story closed canopy conditions. Therefore, managers can us these data to identify specific areas needing protection from human disturbance during critical elk calving periods.

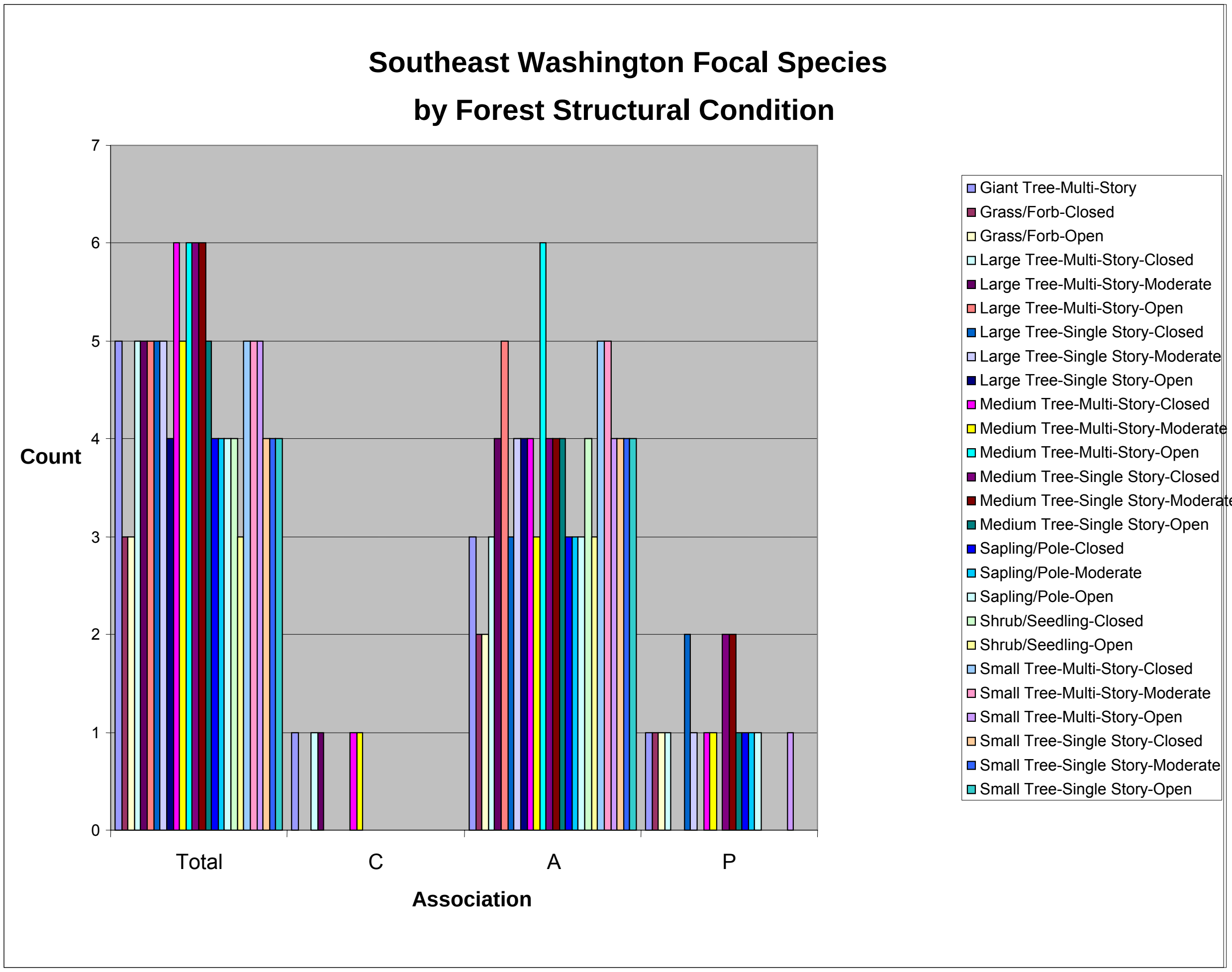

Figure 47. Ponderosa pine focal species structural condition associations (NHI 2003).

5.2.1.5 Ponderosa Pine Key Ecological Functions

A key ecological function (KEF) is:

> "*the major ecological role played by a species. Examples include herbivory, symbiotic dispersal of seeds and spores, primary creation of tree cavities and ground burrows, nutrient cycling, and many others. To keep a system 'fully functional,' one could strive to maintain all categories of naturally-occurring functions among all native species. In the NHI database, KEFs are denoted for each species using a standard classification system of 85 KEF categories. A limitation of the concept is that there has been little research done to quantify the rates of key ecological functions, such as number of cavities excavated by primary cavity excavators per acre per year, or tonnage of soil worked by burrowing and digging animals per acre per year, etc.*"

Key ecological functions performed by ponderosa pine focal species are listed in Table 37 (see section 5.3 for further discussion on KEFs). As shown, only the white-headed woodpecker and Rocky Mountain elk perform a key ecological function within this habitat type (NHI 2003). Although not all KEFs are represented by members of the focal species assemblage, the ponderosa pine habitat type is functional because other wildlife species provide functional redundancy (Figure 48). Northwest Habitat Institute biologists set the functional redundancy threshold at three species – less than three species performing a KEF suggests it is a critical function to watch as high redundancy imparts greater resistance of the community to changes in its overall functional integrity.

Although only seven key ecological functions are examined, managers are encouraged to review all KEFs associated with focal habitatss and non-focal habitats alike. For example, wildlife that consume terrestrial invertebrates (KEC 1.1.2.1.1) have decreased by almost 40 percent. This could have a significant impact on forest health as it pertains to moth and beetle outbreaks.

Table 37. Ponderosa pine focal species key ecological functions (NHI 2003).

KEF	KEF Description	Common Name
5.1	physically affects (improves) soil structure, aeration (typically by digging)	None
3.9	primary cavity excavator in snags or live trees	White-headed woodpecker
3.6	primary creation of structures (possibly used by other organisms)	None
3.5	creates feeding, roosting, denning, or nesting opportunities for other organisms	None
1.1.1.9	fungivore (fungus feeder)	Rocky Mountain Elk
1.1.1.4	grazer (grass, forb eater)	Rocky Mountain Elk
1.1.1.3	browser (leaf, stem eater)	Rocky Mountain Elk

5.2.2 Shrubsteppe Focal Species Information

5.2.2.1 Sage Sparrow

5.2.2.1.1 General Habitat Requirements

Sage sparrows are still common throughout sagebrush habitats and have a high probability of being sustained wherever large areas of sagebrush and other preferred native shrubs exist for breeding. Similar to other shrubsteppe obligate species, sage sparrows are associated with habitats dominated by big sagebrush cover and perennial bunchgrasses (Paige and Ritter 1999; Vander Haegen *et al.* 2000). Habitat attribute conditions recommended for sage sparrows include; dominant sagebrush canopy with 10 to 25 percent sagebrush cover, mean sagebrush height greater than 20 inches, 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, suitable habitat conditions in patches greater than 400 acres (Altman and Holmes 2000), (Table 31).

5.2.2.1.2 Limiting Factors

Habitat fragmentation, conversion of sagebrush plant communities to tilled agriculture, livestock grazing, exotic vegetation, fire, and herbicides are the major habitat stressors that impact sage sparrows. Parasitism and predation also play a role in limiting sage sparrow populations, especially in developed areas. In addition, urban and suburban development, road and powerline development, and range improvement programs that replace sagebrush with annual grasslands for livestock forage are also detrimental to sage sparrows. Agricultural set-aside programs such as CRP may eventually increase the quantity of potential breeding habitat for sage sparrows, but it is not clear how long this will take.

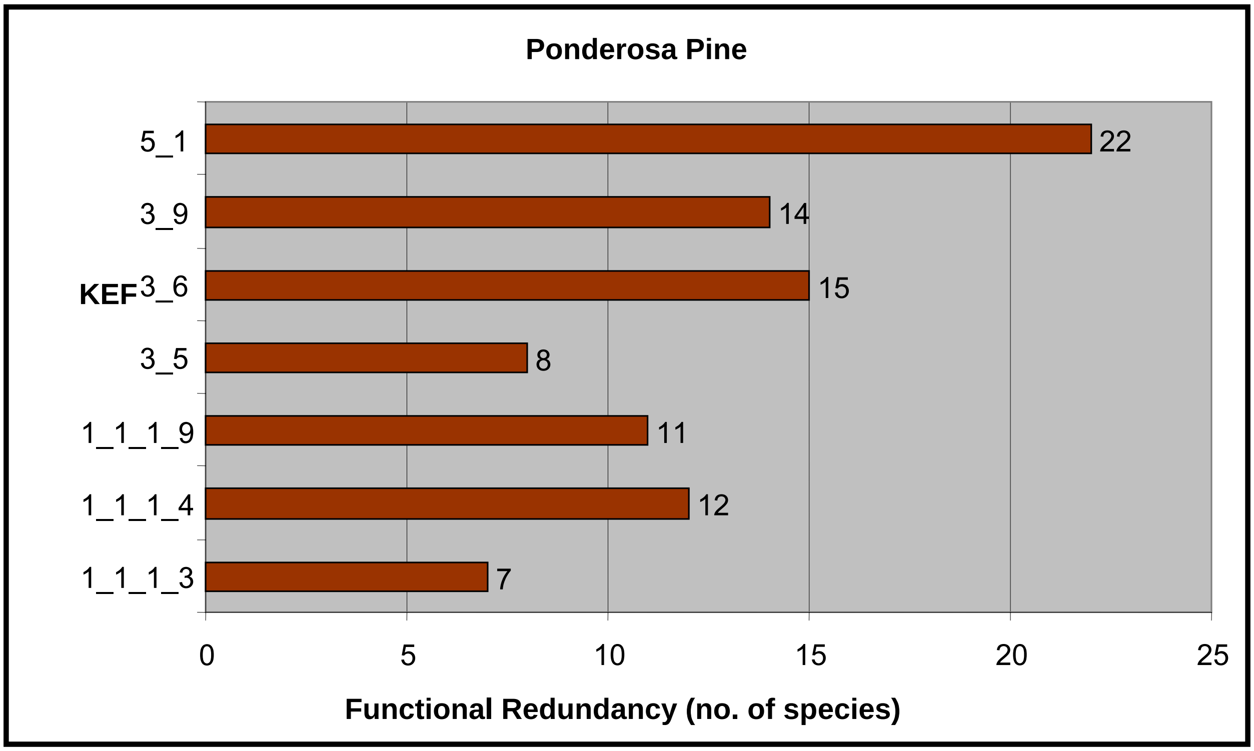

Figure 48. Functional redundancy within the ponderosa pine habitat type (NHI 2003).

Habitat fragmentation has been documented to negatively influence sage sparrow occurrence in Washington (Vander Haegen *et al.* 2000). 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). Conversion of shrubsteppe habitat to agricultural fields eliminates sage sparrow habitat. Similarly, urban development and transportation and transmission line corridors reduce the amount of habitat available to sage sparrows.

Livestock grazing impacts are mixed and dependent upon grazing intensity. 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 communities, 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 greater than 50 percent of annual vegetative herbaceous growth of perennial bunchgrasses through the following season is recommended (Altman and Holmes 2000).

Invasive grasses, such as cheatgrass, readily invade disturbed sites 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 shrubsteppe habitat.

Fire on cheatgrass dominated sites has altered the natural fire regime on western ranges. Fires tend to increase in frequency, intensity, and size in areas dominated by exotic vegetation, converting sagebrush sites to grasslands and resulting in less habitat for sage sparrows (Paige and Ritter 1999).

Pesticides and herbicides applied at the landscape scale (greater than 10 mi^2) resulted in a significant decline in sage sparrow abundance two years after aerial spraying of sagebrush habitat with the herbicide 2,4-D. Because sage sparrows display high site fidelity to breeding areas, birds may not occupy areas rendered unsuitable (Wiens and Rotenberry 1985).

Parasitism from brown-headed cowbird may cause sage sparrows to abandon the nest (see Reynolds 1981). Prior to European-American settlement, sage sparrows were largely isolated from cowbird brood parasitism, but are 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 by Townsend ground squirrel (*Spermophilus townsendi*) in Oregon affected sage sparrow reproductive success when squirrel densities were high. Sage sparrow populations in southeastern Washington and northern Nevada incurred high rates of nest predationy 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 productivity (Reynolds 1979). Feral cats near human habitations may also increase predation (Martin and Carlson 1998).

5.2.2.1.3 Out-of-Subbasin Effects and Assumptions

No data could be found on sage sparrow migration and wintering grounds. Sage sparrows are a short distance migrant, wintering in the southwestern United States and northern Mexico. As a result, sage sparrows face a complex set of potential effects during their annual migration cycle. Habitat loss or conversions are likely happening along the entire migration route (H. Ferguson, WDFW, personal. communication, 2003). Management requires the protection of shrubsteppe and desert scrub habitats and the elimination or control of noxious weeds.

5.2.2.1.4 Current Distribution

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 in the Upper Sonoran Zone and of the neighboring bunchgrass areas of the Transition zone in eastern Washington (Figure_49). Jewett *et al.* (1953) also note that the sage sparrow was found throughout sagebrush dominated sites in eastern Washington, notably in the vicinity of Wilbur, Waterville, Prescott, and Horse Heaven. Hudson and Yocom (1954) described the sage sparrow as a summer resident and migrant in sagebrush areas of Adams, Franklin, and Grant Counties.

5.2.2.1.5 Population Trend Status

North American Breeding Bird Survey data indicate that sage sparrows have declined 1.0-2.3 percent in recent decades (1966-1991); the greatest declines have occurred in Arizona, Idaho, and Washington (Martin and Carlson 1998). Sage sparrows are listed as a candidate species by WDFW, by the Oregon-Washington Partners in Flight as a priority species, and they are 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.

The BBS data (1966-1996) for Washington State show a non-significant 0.3 percent average annual increase in sage sparrows survey-wide (n = 187 survey routes) (Figure_50). There has been a significant decline of -4.8 percent per year from 1966 to 1979 (n = 73), and a recent significant increase of 2.0 percent per year from 1980 to 1996 (n = 154) (Sauer *et al.* 1997). BBS data indicate recent non-significant declines in California and Wyoming from 1980 to 1995.

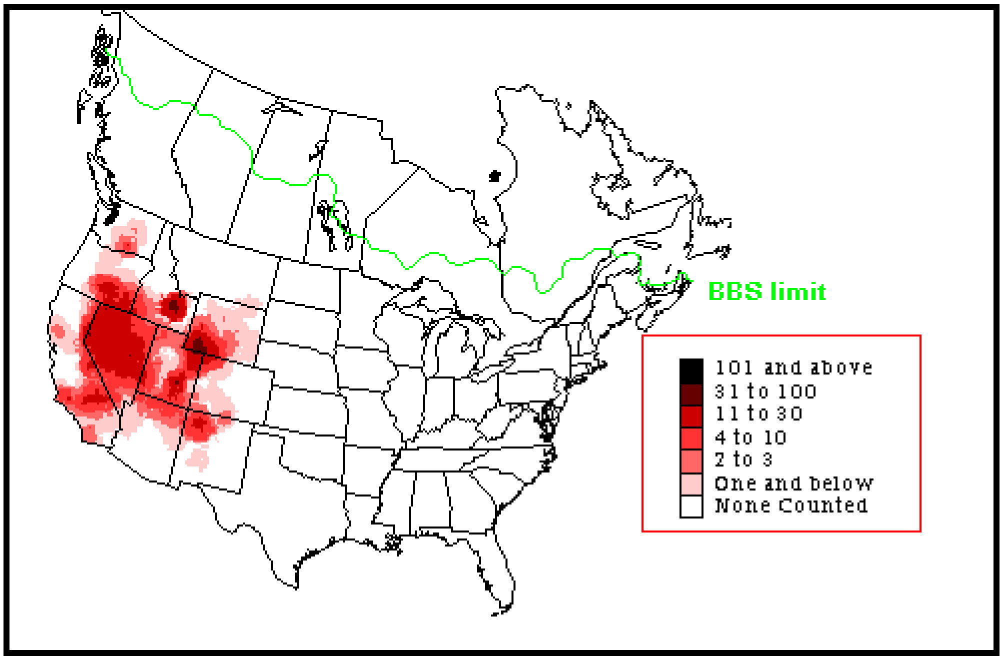

Figure 49. Sage sparrow breeding season abundance from BBS data (Sauer *et al.* 2003).

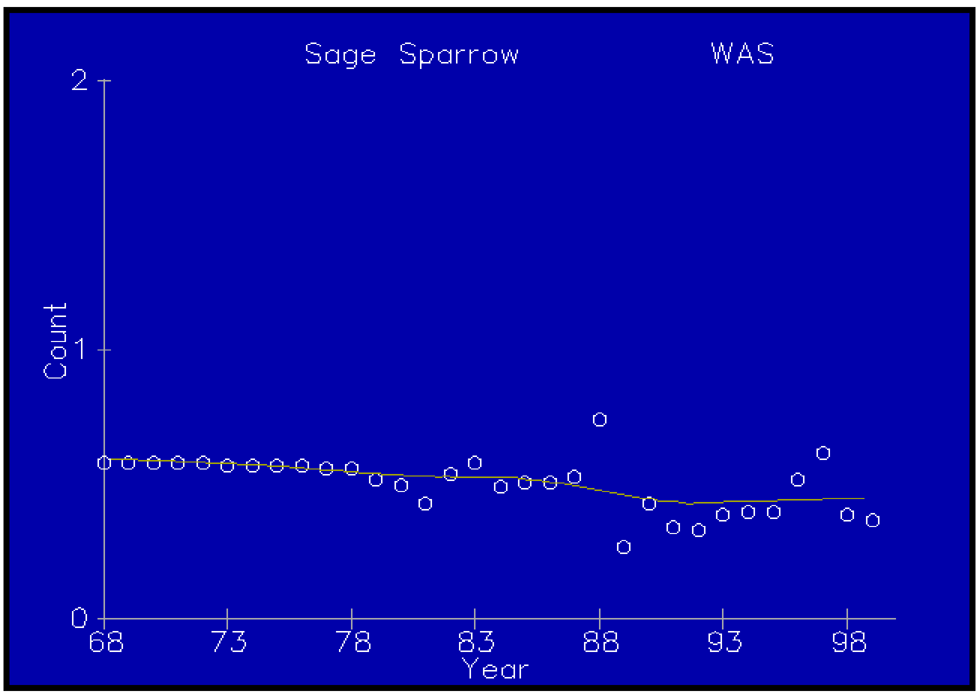

Figure 50. Sage sparrow population trend data, Washington (from BBS), (Sauer *et al.* 2003).

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 51.

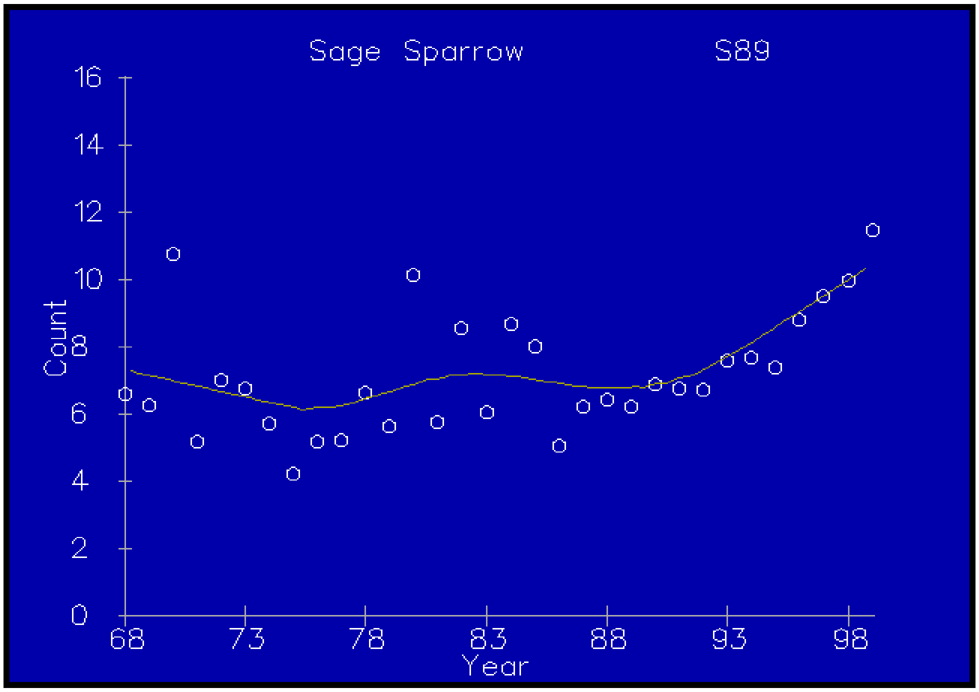

Figure 51. Sage sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

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 to 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). Within the entire Columbia Basin, over 48 percent of watersheds show moderately or strongly declining trends in source habitats for this species (Altman and Holmes 2000).

5.2.2.1.6 Structure Condition Associations

Structural conditions associated with sage sparrows are summarized in Table 38 (NHI 2003). During breeding season (B), sage sparrows are closely associated (C) with six structural conditions linked to medium shrub height. The magnitude of the close association with structural conditions within the shrubsteppe habitat type supports the view that sage sparrows are shrubsteppe obligate species. In addition, the sparrows are generally associated (A) with, but not dependent upon, areas comprised of low shrubs during breeding season (NHI 2003).

Table 38 Sage sparrow structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structure Condition (SC)	SC Activity	SC Assoc.
Sage Sparrow	Shrubsteppe	Low Shrub - Closed Shrub Overstory - Mature	B	A
		Low Shrub - Closed Shrub Overstory - Old	B	A
		Low Shrub - Closed Shrub Overstory - Seedling/Young	B	A
		Low Shrub - Open Shrub Overstory - Mature	B	A

Common Name	Focal Habitat	Structure Condition (SC)	SC Activity	SC Assoc.
		Low Shrub - Open Shrub Overstory - Old	B	A
		Low Shrub - Open Shrub Overstory - Seedling/Young	B	A
		Medium Shrub - Closed Shrub Overstory - Mature	B	C
		Medium Shrub - Closed Shrub Overstory - Old	B	C
		Medium Shrub - Closed Shrub Overstory - Seedling/Young	B	C
		Medium Shrub - Open Shrub Overstory - Mature	B	C
		Medium Shrub - Open Shrub Overstory - Old	B	C
		Medium Shrub - Open Shrub Overstory - Seedling/Young	B	C

5.2.2.2 Sage Thrasher

5.2.2.2.1 General Habitat Requirements

Sage thrashers are a shrubsteppe obligate species and are dependent upon areas of tall, dense sagebrush within large tracts of shrubsteppe habitat (Knock and Rotenberry 1995; Paige and Ritter 1998; Vander Haegen 2003). The presence of sage thrashers is positively associated with shrub cover and negatively associated with increased annual grass cover (Dobler *et al.* 1996). 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).

Recommended habitat conditions for sage thrashers include areas of shrubsteppe greater than 40 acres where average sagebrush cover is 5 to 20 percent and shrub height is greater than 31 inches. Sagebrush should be patchily distributed rather than dispersed, and mean herbaceous cover 5 to 20 percent with less than 10 percent cover of non-native annuals (Altman and Holmes 2000). Habitat attributes and parameters are summarized in Table_31.

5.2.2.2.2 Limiting Factors

Habitat loss and fragmentation, range management practices, livestock grazing, introduced vegetation, fire, and predation are the primary factors affecting sage thrasher populations. As with other shrubsteppe obligate species, 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-way establishment. 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 the fragmentation of remaining shrubsteppe habitats. 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 less than 24 acres (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).

Range management practices such as mowing, burning, and herbicide treatments have reduced the quantity and quality of sagebrush habitat (Braun *et al.* 1976; Cannings 1992; Reynolds *et al.* 1999). Range improvement programs remove sagebrush by burning, herbicide application, and mechanical treatment, replacing sagebrush with annual grassland to promote forage for livestock.

Livestock grazing in sagebrush habitats may not be incompatible with sustaining a sage thrasher population. Although sage thrashers are found on grazed rangeland, 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). Some evidence suggests 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 versus grazed shrubsteppe habitats in south-central Idaho. Altman and Holmes (2000) suggest maintaining greater than 50 percent of annual vegetative growth of perennial bunchgrasses through the following growing season.

Grazing can increase sagebrush density, positively affecting sage 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.

Introduced vegetation such as cheatgrass readily invades disturbed sites and has come to dominate the grass-forb communities of more than half the sagebrush region in the West (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 shrubsteppe.

Wildfire is a threat to sagebrush communities as 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).

5.2.2.2.3 Out-of-Subbasin Effects and Assumptions

No data could be found on sage thrasher migration and wintering grounds. Sage thrashers are a short distance migrant, wintering in the southwestern United States and northern Mexico. As a result, sage thrashers face a complex set of potential effects during their annual migration cycle. Habitat loss or conversions are likely happening along their entire migration route (H. Ferguson, WDFW, personal communication, 2003). Management requires the protection of shrubsteppe, desert scrub habitats, and the elimination or control of noxious weeds.

5.2.2.2.4 Current Distribution

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) (Figure 52). Estimates of sage thrasher density in eastern Washington during 1988-89 was 0.5 birds/acre (Dobler *et al.* 1996).

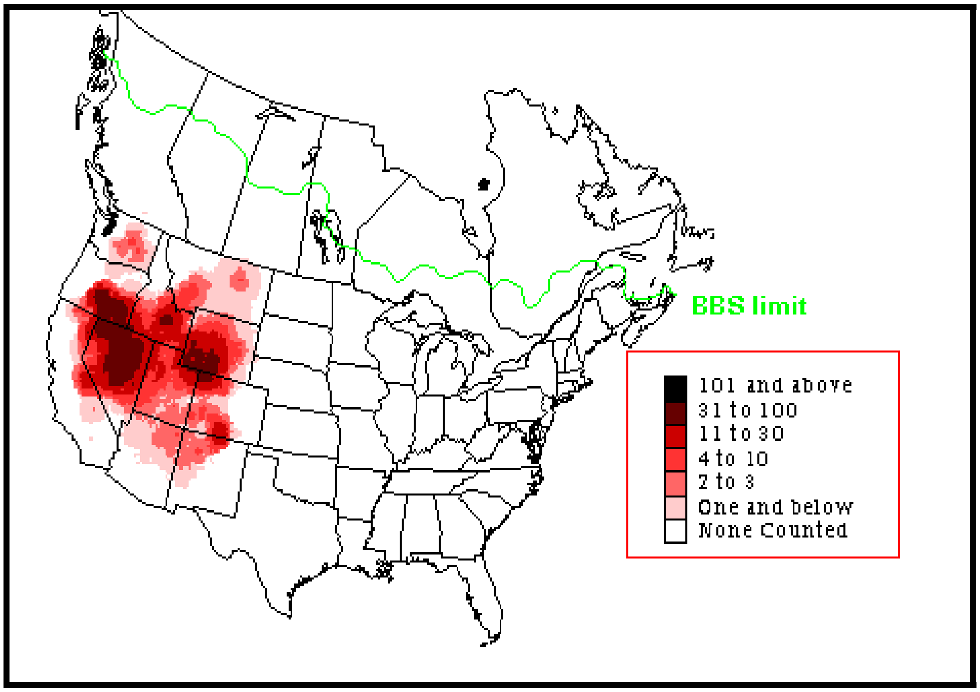

Figure 52. Sage thrasher breeding season abundance from BBS data (Sauer *et al.* 2003).

5.2.2.2.5 Population Trend Status

The sage thrasher is considered a state candidate species by WDFW. In Canada, sage thrashers are on the British Columbia Environment Red List. They are considered a priority species by the Oregon-Washington 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).

Breeding Bird Survey data (1966-1996) show a non-significant sage thrasher survey-wide increase (n = 268 survey routes) (Figure 53). 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. Breeding Bird Survey data indicate a significant decline in the Intermountain Grassland physiographic region 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 1966-1996 BBS data for the Columbia Plateau are illustrated in Figure 54. 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).

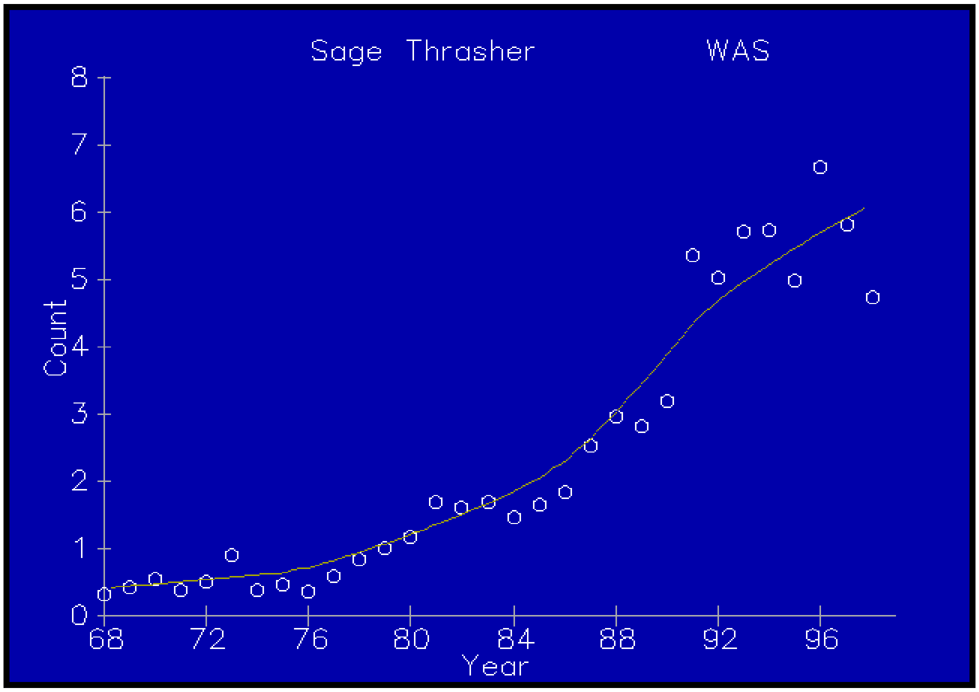

Figure 53. Sage thrasher trend results from BBS data, Washington (Sauer *et al.* 2003).

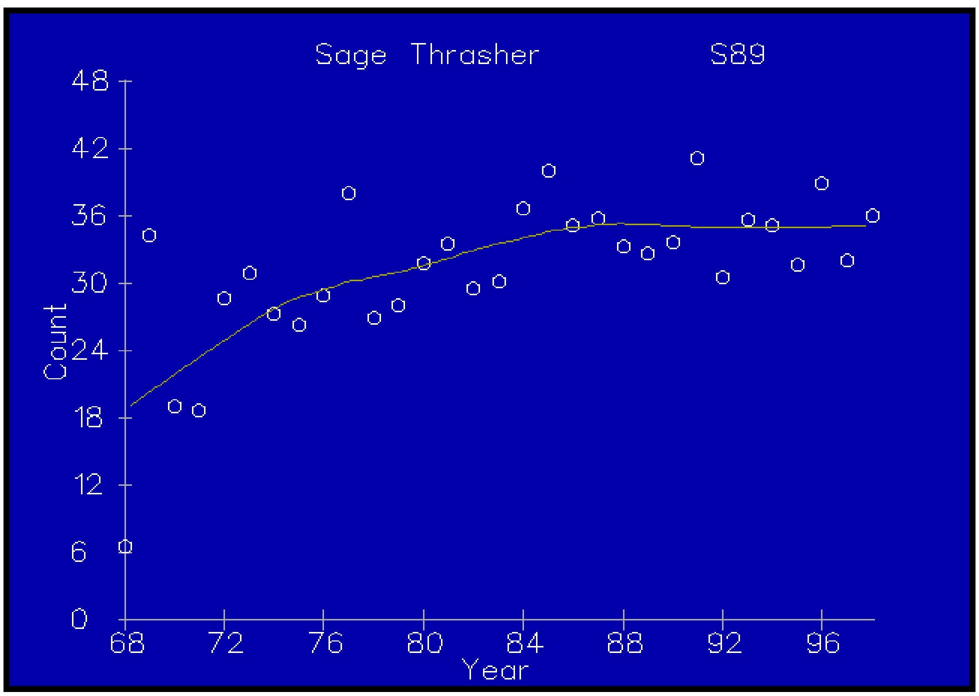

Figure 54. Sage thrasher trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

5.2.2.2.6 Structure Condition Associations

Structural conditions associated with sage thrashers are summarized in Table 39 (NHI 2003). During breeding season (B), sage thrashers are closely associated (C) with eight structural conditions linked to low to medium shrub height and mature overstory. Furthermore, sage thrashers are generally associated (A) with, but not dependent upon, areas comprised of low to medium shrubs with a seedling or young overstory (NHI 2003). The relatively high incidence of close associations with shrubsteppe structural conditions supports the view that sage thrashers are shrubsteppe obigate species.

Table 39. Sage thrasher structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structure Condition (SC)	SC Activity	SC Assoc.
Sage Thrasher	Shrubsteppe	Low Shrub - Closed Shrub Overstory - Seedling/Young	B	A
		Low Shrub - Open Shrub Overstory - Seedling/Young	B	A
		Medium Shrub - Closed Shrub Overstory - Seedling/Young	B	A
		Low Shrub - Closed Shrub Overstory - Mature	B	C
		Low Shrub - Closed Shrub Overstory - Old	B	C
		Low Shrub - Open Shrub Overstory - Mature	B	C
		Low Shrub - Open Shrub Overstory - Old	B	C
		Medium Shrub - Closed Shrub Overstory - Mature	B	C
		Medium Shrub - Closed Shrub Overstory - Old	B	C
		Medium Shrub - Open Shrub Overstory - Mature	B	C
		Medium Shrub - Open Shrub Overstory - Old	B	C

5.2.2.3 Brewer’s Sparrow

5.2.2.3.1 General Habitat Requirements

Brewer’s sparrow is a sagebrush obligate species that prefers abundant sagebrush cover (Altman and Holmes 2000). 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 they were mor abundant on rangelands in good or fair condition than those in poor condition. Knopf *et al.* (1990) reported that Brewer’s sparrows are strongly associated throughout their range with high sagebrush vigor.

Brewer’s sparrow is positively correlated with shrub cover, above average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness). Brewer’s sparrows prefer areas dominated by shrubs rather than grass. They prefer sites with high shrub cover and large patch size (Knick and Rotenberry 1995). In southwestern Idaho, the probability of habitat occupancy by Brewer’s sparrows increased with increasing shrub cover and shrub patch size; shrub cover was the most important determinant of occupancy (Knick and Rotenberry 1995). Brewer’s sparrow abundance in Washington increased significantly on sites where sagebrush cover approached the historic 10 percent level (Dobler *et al.* 1996).

In contrast, Brewer's sparrows are negatively correlated with grass cover, spiny hopsage, and budsage (Larson and Bock 1984; Rotenberry and Wiens 1980; Wiens 1985; Wiens and Rotenberry 1981). In eastern Washington, abundance of Brewer's sparrows was negatively associated with increasing annual grass cover; higher densities of Brewer's sparrows occurred in areas where annual grass cover (i.e., cheatgrass) was less than 20 percent (Dobler 1994). Removal of sagebrush cover to less than 10 percent has a negative impact on Brewer's sparrow populations (Altman and Holmes 2000).

Recommended habitat objectives include patches of 10 to 30 percent sagebrush cover, mean sagebrush height greater than 24 inches, high foliage density of sagebrush, average cover of native herbaceous plants greater than 10 percent, and bare ground greater than 20 percent (Altman and Holmes 2000) (Table_31).

5.2.2.3.2 Limiting Factors

Habitat loss and fragmentation, livestock grazing, introduced vegetation, fire, and predators are the primary factors affecting Brewer's sparrows. Direct habitat loss due to conversion of shrublands to agriculture coupled with sagebrush removal/reduction programs and development have significantly reduced available habitat and contributed towards habitat fragmentation of remaining shrublands. 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 Altman and Holmes 2000).

Livestock 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. Historic 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. Rangeland in poor condition is less likely to support Brewer's sparrows than rangeland in good and fair condition.

Introduced vegetation such as 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 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 grasslands dominated by introduced vegetation as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe, altering shrubland habitats.

5.2.2.3.3 Historic Distribution

Jewett *et al.* (1953) described the distribution of the Brewer's sparrow as a fairly common migrant and summer resident, at least from 29 March to 20 August, 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. Hudson and Yocom (1954) described the

Brewer's sparrow as an uncommon summer resident and migrant in open grassland and sagebrush.

5.2.2.3.4 Current Distribution

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 sparrows may also occur in western Walla Walla County, where limited sagebrush habitat still exists. Washington is near the northwestern limit of breeding range for Brewer's sparrows (Figure 55). Birds occur primarily in Okanogan, Douglas, Grant, Lincoln, Kittitas, and Adams Counties (Smith *et al.* 1997).

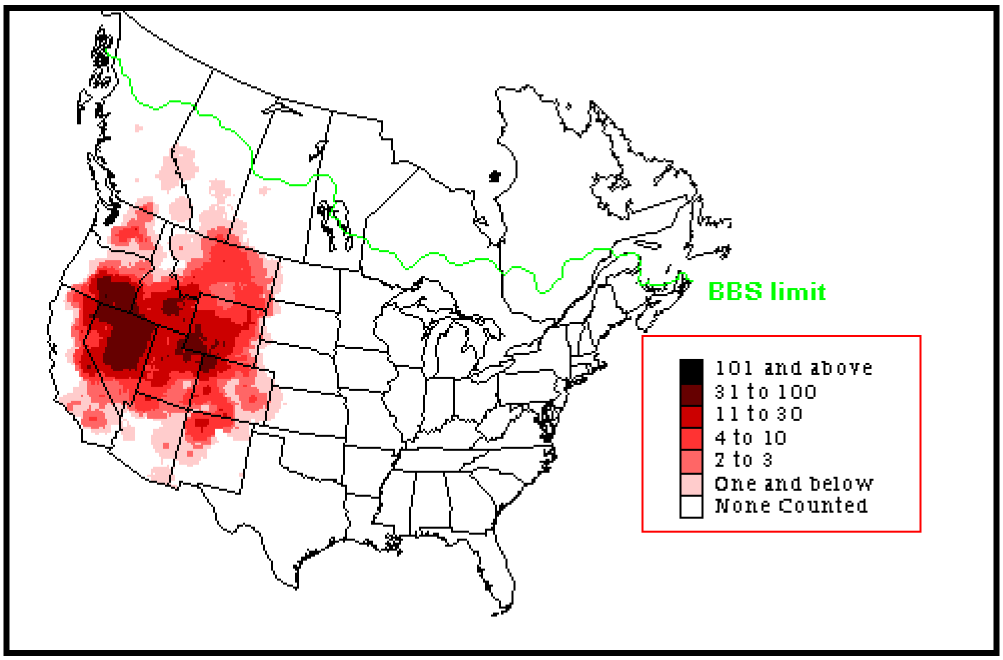

Figure 55. Brewer's sparrow breeding range and abundance (Sauer *et al.* 2003).

5.2.2.3.5 Population Trend 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.

Historically, the Brewer's sparrow may have been the most abundant bird in the Intermountain West (Paige and Ritter 1998), but BBS 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. The Oregon-Washington chapter of Partners in Flight considers the Brewer's sparrow a focal species for conservation strategies in the Columbia Plateau (Altman and Holmes 2000).

Breeding Bird Survey data for 1966 -1996 show significant and strong survey-wide declines averaging -3.7 percent per year (n = 397 survey routes) (Figure 56). The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure 57. 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.

Note that although positively correlated with the presence of sage thrashers, 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).

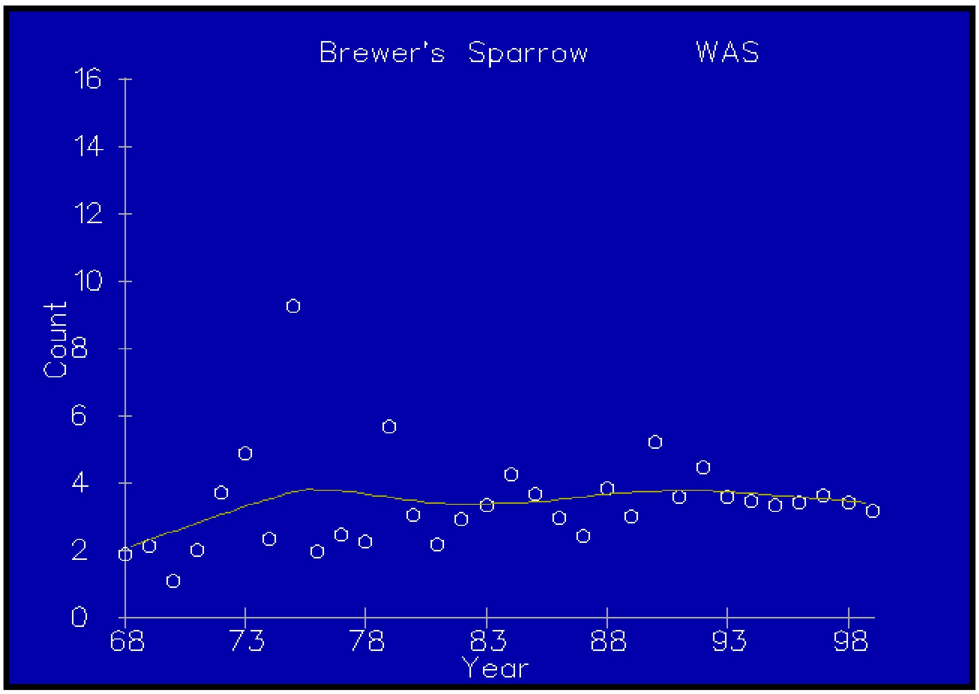

Figure 56. Brewer's sparrow trend results from BBS data, Washington (Sauer *et al.* 2003).

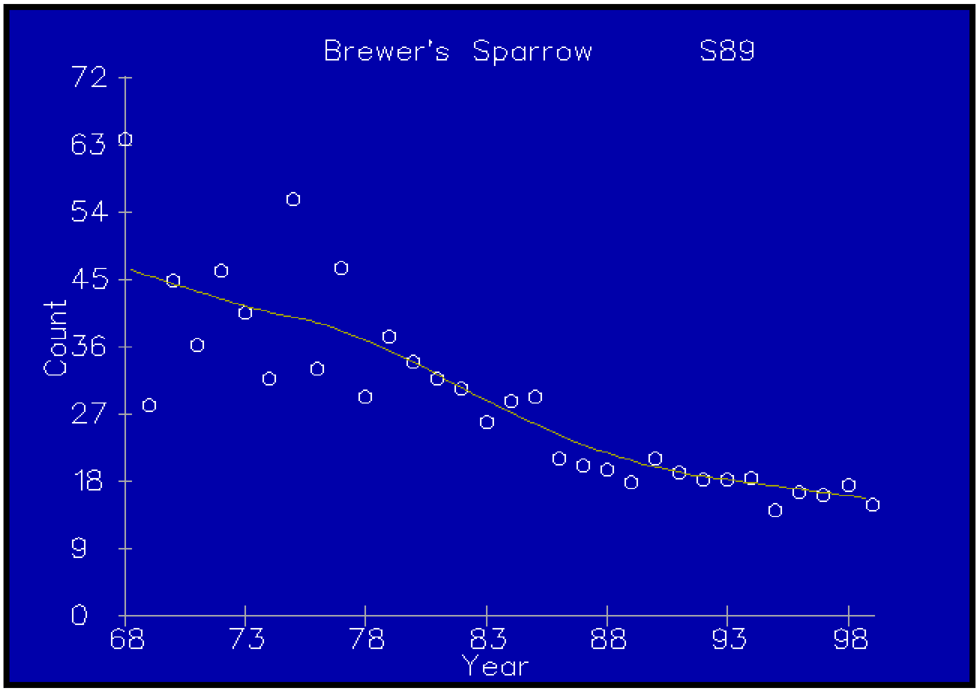

Figure 57. Brewer's sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

5.2.2.3.6 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 conversion is likely happening along its entire migration route (H. Ferguson, WDFW, personal communication, 2003). Management requires the protection of shrub, shrubsteppe, and desert scrub habitats as well as the elimination or control of noxious weeds.

5.2.2.3.7 Structural Condition Associations

Structural conditions (NHI 2003) associated with Brewer's sparrows are summarized in Table 40. Brewer's sparrows are closely associated (C) with four structural conditions linked to medium shrub height. In addition, the sparrows are generally associated (A) with, but not dependent upon, areas comprised of low to medium height shrubs (NHI 2003). The general association with the relatively large number (n=10) of structural conditions suggests that Brewer's sparrows are not necessarily shrubsteppe obligates and can likely tolerate a wider range of conditions when compared to sage sparrows and sage thrashers.

Table 40. Brewer's sparrow structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Brewer's Sparrow	Shrubsteppe	Grass/Forb - Closed	B	A
		Grass/Forb - Open	B	A
		Low Shrub - Closed Shrub Overstory - Mature	B	A
		Low Shrub - Closed Shrub Overstory - Old	B	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Low Shrub - Closed Shrub Overstory - Seedling/Young	B	A
		Low Shrub - Open Shrub Overstory - Mature	B	A
		Low Shrub - Open Shrub Overstory - Old	B	A
		Low Shrub - Open Shrub Overstory - Seedling/Young	B	A
		Medium Shrub - Closed Shrub Overstory - Seedling/Young	B	A
		Medium Shrub - Open Shrub Overstory - Seedling/Young	B	A
		Medium Shrub - Closed Shrub Overstory - Mature	B	C
		Medium Shrub - Closed Shrub Overstory - Old	B	C
		Medium Shrub - Open Shrub Overstory - Mature	B	C
		Medium Shrub - Open Shrub Overstory - Old	B	C

5.2.2.4 Mule Deer

5.2.2.4.1 General Habitat Requirements

Mule deer need the same basic elements for life as other organisms. However, mule deer occupy a variety of cover types across eastern Washington. Consequently, habitat requirements vary with vegetative and landscape components contained within each herd range. Forested habitats provide mule deer with forage as well as snow intercept, thermal, and escape cover. Mule deer occupying mountain-foothill habitats live within a broad range of elevations, climates, and topography, which includes a wide range of vegetation; many of the deer using these habitats are migratory. Mule deer are found in the deep canyon complexes along the major rivers and in the channeled scablands of eastern Washington; these areas are dominated by native bunch grasses or shrubsteppe vegetation. Mule deer also occupy agricultural areas that were once shrubsteppe.

In southeast Washington, the largest populations of mule deer occur in the foothills of the Blue Mountains, farmland areas, and along the breaks of the Snake River. Agricultural lands are important for mule deer in these areas because croplands and CRP lands provide both food and cover. Since 1986, approximately 284,251 acres of croplands have been converted to CRP, which has greatly enhanced habitat for mule deer and other wildlife in southeast Washington. Walla Walla County contains 157,298 acres of CRP; Columbia County, Garfield County, and Asotin County contain 46,095 acres, 51,225 acres; and 29,633 acres, respectively (USDA 2003).

5.2.2.4.2 Limiting Factors

Mule deer and their habitats are negatively impacted dam construction, urban and suburban developement, road and highway construction, mismanaged livestock grazing, inappropriate logging operations, competition by other ungulates, drought, fire, over-harvest by hunters, predation, disease and parasites.

Weather conditions can play a major role in the productivity and abundance of mule deer. Drought conditions can have a severe impact on mule deer because forage does not replenish itself on summer or winter range, and nutritional quality is low. Drought conditions during the summer and fall can result in low fecundity in does, and poor physical condition going into the winter months. Severe winter weather can result in high mortality of all age classes, but bucks usually sustain the highest mortality. If mule deer are subjected to drought conditions in the summer and fall, followed by a severe winter, the result can be high mortality rates and low productivity the following year.

Habitat conditions in southeast Washington have deteriorated in some areas and improved dramatically in others. The conversion of shrubsteppe and grassland habitat to agricultural cropland has resulted in the loss of hundreds of thousands of acres of deer habitat in southeast Washington. However, this has been mitigated to some degree in by the conversion of 400,000 acres to CRP. Noxious weeds have invaded many areas of the Ecoregion, resulting in a tremendous loss of good habitat for mule deer. Yellow starthistle has invaded the breaks of the Snake River from Asotin to the Oregon border, greatly reducing the ability of this area to support mule deer populations at historic levels. Yellow starthistle is also a major problem in the Tucannon and Touchet River watersheds.

Fire suppression has resulted in a decline of habitat conditions in the Blue Mountains. Browse species need to be regenerated by fire in order to maintain availability and nutritional value to big game. Lack of fire has allowed many browse species to grow out of reach for mule deer (Leege 1968, 1969; Young and Robinette 1939).

Mule deer habitat in the Blue Mountains east of Walla Walla has experienced a significant level of land development over the last 20 years. Subdivisions have resulted in the loss of thousands of acres of habitat, and mule deer populations in those areas have declined accordingly.

Approximatley 284,251 acres of CRP have been created in Ecoregion agricultural areas by converting cropland to grassland. This has resulted in an improvement in habit for mule deer. Conservation Reserve Program lands provide both food and cover where little existed before the CRP was created.

Mountain lion populations have increased significantly in the Blue Mountains over the last 20 years (P. Fowler, WDFW, personal communication, 2003). During this period, the mule deer population has declined to a fraction of historic levels. Cougar predation on mule deer could be a major factor contributing to the population decline. Coyote predation on fawns can have a significant impact on the deer population when coyote populations are high, and fawn productivity is low.

The deer harvest by licensed hunters is restricted to bucks with a minimum of three points on one side, while the antlerless harvest is generally regulated by special permit. This system allows for harvesting deer at optimum levels, while preventing overharest. However, in order to maintain buck survival at management objective, hunting opportunity needs to be strictly regulated.

Four dams were constructed on the Lower Snake River during the 1960s and early 1970s; Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The reservoirs created by these dams inundated thousands of acres of prime, riparian habitat that supported many species of wildlife, including mule deer. This riparian zone provided high quality habitat, especially during the winter months. The loss of this important habitat and the impact it has had on the mule deer population along the breaks of the Lower Snake River may never be fully understood.

Mule deer populations in GMUs 145 and 149 have reached a level at which landowner complaints are on the increase. In response, WDFW has increased antlerless permits and, in some cases, authorized “hotspot” hunts to reduce crop damage.

5.2.2.4.3 Current Distribution

Mule deer where generally thought to have occupied much of what is known as eastern Washington. Mule deer can be found in every county within eastern Washington.

5.2.2.4.4 Population Trend Status

Mule deer populations along the Snake River and in the foothills of the Blue Mountains are at management objective. Mule deer populations in the mountains and south of Clarkston in GMU 181 are improving.

Several factors have contributed to improved Ecoregion deer populations. Five mild winters contributed to good fawn production and survival, and over 400,000 acres of CRP lands have improved habitat conditions, providing forage, escape cover, and hiding cover for adults and fawns.

Increased hunting opportunity and lower fawn survival along the breaks of the Snake River puts significant pressure on the mule deer buck population. Lower fawn production and survival in 2002 will likely result in fewer antlered bucks recruited into the population in 2003. Post-hunt mule deer buck ratios in 2002 declined to 14 bucks per 100 does. The average post-hunt ratio for mule deer in 2000 and 2001 was 25 bucks per 1,100 does. The 10-year average (1992-2001) post-hunt buck ratio for mule deer ranged between 14 and 29 bucks per 100 does, and averaged 20.7 bucks per 100 does (Table_41).

Most mule deer herds are currently thought to be stable or declining across much of eastern Washington. There are exceptions to the current, widespread decline, most notably, herds in southeastern Washington and portions of Grant, Douglas, Spokane, and Whitman Counties.

Mule deer populations in southeast Washington vary by Game Management Unit. Along the breaks of the Snake River in GMUs 145 and 149 (Lower Snake), mule deer populations have peaked and may start declining over the next few years, especially if summer/fall drought conditions continue to prevail. Mule deer populations in the mountains have declined significantly over the last 15 years, but appear to be slowly improving. The mule deer population along the breaks of the Snake River in GMU 181 Couse and GMU 186 Grande Ronde have declined from historic levels, and have not improved significantly over the last 15 years. Two factors may be responsible for the lack of recovery in these mule deer populations; noxious weeds and predation. Noxious weeds (yellow starthistle) have inundated thousands of acres of prime mule deer habitat along the breaks of the Snake and Grande Ronde Rivers. At the same time, mountain lion populations have also increased, putting additional pressure on the mule deer population.

5.2.2.4.5 Structural Condition Associations

Structural conditions (NHI 2003) associated with mule deer are summarized in Table_42. Mule deer are generally associated (A) with, but not dependent upon, a wide range of structural conditions within the shrubsteppe habitat type (NHI 2003). In contrast, this species is not closely associated (C) with any structural condition within this habitat type. The lack of a close association with a structural condition and the large number of general associations infers that mule deer are a “generalist” species within shrubsteppe communities and are adapted to a wide range of conditions.

Table 41. Post-hunt mule deer surveys, Blue Mountains, Washington (1989 – 2002).

Year	Adults	Yearlings	Does	Fawns	Total	Bucks:100 Does Fawns:100 Bucks
1989	6	23	790	234	1053	30:100:4
1990	15	111	1358	544	2028	40:100:9
1991	17	133	943	455	1548	48:100:16
1992	40	153	1231	431	1868	35:100:17
1993	45	119	995	559	1718	56:100:17
1994	20	163	879	381	1443	43:100:21
1995	43	69	693	264	1069	38:100:16
1996	51	85	993	697	1826	70:100:14
1997	47	157	822	489	1515	60:100:25
1998	81	117	705	460	1363	65:100:28
1999	72	180	1316	796	2364	61:100:19
2000	8	20	98	52	78	53:100:29
2001	71	109	876	471	1529	53:100:21
2002	77	158	1651	581	2465	35:100:14

Table 42. Mule deer structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Mule Deer	Shrubsteppe	Grass/Forb-Closed	B	A
		Grass/Forb-Open	B	A
		Low Shrub-Closed Shrub Overstory-Mature	B	A
		Low Shrub-Closed Shrub Overstory-Old	B	A
		Low Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Low Shrub-Open Shrub Overstory-Mature	B	A
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Closed Shrub Overstory-Mature	B	A
		Medium Shrub-Closed Shrub Overstory-Old	B	A
		Medium Shrub-Closed Shrub Overstory-Seedling/Young	B	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Tall Shrub-Closed Shrub Overstory-Mature	B	A
		Tall Shrub-Closed Shrub Overstory-Old	B	A
		Tall Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Tall Shrub-Open Shrub Overstory-Mature	B	A
		Tall Shrub-Open Shrub Overstory-Old	B	A
		Tall Shrub-Open Shrub Overstory-Seedling/Young	B	A

5.2.2.5 Shrubsteppe Focal Species Structural Condition Summary

Shrubsteppe structural conditions are summarized by association in Figure_58. The species assemblage selected to represent this habitat type is more closely associated (C) with structural conditions than focal species assemblages representing interior grassland, ponderosa pine, or riparian forest habitats. Moreover, the species assemblage is also generally associate (A) with numerous shrubsteppe structural conditions. This infers that shrubsteppe obligate species are present within the focal species assemblage and that the shrubsteppe habitat type is adequately represented relative to structural conditions. The presence of viable populations of sage sparrows, sage thrashers, Brewer’s sparrows, and mule deer, coupled with the large number of close and general associations of structural conditions, would suggest that shrubsteppe habitats are functioning adequately. However, local population data is lacking and is considered a data gap for sage sparrows, sage thrashers, and Brewer’s sparrows. As a result, habitat functionality cannot be determined. In contrast, the mule deer (a generalist species) population in Ecoregion shrubsteppe habitats has peaked and may be starting to decline in some areas (P. Fowler, WDFW, personal communication, 2003), which suggests that habitat conditions are adequate for at least some shrubsteppe associated species.

Structural conditions summarized in Figure_58 and associated tables can also be used to define the range of recommended shrubsteppe structural conditions, prioritize protection strategies, and guide wildlife managers in identifying important structural condition considerations when making species specific shrubsteppe management decisions. Wildlife managers are also encouraged to review the Key Ecological Coorelates (KECs) (fine filter) associated with structural conditions (course filter) in the NHI (2003) database to gain additional insights into habitat functionality and quality.

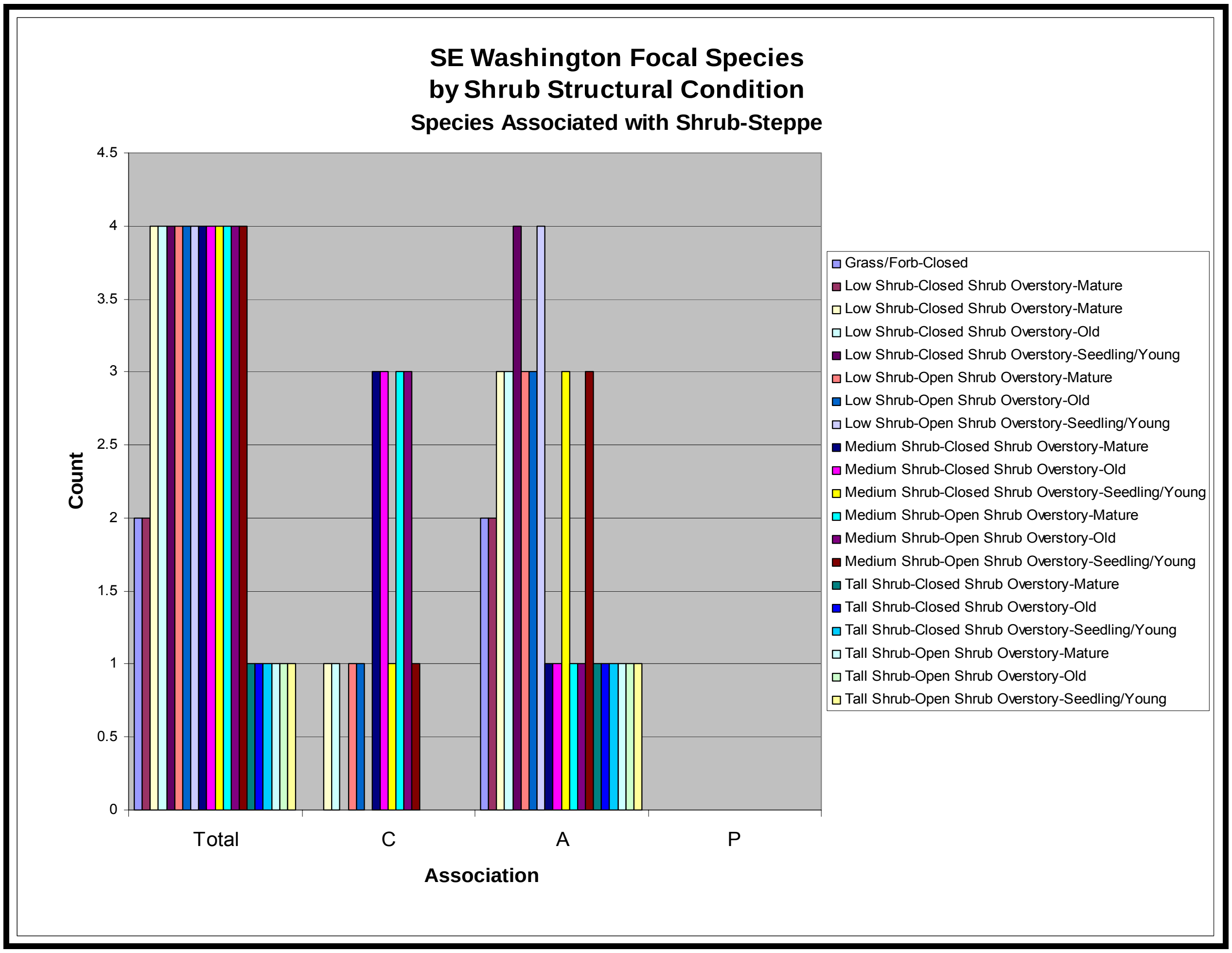

Figure 58. Shrubsteppe focal species structural condition associations (NHI 2003).

5.2.2.6 Shrubsteppe Key Ecological Functions

Key ecological functions performed by shrubsteppe focal species are limitied to those carried out by mule deer (Table 43) (NHI 2003). Similarly, key ecological functions performed by non focal species and functional redundancy within the Ecoregion are illustrated in Figure 59. The overall low functional redundancy (three or less species) associated with KEF 3.9 is not negative, because snags and trees are not an inherent component of the shrubsteppe habitat type found within the Ecoregion. Similarly, the complete lack of functional redundancy for KEF 3.5 is not an issue in shrubsteppe habitats because this key ecological function is associated with forest cover types. Functional redundancy results in conjunction with structural condition associations clearly supports the conclusion that shrubsteppe habitats within the Ecoregion are functional at this juncture.

Table 43. Key ecological functions performed by shrubsteppe focal species (NHI 2003).

KEF	KEF Description	Common Name
5.1	Physically affects (improves) soil structure, aeration (typically by digging)	None
3.9	Primary cavity excavator in snags or live trees	None
3.6	Primary creation of structures (possibly used by other organisms)	None
3.5	Creates feeding, roosting, denning, or nesting opportunities for other organisms	None
1.1.1.9	Fungivore (fungus feeder)	Mule Deer
1.1.1.4	Grazer (grass, forb eater)	Mule Deer
1.1.1.3	Browser (leaf, stem eater)	Mule Deer

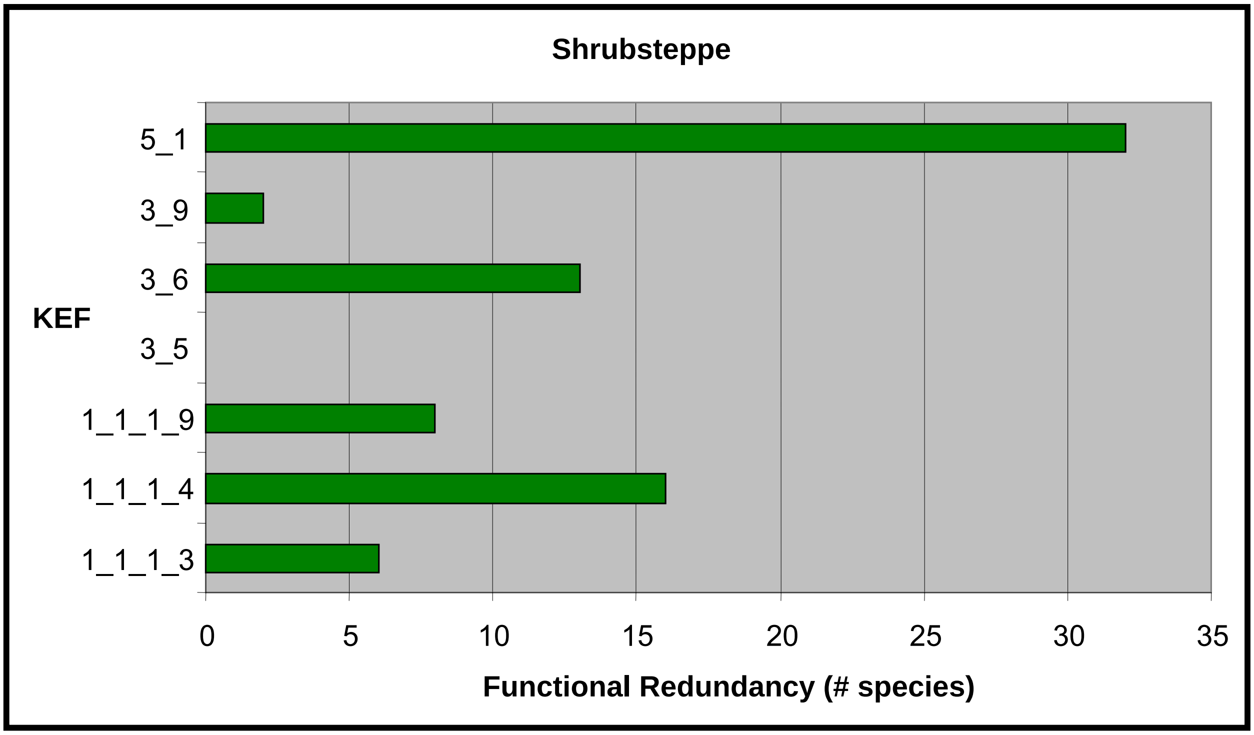

Figure 59. Functional redundancy in shrubsteppe habitat (NHI 2003).

5.2.3 Eastside (Interior) Riparian Wetlands Focal Species Information

5.2.3.1 Yellow Warbler

5.2.3.1.1 General Habitat Requirements

The yellow warbler is a riparian obligate species most strongly associated with wetland habitats and deciduous tree cover and is a good indicator of functional subcanopy and shrub habitats in riparian areas. Yellow warbler abundance is positively associated with deciduous tree basal area, and bare ground; abundance is negatively associated with mean canopy cover of Douglas-fir, Oregon grape (*Berberis nervosa*), mosses, swordfern (*Polystuchum munitum*), blackberry (*Rubus discolor*), hazel (*Corylus cornuta*), and oceanspray (*Holodiscus discolor*) (Rolph 1998). Altman (2001) reported that at the landscape level yellow warbler habitat should include a high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches, and a low percentage of agricultural land use. Specific habitat attributes are described in Table_31.

5.2.3.1.2 Limiting Factors

Habitat loss in the Ecoregion due to hydrologic diversions and control of natural flooding regimes, inundation from impoundments, cutting and spraying riparian woody vegetation for water access, gravel mining, and urban development have negatively affected yellow warblers. Similarly, yellow warblers have been impacted by habitat degradation, including the loss of vertical stratification of riparian vegetation; lack of recruitment of young cottonwoods, ash, willows, and other subcanopy species; streambank stabilization; invasion of exotic species; mismanaged livestock grazing; and reductions in riparian corridor widths.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird) and domestic predators (cats), and be subject to high levels of human disturbance. Recreational disturbances during nesting season, particularly in high-use recreation areas, may contribute towards nest abandonment. Furthermore, Increased use of pesticides and herbicides associated with agricultural practices may reduce the warbler's insect food base.

5.2.3.1.3 Current Distribution

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west to the Pacific coast (AOU 1998). Browning (1994) recognized 43 subspecies; two of these occur in Washington, and one of them, *D.p. brewsteri*, is found in western Washington. This species is a long-distance migrant and has a winter range extending from western Mexico south to the Amazon lowlands in Brazil (AOU 1998).

The yellow warbler is a common breeder in riparian habitats with hardwood trees throughout Washington State. It is a locally common breeder along rivers and creeks in the Columbia Basin, where it is declining in some areas. Jewett *et al. (*1953) noted that the yellow warbler was common in the willows and alders along the streams of southeastern Washington and also occured in brushy thickets. Jewett *et al.* (1953) also observed nesting yellow warblers along the Grande Ronde River, near Spokane, around Sylvan Lake, and in shade trees in Walla Walla. Core zones of distribution in Washington are the forested zones below the subalpine fir and mountain hemlock zones, plus steppe zones other than the central arid steppe and canyon grassland zones, which are peripheral. The distribution of the yellow warbler in Washington is depicted in Figure_60 (Smith *et al.* 1997). Note the presence of yellow warblers in all subbasins within the Ecoregion.

5.2.3.1.4 Population Trend Status

Within the state of Washington, yellow warblers are apparently secure and are not of conservation concern (Altman 1999). The yellow warbler is one of the more common warblers in North America (Lowther *et al.* 1999). Information from BBS indicates that the population is stable in most areas. Some subspecies, particularly in southwestern North America, have been impacted by degradation or destruction of riparian habitats (Lowther *et al.* 1999). Because the BBS dates back only about 30 years, population declines in Washington prior to the survey period are unknown and would not be accounted for by that effort (Figure_61).

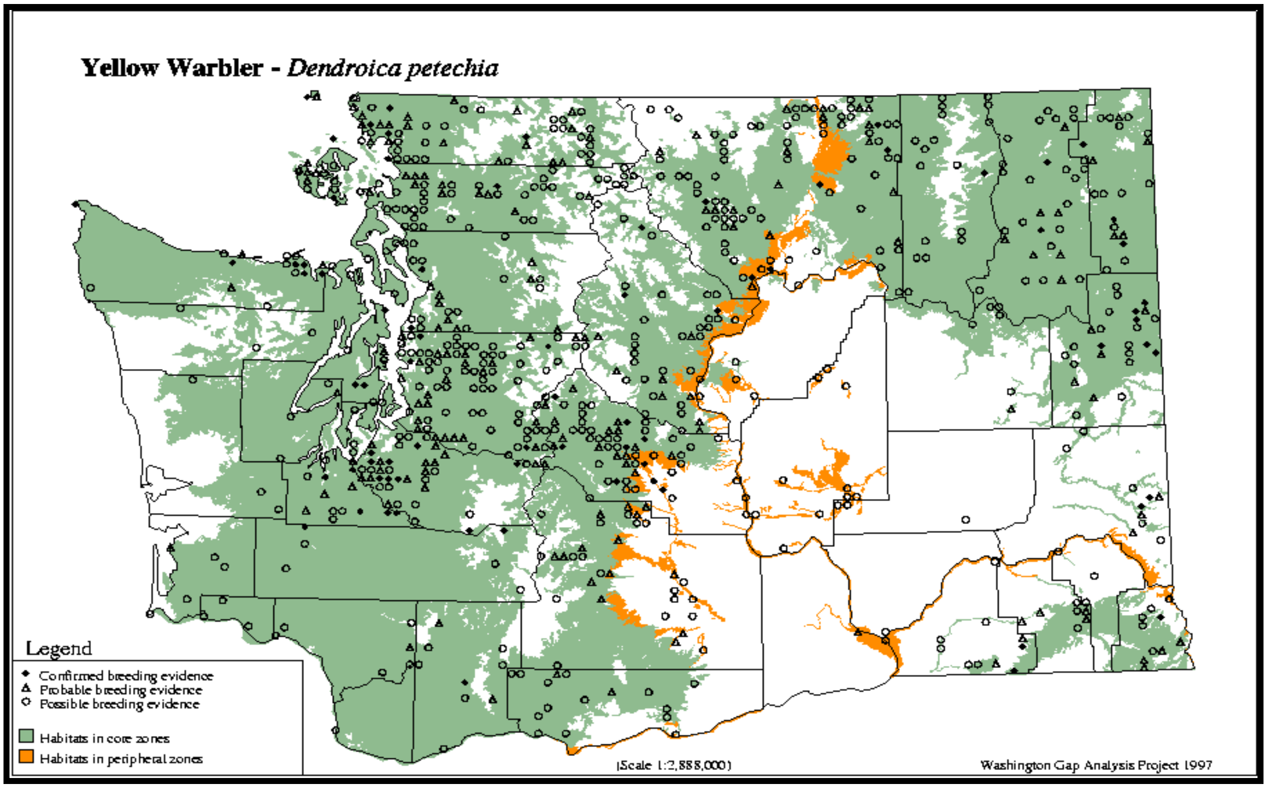

Figure 60. Breeding bird atlas data (1987-1995) and species distribution for yellow warbler (Washington GAP Analysis Project 1997).

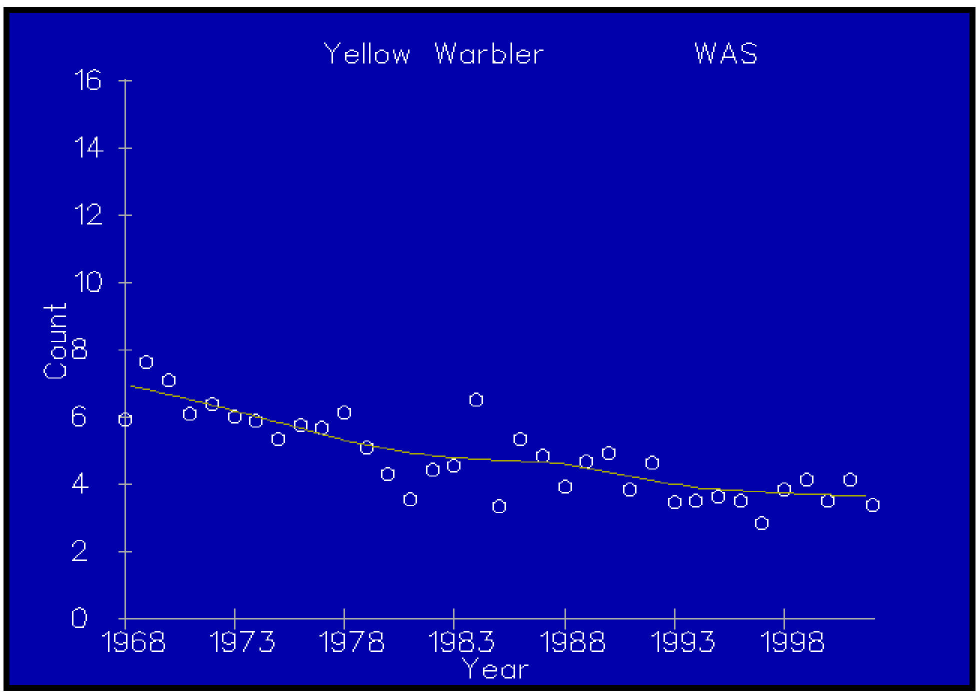

Figure 61. Yellow warbler trend results from BBS data, Washington (1968 - 1991) (Peterjohn 1991).

5.2.3.1.5 Structural Condition Associations

Structural conditions (NHI 2003) associated with yellow warbler are summarized in Table 44. Yellow warblers are generally associated (A) with a wide range of structural conditions during breeding (B), but are not closely associated (C) with any structural condition within the riparian habitat type (NHI 2003). The lack of a close association with a structural condition and the large number of general associations suggests that yellow warblers are linked, in the general sense, to woody riparian habitats, but not dependent upon a specific structural condition.

Table 44. Yellow warbler structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Yellow Warbler	Riparian wetlands	Medium Tree-Multi-Story-Closed	B	A
		Medium Tree-Multi-Story-Moderate	B	A
		Medium Tree-Multi-Story-Open	B	A
		Medium Tree-Single Story-Closed	B	A
		Medium Tree-Single Story-Moderate	B	A
		Medium Tree-Single Story-Open	B	A
		Sapling/Pole-Closed	B	A
		Sapling/Pole-Moderate	B	A
		Sapling/Pole-Open	B	A
		Shrub/Seedling-Closed	B	A
		Small Tree-Multi-Story-Closed	B	A
		Small Tree-Multi-Story-Moderate	B	A
		Small Tree-Multi-Story-Open	B	A
		Small Tree-Single Story-Closed	B	A
		Small Tree-Single Story-Moderate	B	A
		Small Tree-Single Story-Open	B	A

5.2.3.2 American Beaver

5.2.3.2.1 General Habitat Requirements

Suitable beaver habitat in all wetland cover types must have a permanent source of surface water with little or no fluctuation (Slough and Sadleir 1977). Lakes and reservoirs that have extreme annual or seasonal fluctuations will be unsuitable habitat for beaver. Similarly, intermittent streams, or streams that have major fluctuations in discharge or a stream channel gradient of 15 percent or more will have little year-round value as beaver habitat. Assuming that there is an adequate food source available, small lakes less than 20 acres in size are assumed to provide suitable habitat. Large lakes and reservoirs larger than 20 acres must have irregular shorelines in order to provide optimum habitat for beaver.

Beavers are generalized herbivores and appear to prefer herbaceous vegetation such as duck potato (*Sagittaria spp.),* duckweed (*Lemna spp.),* pondweed (*Potamogeton spp.),* and water weed (*Elodea* spp.) over woody vegetation during all seasons of the year, if it is available

(Jenkins 1981). The leaves, twigs, and bark of woody plants are eaten, as well as many species of aquatic and terrestrial herbaceous vegetation.

Beaver show strong preferences for particular woody plant species and size classes (Jenkins 1975; Collins 1976a; Jenkins 1979). Denney (1952) reported that beavers preferred, in order of preference, aspen, willow, cottonwood, and alder. Woody stems cut by beavers are usually less than 3 to 4 inches DBH (Bradt 1947; Hodgdon and Hunt 1953; Longley and Moyle 1963; Nixon and Ely 1969). Jenkins (1980) reported a decrease in mean stem size and greater selectivity for size and species with increasing distance from the water's edge. Food preferences may vary seasonally, or from year to year, as a result of variation in the nutritional value of food sources (Jenkins 1979). Specific habitat attributes are shown in Table_31.

5.2.3.2.2 Limiting Factors

Beavers readily adapt to living in urban areas near humans and are limited by the availability of permanent water with limited fluctuations and accessibility of food. Riparian habitat along many water ways has been removed in order to plant agricultural crops, thus removing important habitat and food sources for beaver in southeast Washington.

5.2.3.2.3 Current Distribution

The beaver is found throughout most of North America except in the Arctic tundra, peninsular Florida, and the Southwestern deserts (Figure_62) (Allen 1983; VanGelden 1982; Zeveloff 1988).

Figure 62. Geographic distribution of American beaver (Linzey and Brecht 2002).

5.2.3.2.4 Population Trend Status

Trend information is not available. No population data are available for southeast Washington.

5.2.3.2.5 Structural Condition Associations

Structural conditions (NHI 2003) associated with beaver are summarized in Table 45. Although beaver are generally associated (A) with multiple tree/shrub attributes and feed (F) and reproduce (R) in a wide range of structural conditions, they are not closely associated (C) with any structural condition within the riparian habitat type (NHI 2003). Beaver may also be present (P) within, but not dependent upon grass/forbs communities and giant tree forest types (NHI 2003).

Similar to yellow warbler, the lack of a close association with specific structural conditions and the large number of general associations suggests that beaver are linked to woody riparian habitats (primarily for food) and are not dependent upon a specific structural condition. Other than the availability of a food source, the water regimen is the key environmental determinant regarding the presence/absence of beaver throughout the Ecoregion.

Table 45. Beaver structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
American Beaver	Riparian wetlands	Large Tree-Multi-Story-Closed	F/R	A
		Large Tree-Multi-Story-Moderate	F/R	A
		Large Tree-Multi-Story-Open	F/R	A
		Large Tree-Single Story-Closed	F/R	A
		Large Tree-Single Story-Moderate	F/R	A
		Large Tree-Single Story-Open	F/R	A
		Medium Tree-Multi-Story-Closed	F/R	A
		Medium Tree-Multi-Story-Open	F/R	A
		Medium Tree-Single Story-Closed	F/R	A
		Medium Tree-Single Story-Moderate	F/R	A
		Medium Tree-Single Story-Open	F/R	A
		Sapling/Pole-Closed	F/R	A
		Sapling/Pole-Moderate	F/R	A
		Sapling/Pole-Open	F/R	A
		Shrub/Seedling-Closed	F/R	A
		Shrub/Seedling-Open	F/R	A
		Small Tree-Multi-Story-Closed	F/R	A
		Small Tree-Multi-Story-Moderate	F/R	A
		Small Tree-Multi-Story-Open	F/R	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Small Tree-Single Story-Closed	F/R	A
		Small Tree-Single Story-Moderate	F/R	A
		Small Tree-Single Story-Open	F/R	A
		Giant Tree-Multi-Story	F/R	P
		Grass/Forb-Closed	F/R	P
		Grass/Forb-Open	F/R	P

5.2.3.3 Great Blue Heron

5.2.3.3.1 General Habitat Requirements

The great blue heron requires multiple cover types to meet its life requisites. Herons require wooded areas suitable for colonial nesting and wetlands within a specified distance of the heronry for foraging. A heronry frequently consists of a relatively small area comprised of large hardwood trees, such as cottonwoods, structurally capable of supporting a heron's large nest.

Suitable great blue heron foraging habitats include herbaceous wetlands, scrub-shrub wetlands, forested wetlands, riverine, lacustrine or estuarine habitats within 0.5 mile of heronries or potential heronries. Optimum foraging habitats have shallow, clear water with a firm substrate and a huntable population of small fish, amphibians, and other aquatic organisms. Human disturbance can render suitable foraging habitat useless. Suitable great blue heron foraging areas are those in which there is no human disturbance near the foraging zone during the four hours following sunrise or preceding sunset or when the foraging zone is more than 300 feet from human activities and/or habitation, or more than 150 feet from roads with occasional, slow-moving traffic (Short and Cooper 1985). Specific habitat attributes are summarized in Table_31.

5.2.3.3.2 Limiting Factors

Habitat destruction resulting in loss of nesting and foraging sites, reductions in water quality, and human disturbance are the most important factors contributing to declines in some great blue heron populations in recent years (Thompson 1979; Kelsall and Simpson 1980; McCrimmon 1981). The loss of cottonwood galleries, island habitats, and riverine function due to hydropower development coupled with the degradation of remaining riparian habitats from agriculture practices, livestock grazing, and development have contributed significantly towards the decline of heron and shorebird populations.

Poor water quality reduces the amount of large fish and invertebrate species available in wetland areas. Toxic chemicals from runoff and industrial discharges pose yet another threat. Although great blue herons currently appear to tolerate low levels of pollutants, these chemicals can move through the food chain, accumulate in the tissues of prey, and may eventually cause reproductive failure.

Several authors have observed eggshell thinning in great blue heron eggs, presumably as a result of the ingestion of prey containing high levels of organochlorines (Graber *et al.* 1978; Ohlendorf *et al.* 1980). Konermann *et al.* (1978) blamed high levels of dieldrin and DDE use for reproductive failure, followed by colony abandonment in Iowa. Vermeer and Reynolds (1970) recorded high levels of DDE in great blue herons in the prairie provinces of Canada, but felt that reproductive success was not diminished as a result. Thompson (1979) believed that it was too early to tell if organochlorine residues were contributing to heron population declines in the Great Lakes region.

Human disturbance may render optimum habitat unsuitable for herons. Heronries often are abandoned as a result of human disturbance (Markham and Brechtel 1979). Werschkul *et al.* (1976) reported more active nests in undisturbed areas than in areas that were being logged. Housing and industrial development (Simpson and Kelsall 1979) and water recreation and highway construction (Ryder *et al.* 1980) also have resulted in the abandonment of heronries. Grubb (1979) felt that airport noise levels could potentially disturb a heronry during the breeding season as well.

5.2.3.3.3 Current Distribution

Two known heron rookeries occur within the Walla Walla subbasin, one on the Walla Walla River and one on the Touchet River (NPPC 2001e). The Walla Walla River rookery contains approximately 13 active nests. The Touchet River rookery contains approximately 8-10 active nests. Blue herons are observed throughout the lowlands of the Ecoregion near rivers or streams (P. Fowler, WDFW, personal communications, 2003). Due to heron sensitivity to human disturbance, specific heronry locations are not described, nor shown on maps within this document. General great blue heron distribution is depicted in Figure 63.

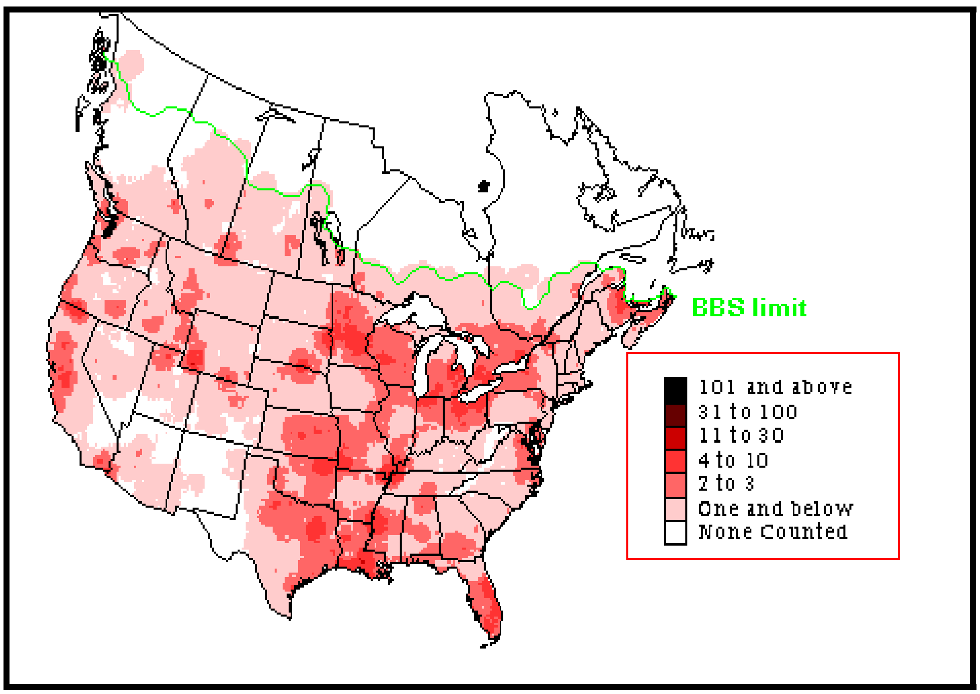

Figure 63. Great blue heron summer distribution from BBS data (Sauer *et al.* 2003).

5.2.3.3.4 Population Trend Status

Surveys of blue heron populations are not conducted. However, populations appear to be stable and possibly expanding in some areas. Two new nesting colonies have been found on the Lower Snake River (P. Fowler, WDFW, personal communication, 2003). Great blue heron BBS trend results are shown in Figure 64 while great blue heron BBS Washington trend results are illustrated in Figure 65.

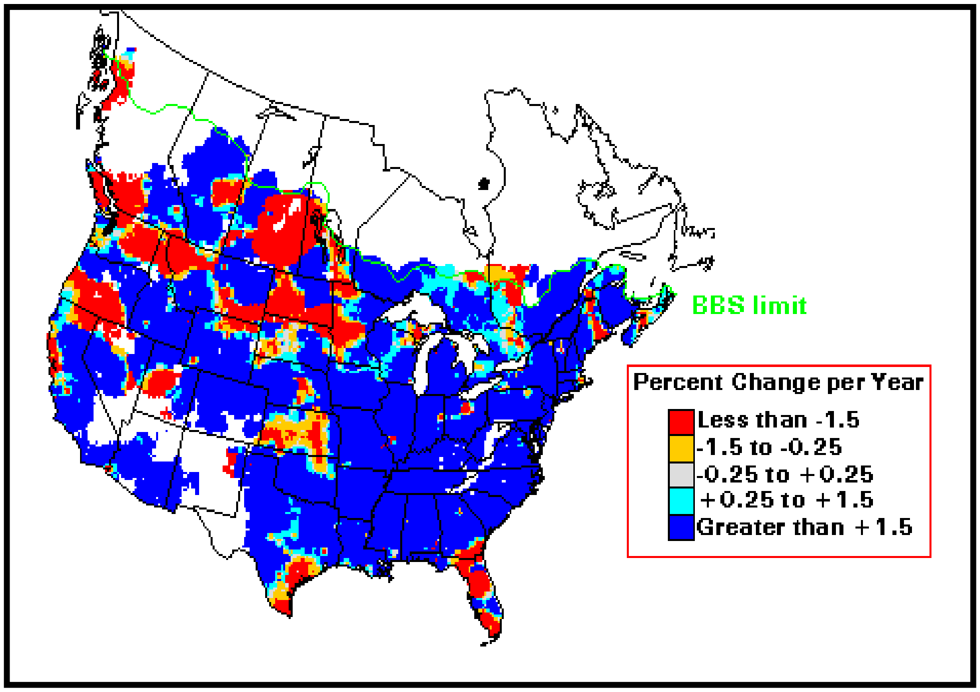

Figure 64. Great blue heron trend results from BBS data, North America (1966-1996) (Sauer *et al*. 2003).

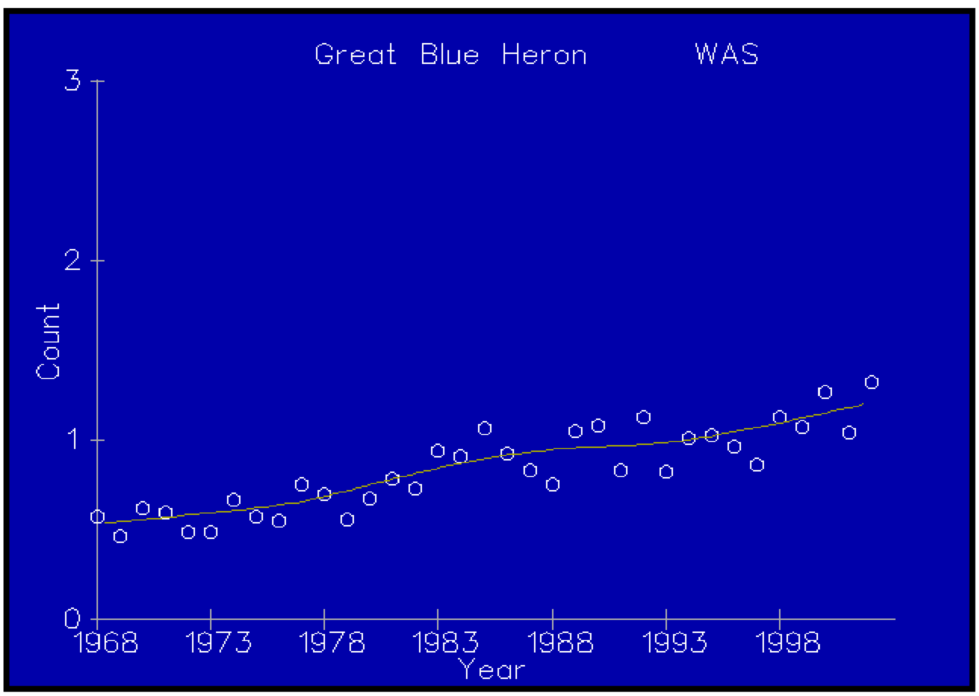

Figure 64. Great blue heron trend results from BBS data, Washington (1966-2002) (Sauer *et al.* 2003).

5.2.3.3.5 Structural Condition Associations

Structural conditions (NHI 2003) associated with great blue heron are summarized in Table 46. Heron are generally associated (A) primarily with large to giant tree structure with moderate to open canopy for reproduction (R). They may be present (P) within, but not dependent upon closed canopy tree structure for reproduction regardless of tree size (NHI 2003). Although herons are not closely associated (C) with any structural condition, they appear to favor large, multi-story, open canopy tree galleries for breeding (NHI 2003). Wildlife managers can refer to the structural conditions described in Table 46 to establish site specific riparian habitat objectives.

Table 46. Great blue heron structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Great Blue Heron	Riparian Wetlands	Giant Tree-Multi-Story	R	A
		Large Tree-Multi-Story-Moderate	R	A
		Large Tree-Multi-Story-Open	R	A
		Large Tree-Single Story-Moderate	R	A
		Large Tree-Single Story-Open	R	A
		Medium Tree-Multi-Story-Open	R	A
		Large Tree-Multi-Story-Closed	R	P
		Large Tree-Single Story-Closed	R	P
		Medium Tree-Multi-Story-Closed	R	P
		Medium Tree-Multi-Story-Moderate	R	P
		Medium Tree-Single Story-Closed	R	P
		Medium Tree-Single Story-Moderate	R	P
		Medium Tree-Single Story-Open	R	P

5.2.3.4 Eastside (Interior) Riparian Wetlands Structural Condition Summary

Riparian habitat structural conditions are summarized by association in Figure 66. The species selected to represent this habitat type are either generally associated (A) with structural conditions, or are present (P). The large number of structural conditions generally associated (A) with the chosen species assemblage ensures that most key structural components will be considered by wildlife/land managers during the planning phase. The lack of closely associated (C) structural attributes, however, suggests the need to closely examine how managing riparian habitats for the focal species assemblage will provide for the needs of riparian habitat obligate species. Future analysis should include the addition of riparian obligate species that are closely associated with structural conditions.

Structural conditions summarized in Figure 66 and associated tables can also be used to help define the range of recommended riparian habitat structural conditions, prioritize protection strategies, and guide wildlife/land managers in identifying important structural considerations when making specific management decisions. Wildlife managers are also encouraged to review the key environmental correlates (KECs) (fine filter) associated with structural conditions

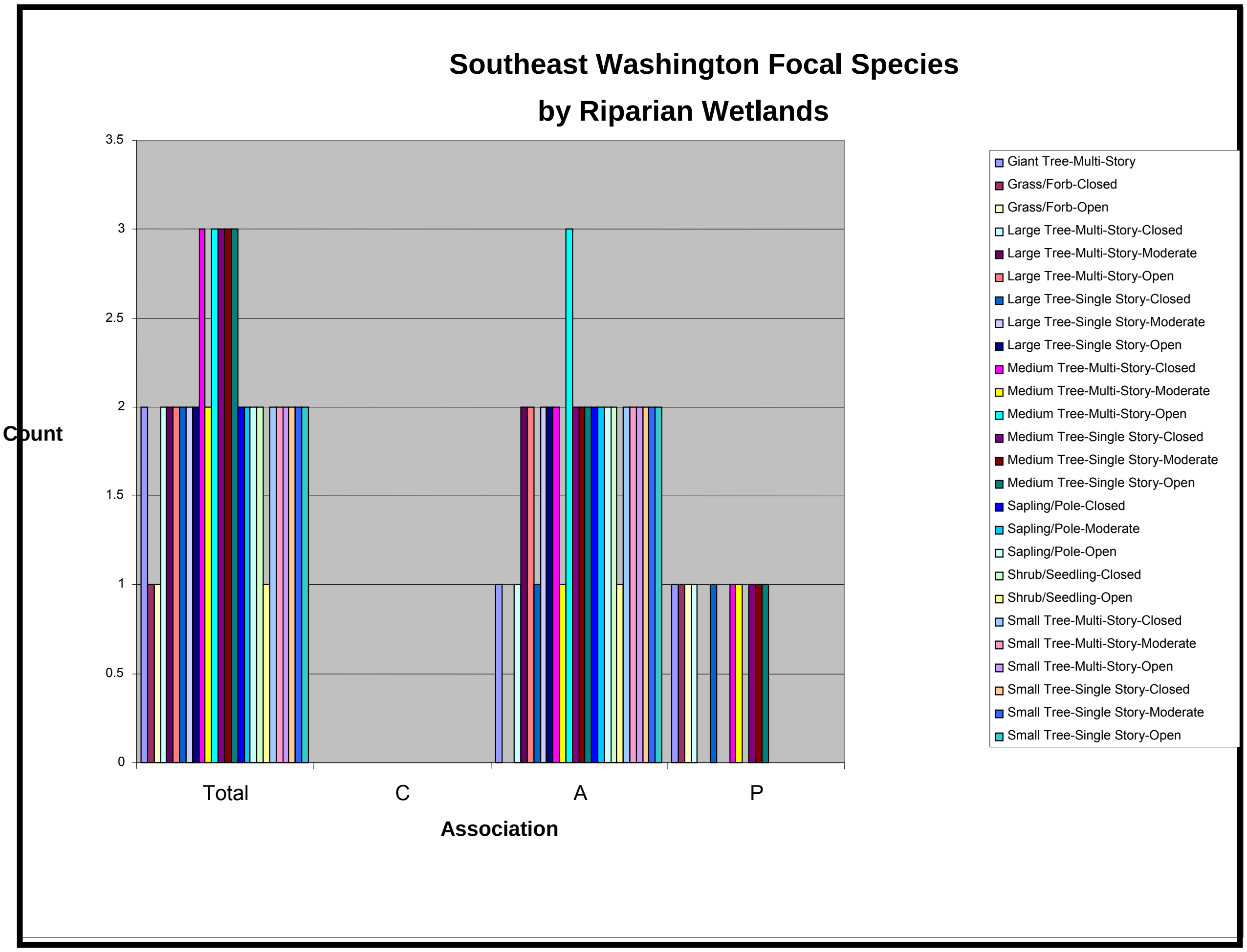

Figure 65. Riparian wetland focal species structural condition associations (NHI 2003).

(course filter) in the NHI (2003) database to gain additional insights into habitat functionality and quality.

5.2.3.5 Eastside (Interior) Riparian Wetlands Key Ecological Functions

Key ecological functions performed by riparian wetland focal species are limitied to those carried out by beaver and great blue heron (Table 47) (NHI 2003). KEFs performed by non focal species and functional redundancy within the Ecoregion are illustrated in Figure 67. The functional redundancy provided by non-focal species suggests that riparian habitats, at the Ecoregion scale, can resist some change in its overall functional integrity (this may not be true at the local watershed or 6^{th} - level HUC scale). In order to document potential changes in KEFs/functional redundancy, wildlife managers should monitor species response to habitat changes at the subbasin/project level and infer riparian obligate species population trends at the Ecoregion scale.

Table 47. Key ecological functions performed by riparian wetland focal species (NHI 2003).

KEF	KEF Description	Common Name
5.1	physically affects (improves) soil structure, aeration (typically by digging)	Beaver
3.9	primary cavity excavator in snags or live trees	None
3.6	primary creation of structures (possibly used by other organisms)	Beaver/Heron
3.5	creates feeding, roosting, denning, or nesting opportunities for other organisms	Heron
1.1.1.9	fungivore (fungus feeder)	None
1.1.1.4	grazer (grass, forb eater)	None
1.1.1.3	browser (leaf, stem eater)	Beaver

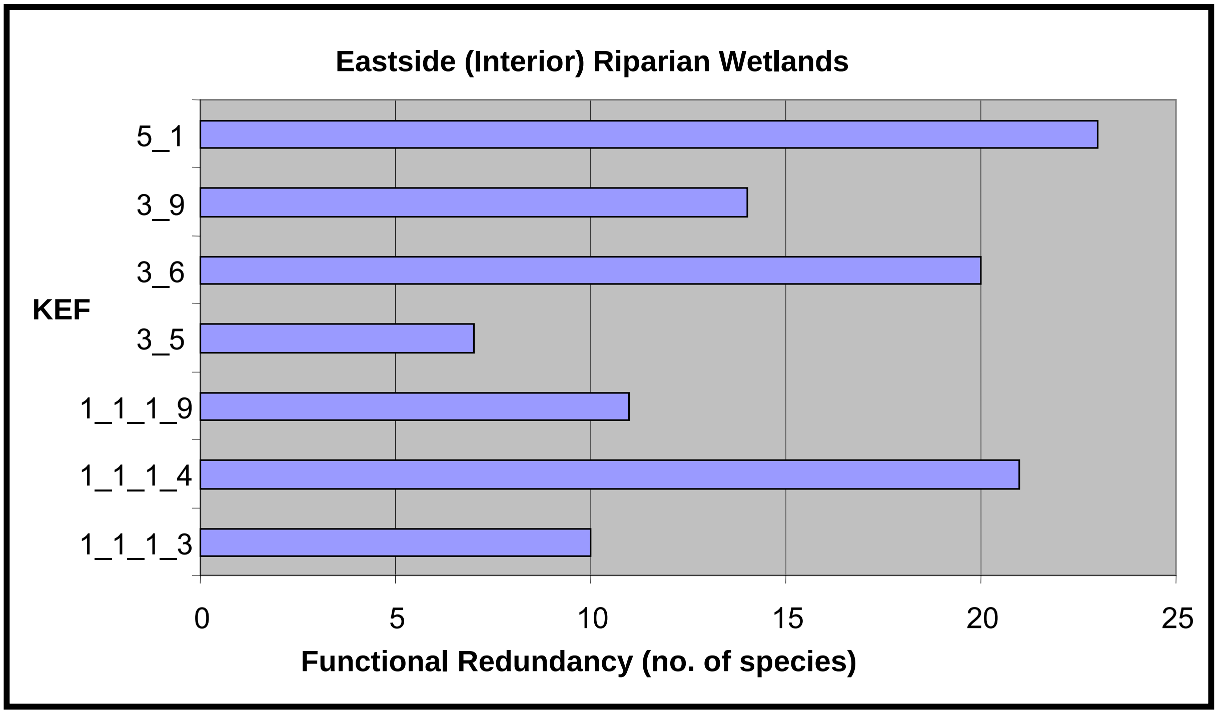

Figure 66. Functional redundancy in Ecoregion riparian wetlands (NHI 2003).

5.2.4 Eastside (Interior) Grassland Focal Species Information

5.2.4.1 Grasshopper Sparrow

5.2.4.1.1 General 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, 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 occasionally inhabit croplands, 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).

5.2.4.1.2 Limiting Factors

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. 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, habitat fragmentation 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 shrubsteppe species (Saab and Rich 1997), which include the grasshopper sparrow.

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 1994; Bock *et al.* 1999). Herkert (1991) in Illinois, found that grasshopper sparrows were not present in grassland patches smaller than 74 acres despite the fact that their published average territory size is only about 0.75 acres. Minimum requirement size in the Northwest is unknown.

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. Historic 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 habitat remains untouched by livestock, 20 percent is lightly grazed, 30 percent is moderately grazed with native understory remaining, and 30 percent is 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. Extensive and intensive grazing in North America has had negative impacts on this species (Bock and Webb 1984).

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).

The degree of degradation of terrestrial ecosystems is often diagnosed by the presence and extent of exotic plant species (Andreas and Lichvar 1995). Frequently, their presence is related to soil disturbance and overgrazing. Increasingly, however, aggressive exotic species are becoming established even in ostensibly undisturbed bunchgrass vegetation. The most notorious exotic 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).

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).

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 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 has 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 will likely demonstrate a negative response to fire (CPIF 2000).

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).

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).

5.2.4.1.3 Current Distribution

Grasshopper sparrows are found in North and South America and 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 1996; Vickery 1996).

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 British Columbia, where it is considered endangered, east into Nevada, Utah, Colorado, Oklahoma, Texas, and possibly to Illinois and Indiana (Vickery 1996).

Grasshopper sparrows have a spotty distribution at best across eastern Washington. Over the years they have been found in various locales including CRP lands. They appear to utilize CRP on a consistent basis in southeast Washington (M. Denny, USFS, personal communication, 2003).

5.2.4.1.4 Structural Condition Associations

Structural conditions (NHI 2003) associated with the grasshopper sparrow are summarized in Table 48. Grasshopper sparrows are generally associated (A) with open canopy shrub structure and are closely associated (C) with grass/forbs plant communities, which suggests that this sparrow is a grassland obligate species (NHI 2003).

Table 48. Grasshopper sparrow structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Grasshopper Sparrow	Grasslands	Low Shrub-Open Shrub Overstory-Mature	B	A
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Grass/Forb-Closed	B	C
		Grass/Forb-Open	B	C

5.2.4.2 Sharp-tailed Grouse

5.2.4.2.1 General Habitat Requirements

The Columbian sharp-tailed grouse is one of six subspecies of sharp-tailed grouse and the only one found in Washington. Native habitats important for sharptails 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).

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 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). Fields enrolled in agricultural set-aside programs are often preferred. Giesen (1987) reported density of shrubs less than 3 feet tall were 5 times higher at nest sites than at random sites or sites 33 feet from the nest. Meints (1991) found that mean grass height at successful nests averaged just under 1 foot, while 7 inches was the average at unsuccessful nests. Hoffman (2001) recommended that the minimum height for good quality nesting and brood-rearing habitat is 8 inches, with 1 foot being preferred. Bunchgrasses, especially those with a high percentage of leaves to stems like bluebunch wheatgrass, is preferred by nesting sharp-tailed grouse over sod-forming grasses such as smooth brome.

Columbian sharp-tailed grouse 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).

After hatching, hens with broods move to areas where succulent vegetation and insects can be found (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).

Food items in the spring and summer include wild sunflower (*Helianthus* spp.), chokecherry, sagebrush, serviceberry, salsify (*Tragopogon* spp.), dandelion (*Taraxacum* spp.), bluegrass, and brome (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, sharptails commonly forage on persistent fruits and buds of chokecherry, serviceberry, hawthorn, snowberry, aspen, birch, willow, and wild rose (Giesen and Connelly 1993; Schneider 1994).

5.2.4.2.2 Limiting Factors

Columbian sharp-tailed grouse have suffered dramatic declines as a result of the conversion of native shrubsteppe habitat for agricultural purposes, flooding of habitat resulting from hydropower facilities, fragmentation of existing habitats, degradation of existing habitats from overgrazing, and vegetation removal in riparian areas (Yokum 1952; Ziegler 1979). Noxious weeds such as cheatgrass, yellow starthistle, Scotch thistle, Canada thistle (*Cirsium arvense*), jointed goatgrass (*Aegilops cylindrical*), and spotted knapweed continue to be factors negatively affecting the quality of habitat in southeastern Washington.

Restoration of native habitat will be necessary to reestablish viable populations of sharp-tailed grouse within the Asotin, Tucannon, Touchet, or Walla Walla subbasins. Reestablishment may require restoration of agricultural land to permanent cover for nesting and brood rearing near sites with sufficient winter range.

5.2.4.2.3 Current Distribution, Status and Trends

There has been a clear decline in sharptail abundance and distribution within the State of Washington (Hays *et al.* 1998; Schroeder *et al.* 2000). The Palouse prairie underwent major declines of sharp-tailed grouse between the late 1800s and the 1920s (Buss and Dziedzic 1955). Other portions of Washington underwent steady declines throughout most of the 1900s (McClanahan 1940; Yocom 1952; Aldrich 1963; Miller and Graul 1980). In southeast Washington, the last known sighting of a sharp-tailed grouse was in 1947 (P. Fowler, WDFW, personal communication, 2003). Ancedotal information indicates that several sharp-tailed grouse were observed in the Asotin subbasin as late as 2000 (M. Schroeder, WDFW, personal communication, 2003).

Columbian sharp-tailed grouse 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.

Within the Asotin, Tucannon, Palouse, Walla Walla, and Lower Snake subbasins, no known populations of sharptails exist. There have been reports of sharp-tailed grouse sightings in the

Asotin subbasin during the past 10 years, but these are likely a result of birds migrating across the Snake River from an Idaho release site (P. Fowler, WDFW, personal communication, 2003). The remaining populations of sharptails in Washington have continued to decline over the last 30 years. In 1998, this decline lead to the 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.

The 2003 sharp-tailed grouse population estimate for Washington was 598, with a 4.2 percent (SE = 3.5 percent) average annual decline from 1970 through 2003 (Schroeder 2003). The overall decline from 1970 through 2003 is estimated at 88.2 percent. In 2003, populations appeared to continue the decline, at least slightly. Analysis of sharptail genetic samples from Washington and other states is taking place. 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 percent between 1970 and 2003 (Shroeder 2003).

Out-of-Subbasin Effects

If Columbian sharpt-tailed grouse can become reestablished in one or all of the Ecoregion subbasins, habitat manipulations need to continue. Noxious weeds are established in most areas that were historically used by sharptails, 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 sharptail populations in adjacent subbasins would increase the possibility of interpopulation movements and reduce the risks associated with small isolated populations (genetically or extirpation).

5.2.4.2.4 Structural Condition Associations

Structural conditions (NHI 2003) associated with the sharp-tailed grouse are summarized in Table_49. Sharp-tailed grouse are closely associated (C) with five structural conditions dominated by grass/forbs plant communities and shrubs with an open overstory. Sharp-tails are also generally associated (A) with open canopy shrub structure and may be present (P) in old and decadent shrublands (NHI 2003). Based on the information presented in Table_49, land managers should develop management strategies that focus on limiting the amount of shrub encroachment into grassland habitats.

Table 49. Sharp-tailed grouse structural conditions and association relationships (NHI 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Sharp-tailed Grouse	Grasslands	Low Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Grass/Forb-Closed	B	C
		Grass/Forb-Open	B	C
		Low Shrub-Open Shrub Overstory-Mature	B	C

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	C
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	C
		Medium Shrub-Open Shrub Overstory-Old	B	P

5.2.4.3 Eastside (Interior) Grassland Structural Condition Summary

Wildlife species selected to represent this habitat type are either closely associated (C) or generally associated (A) with grassland structural conditions (NHI 2003) (Figure 67). The number of close and general structural associations suggests that the focal species assemblage is comprised of keystone grassland species. This, however, must be tempered by the overall lack of multiple structural conditions represented by the species assemblage. Future analysis should include additional grassland species that are generally/closely associated with structural conditions.

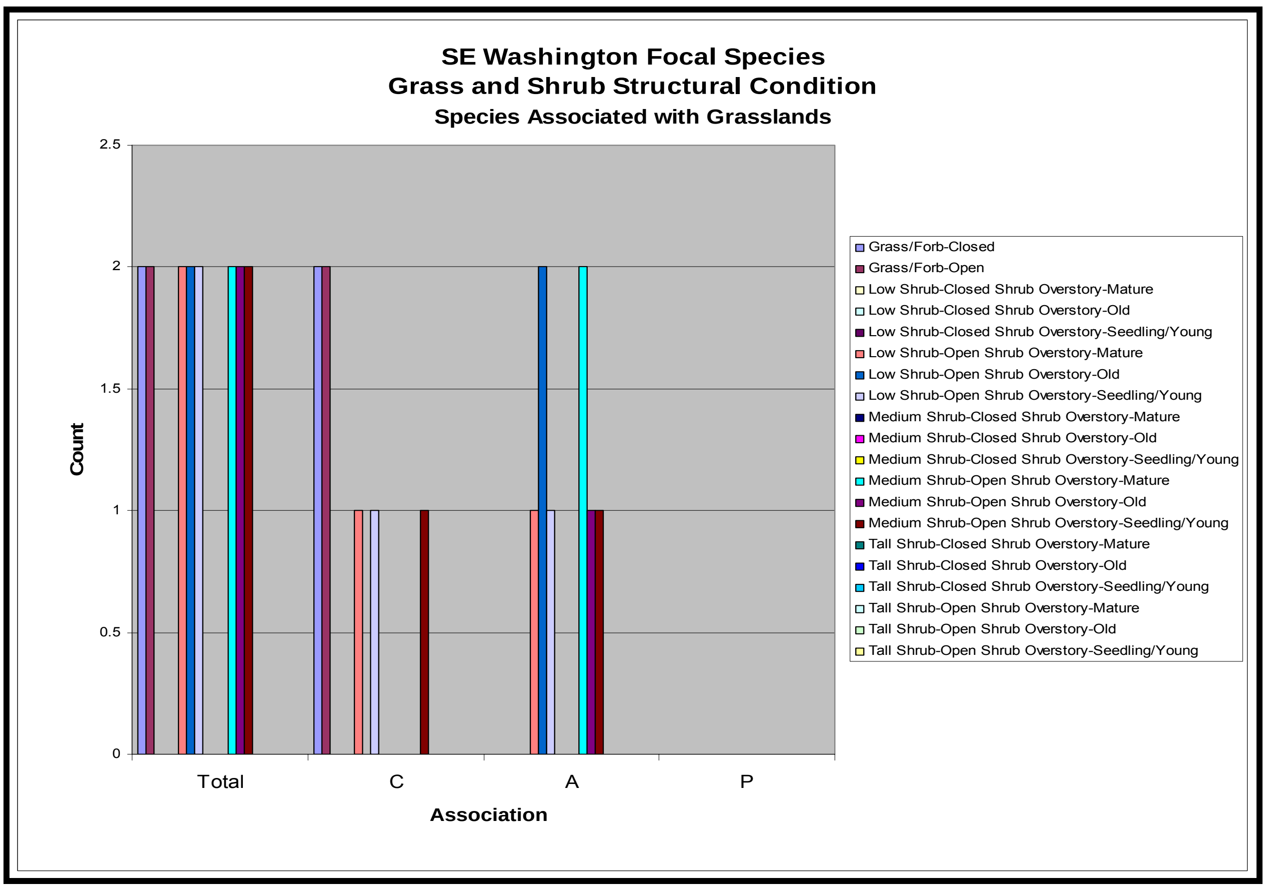

Figure 67. Eastside (interior) grassland focal species structural condition associations (NHI 2003).

The close association of structural components required by sharp-tailed grouse and grasshopper sparrows coupled with the extirpation of sharp-tailed grouse and the lack of recent grasshopper sparrow observations suggests that interior grassland habitats are non functional at this juncture. Several sharp-tailed grouse, however, were supposedly observed displaying in 2000 on the Schlee property located in Asotin County (M. Schroeder, IDFG, personal communication, 2003).

5.2.4.4 Eastside (Interior) Grassland Key Ecological Functions

There are no key ecological functions performed by grassland focal species (Table 50) (NHI 2003). Key ecological functions performed by non focal species and the level of functional redundancy at the Ecoregion scale appears to be adequate (Figure 68). The functional redundancy provided by non-focal species suggests that grassland habitats can resist some change in overall functional integrity (this may not be true at the local watershed scale). Similar to shrubsteppe habitat, the low functional redundancy associated with KEFs 3.5 and 3.9 is not an issue, because these key ecological functions are primarily associated with trees, snags, and/or forest habitats.

Based solely on NHI (2003) data, planners would conclude that interior grasslands are presently functional; however, NHI data do not address habitat quality, extent, and/or fragmentation concerns that have contributed significantly towards the extirpation of sharp-tailed grouse within the Ecoregion. When spatial and extent factors are considered in addition to NHI data, WDFW wildlife biologists again conclude that interior grasslands are non-functional at the Ecoregion level.

Table 50. Key ecological functions performed by Eastside (Interior) Grassland focal species.

KEF	KEF Description	Common Name
5.1	physically affects (improves) soil structure, aeration (typically by digging)	None
3.9	primary cavity excavator in snags or live trees	None
3.6	primary creation of structures (possibly used by other organisms)	None
3.5	creates feeding, roosting, denning, or nesting opportunities for other organisms	None
1.1.1.9	fungivore (fungus feeder)	None
1.1.1.4	grazer (grass, forb eater)	None
1.1.1.3	browser (leaf, stem eater)	None

5.3 Key Ecological Functions

Eighty-five key ecological functions are identified in the NHI database (2003). In order to streamline the analysis process, NHI staff identified seven KEF categories that represent critical functions for most habitat types (Table 51). These key ecological functions were selected because there is less than 20 percent similarity of species composition among the categories. Collectively, these seven categories span the greatest species diversity. Functional redundancy, for the seven key ecological functions described in Table 51, for all Ecoregion habitat types is displayed in Appendix B.

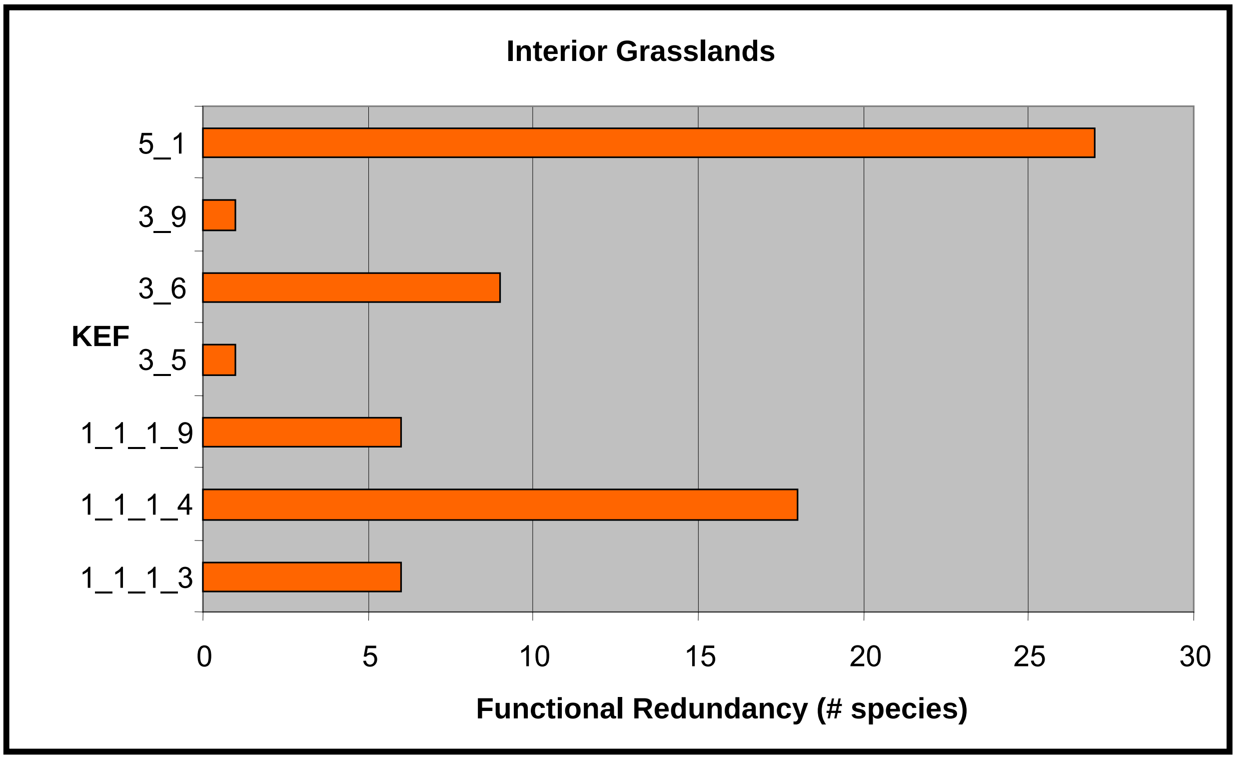

Figure 68. Eastside (Interior) Grassland functional redundancy (NHI 2003).

Table 51. Descriptions of seven critical key ecological functions (NHI 2003).

KEF	KEF Description
5.1	physically affects (improves) soil structure, aeration (typically by digging)
3.9	primary cavity excavator in snags or live trees
3.6	primary creation of structures (possibly used by other organisms)
3.5	creates feeding, roosting, denning, or nesting opportunities for other organisms
1.1.1.9	fungivore (fungus feeder)
1.1.1.4	grazer (grass, forb eater)
1.1.1.3	browser (leaf, stem eater)

In summary, the number of Ecoregion species performing KEF 3.5 has increased over historic periods by almost 13 percent. In contrast, the number of all other species performing the remaining six key ecological functions has decreased from just over 14 percent to nearly 54 percent (Figure 69). Clearly, there is a downward trend in functional redundancy for these seven key ecological functions. This same downward trend is repeated for most of the remaining 77 KEFs with the exception of species that perform key ecological functions associated with humans (for example, KEF 1.1.7: feeds on human garbage/refuse); functional redundancy in these key ecological functions has increased notably over historic periods (Appendix H). Functional redundancy has decreased more than 50 percent in 13 key ecological functions.

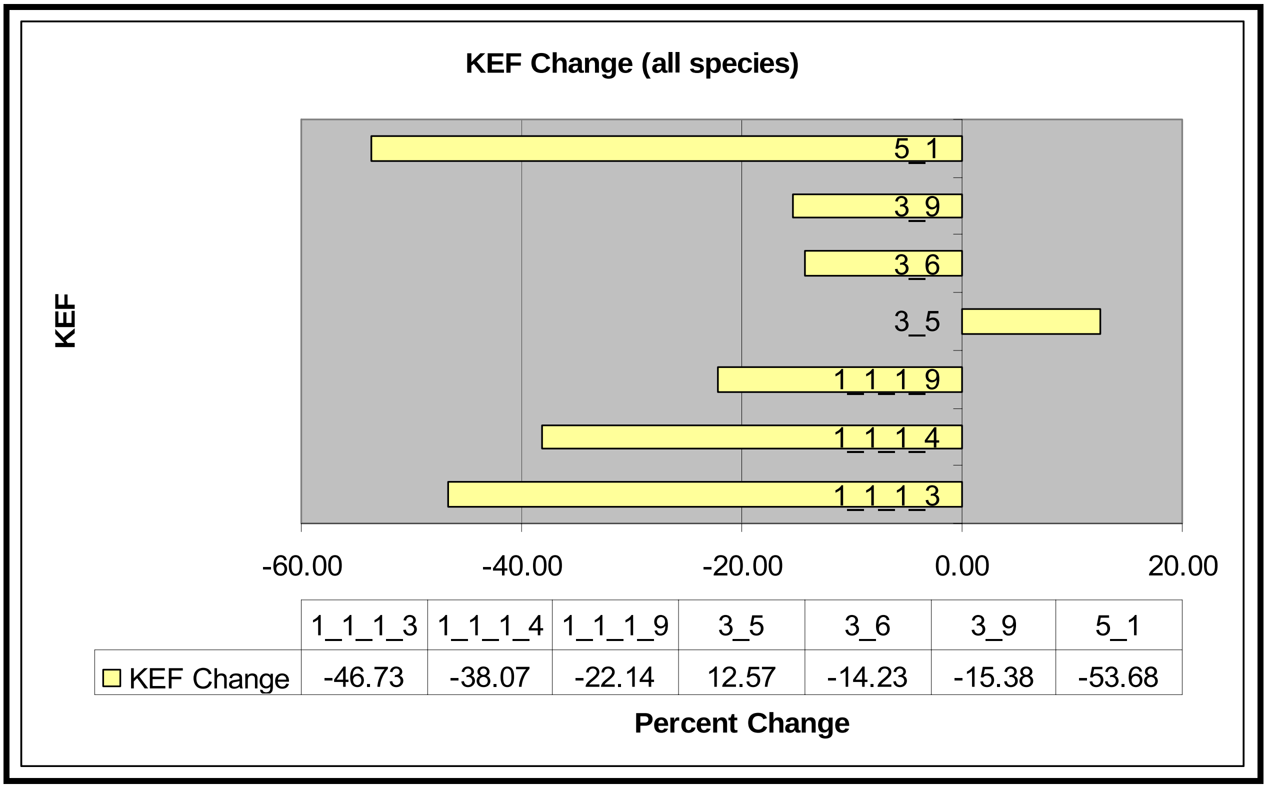

Figure 69. Percent change in functional redundancy for seven KEFs (NHI 2003).

Changes in the seven primary key ecological functions are illustrated in Appendix G. Changes in Ecoregion total functional diversity from circa 1850 to 1999 are displayed at the 6th - level HUC in Figure 70. There is little positive change in functional diversity (blue color shades). The vast majority of the Ecoregion has experienced dramatic declines in total functional diversity (red color shades). The relative difference between the positive change represented by the blue HUCs and the negative change represented by the red HUCs is a factor of just over -9.

5.4 Functional Specialists and Critical Functional Link Species

According to the NHI (2003), functional specialists are:

> "*species that have only one or a very few number of key ecological functions. An example is turkey vulture, which is a carrion-feeder functional specialist. Functional specialist species could be highly vulnerable to changes in their environment (such as loss of carrion causing declines or loss of carrion-feeder functional specialists) and thus might be good candidates for focal species. Few studies have been conducted to quantify the degree of their vulnerability. Note that functional specialists may not necessarily be (and often are not) also critical functional link species (functional keystone species), and vice versa.*"

Wildlife functional specialists are shown in Table 52. No Ecoregion focal species are functional specialists.

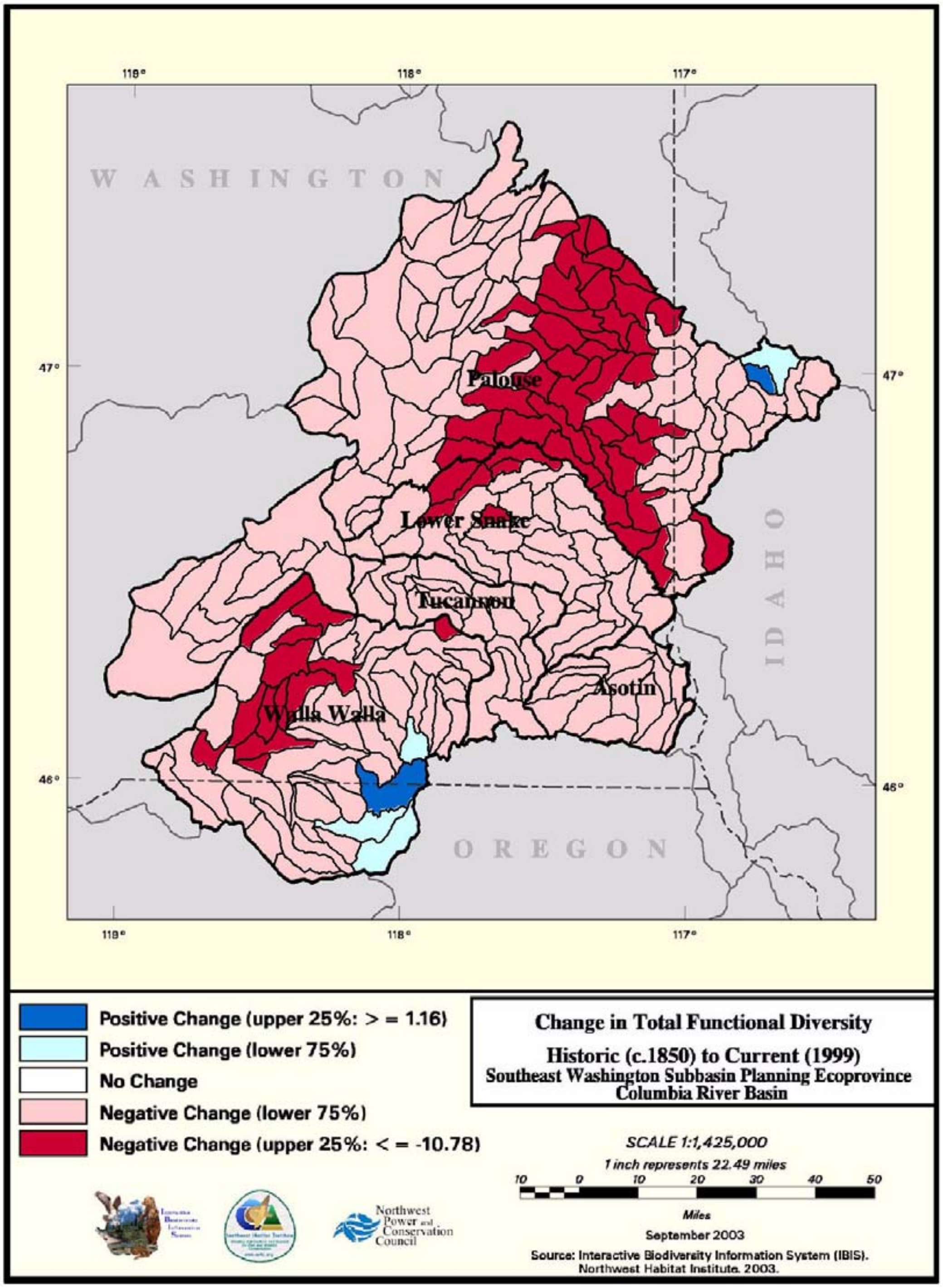

Figure 70. Changes in total functional diversity at the 6th - level HUC (NHI 2003).

Table 52. Wildlife functional specialists in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	Scientific Name	Number of KEFs
Black Swift	*Cypseloides niger*	1
Common Nighthawk	*Chordeiles minor*	1
Common Poorwill	*Phalaenoptilus nuttallii*	1
Turkey Vulture	*Cathartes aura*	1
Boreal Owl	*Aegolius funereus*	2
Brown Creeper	*Certhia americana*	2
Canyon Wren	*Catherpes mexicanus*	2
Eurasian Wigeon	*Anas penelope*	2
Gyrfalcon	*Falco rusticolus*	2
Harlequin Duck	*Histrionicus histrionicus*	2
Long-eared Myotis	*Myotis evotis*	2
Lynx	*Lynx canadensis*	2
Masked Shrew	*Sorex cinereus*	2
Merlin	*Falco columbarius*	2
Montane Shrew	*Sorex monticolus*	2
Northern Pygmy-owl	*Glaucidium gnoma*	2
Northern Waterthrush	*Seiurus noveboracensis*	2
Olive-sided Flycatcher	*Contopus cooperi*	2
Osprey	*Pandion haliaetus*	2
Peregrine Falcon	*Falco peregrinus*	2
Preble's Shrew	*Sorex preblei*	2
Ringneck Snake	*Diadophis punctatus*	2
Rock Wren	*Salpinctes obsoletus*	2
Snowy Owl	*Nyctea scandiaca*	2
Spotted Bat	*Euderma maculatum*	2
Vaux's Swift	*Chaetura vauxi*	2
Western Pipistrelle	*Pipistrellus hesperus*	2
Western Wood-pewee	*Contopus sordidulus*	2
White-throated Swift	*Aeronautes saxatalis*	2
Winter Wren	*Troglodytes troglodytes*	2
Wolverine	*Gulo gulo*	2

Similarly, critical functional link species are:

> "*those species that are the only ones that perform a specific ecological function in a community. Their removal would signal loss of that function in that community. Thus, critical functional link species are critical to maintaining the full functionality of a system. The function associated with a critical functional link species is termed a 'critical function.' Reduction or extirpation of populations of functional keystone species and critical functional links may have a ripple effect in their ecosystem, causing unexpected or undue changes in biodiversity, biotic processes, and the functional web of a community. A limitation of the concept is that little research has been done on the quantitative effects, on other species or ecosystems, or of the reduction or loss of critical functional link species.*"

There are three critical functional link species within the Ecoregion (Table 53).

Table 53. Critical functional link species in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	Focal Habitat
Rocky Mountain Elk	Ponderosa Pine
American Beaver	Eastside (Interior) Riparian Wetlands
Great Blue Heron	Eastside (Interior) Riparian Wetlands

5.5 Key Environmental Correlates

According to the NHI (2003), key environmental correlates (KECs) are:

> "*specific substrates, habitat elements, and attributes of species' environments that are not represented by overall (macro)habitats and vegetation structural conditions. Specific examples of KECs include snags, down wood, type of stream substrate, and many others. In the IBIS database, KECs are denoted for each species using a standard classification system, which include the KECs for vegetation habitat elements, non-vegetation terrestrial elements, aquatic bodies and substrates, anthropogenic structures, and other categories. A limitation of the KEC information in the IBIS database is that it is represented as simple categorical relations with species (e.g., a list of KECs pertinent to each species) rather than as quantified correlations (e.g., specific amounts, levels, or rates of each KEC and corresponding population densities or trends of each species); such data are essentially lacking in most cases.*"

All environmental scales, from broad floristic communities to fine-scale within stand features, are included in the definition of key environmental correlates. The word "*key*" refers to the high degree of influence (either positive or negative) the ecological correlates exert on the fitness of a given species (NHI 2003). Therefore, if a key environmental correlate is associated with a species, that KEC is important to the viability of that species. Key environmental correlates for all Ecoregion species can be obtained from the Nothwest Habitat Institute at: habitat@nwhi.org.

Ecoregion focal species are associated with 7 - 65 KECs (also known as habitat elements) (Table 54). Only aquatic related KECs are discussed further in this document to ensure that a link is made between terrestrial and aquatic habitats and species. Aquatic KECs associated with Ecoregion focal species are shown in Table 55 while all aquatic KECs are listed in Appendix I.

Table 54 Ecoregion focal species key environmental correlate counts (NHI 2003).

Common Name	Count of KEC
Grasshopper Sparrow	7
Brewer's Sparrow	7
Sage Thrasher	8
Sage Sparrow	10
Yellow Warbler	15
White-headed Woodpecker	20
Flammulated Owl	20
Sharp-tailed Grouse	26
Rocky Mountain Elk	39
Mule Deer	40
American Beaver	61
Great Blue Heron	65

Aquatic key environmental correlates associated with terrestrial Ecoregion focal species are shown in Table_55. Half of the Ecoregion focal species are associated with aquatic KECs. Great blue heron and beaver share the highest number of aquatic key environmental correlate associations followed by elk, mule deer, yellow warbler, and sharp-tailed grouse (yellow warbler and sharp-tailed grouse are associated with two KECs each). Not all aquatic key environmental correlates are linked to salmonid bearing streams and/or free running water; they also include wallows, springs, seeps, and ephemeral ponds.

Table 55. Aquatic key environmental correlates associated with focal species (NHI 2003).

Common Name	KEC	KEC Description
Great Blue Heron	4.1	water characteristics
	4.1.2	water depth
	4.2	rivers & streams
	4.2.1	oxbows
	4.2.2	order and class
	4.2.2.3	lower perennial
	4.2.3	zone
	4.2.3.1	open water
	4.2.3.3	shoreline
	4.3	ephemeral pools
	4.6	lakes/ponds/reservoirs
	4.6.1	zone
	4.6.1.1	open water
	4.6.1.3	shoreline
	4.6.3	vegetation
	4.6.3.2	emergent vegetation
	4.8	islands
	4.9	seasonal flooding
Sharp-tailed Grouse	4.2	rivers & streams
	4.2.13	seeps or springs
Yellow Warbler	4.7	wetlands/marshes/wet meadows/bogs and swamps
	4.7.1	riverine wetlands
American Beaver	4.1	water characteristics
	4.1.2	water depth
	4.1.6	water velocity
	4.1.8	free water (derived from any source)
	4.2	rivers & streams
	4.2.1	oxbows
	4.2.12	banks
	4.2.2	order and class

Common Name	KEC	KEC Description
	4.2.2.1	intermittent
	4.2.2.2	upper perennial
	4.2.2.3	lower perennial
	4.2.3	zone
	4.2.3.1	open water
	4.2.3.3	shoreline
	4.2.6	coarse woody debris in streams and rivers
	4.2.7	pools
	4.3	ephemeral pools
	4.6	lakes/ponds/reservoirs
	4.6.1	zone
	4.6.1.1	open water
	4.6.1.3	shoreline
	4.6.4	size
	4.6.4.1	ponds (<2ha)
	4.7	wetlands/marshes/wet meadows/bogs and swamps
	4.7.1	riverine wetlands
	4.7.2	context
	4.7.2.1	forest
	4.7.2.2	non-forest
Rocky Mountain Elk	4.1	water characteristics
	4.1.8	free water (derived from any source)
	4.7	wetlands/marshes/wet meadows/bogs and swamps
	4.7.1	riverine wetlands
	4.7.2	context
	4.7.2.1	forest
	4.7.2.2	non-forest
Mule Deer	4.1	water characteristics
	4.1.8	free water (derived from any source)
	4.7	wetlands/marshes/wet meadows/bogs and swamps
	4.7.2	context
	4.7.2.1	forest
	4.7.2.2	non-forest

The KEC descriptions and associated focal species in Table_55 clearly illustrate the close link between the needs of terrestrial Ecoregion focal species, aquatic habitat elements, life requisites, and other factors influencing fish and other aquatic organisms. For example, herons feed on fish fry and other aquatic organisms in oxbows (KEC 4.2.1), thus influencing fish fry survival rates. Sharp-tailed grouse may depend on hydrophytic shrubs and trees growing within riparian wetland habitats for winter food (KEC 4.2). These same shrubs and trees also shade stream channels, lowering water temperatures important to salmonid survival.

Yellow warblers are linked to riparian wetlands through feeding and nesting activities (KEC 4.7.1). Aquatic insects that emerge from wetlands provide food for both fish and terrestrial bird species, including the yellow warbler. Hydrophytic shrubs are used by warblers for nesting and feeding sites. Overhanging vegetation found in riverine wetlands provide refugia for juvenile fish rearing areas, thermal refugia and micro climates, and opportunities for fish to feed on terrestrial invertebrates that fall in the water from the overhanging vegetation. In addition to providing fish refugia and food for both terrestrial wildlife and fish, properly functioning wetlands may improve water quality for aquatic organisms by filtering sediments and toxic chemicals from water entering the riverine system and by lowering water temperatures through discharging cooled, subterranean water into the system.

Beaver physically influence aquatic habitats and key environmental correlates more than any other Ecoregion focal species through dam building, feeding, and denning activities. Beaver manipulate water depth and velocities (KECs 4.1.2 and 4.1.6) and create pools (KEC 4.2.7), which influence water temperature, fish refugia, aquatic invertebrate populations, and water turbidity. Feeding activities alter vegetation structure and composition adjacent to and within riparian wetland habitats.

Beaver feed on aquatic vegetation, trees, and shrubs and use woody material to construct dams, which adds coarse woody debris to riverine systems (KEC 4.2.6). Adding course woody material to riparian wetland habitats through feeding activities and/or dam construction:

- Alters water chemistry;
- Creates pools that provide fish with deep water winter habitat/refugia, act as sediment traps, and provide habitat for aquatic invertebrates and other wildlife species such as aquatic fur bearers, ducks, and amphibians;
- May change stream course/sinuosity by redirecting the thalweg;
- Adds to fish spawning gravel recruitment as new channels are scoured;
- Increases fish productivity by adding nutrients from the decay of flooded vegetation (C. Donley, WDFW, personal communication, 2003);
- Affects water temperatures both through the removal and establishment of dense woody riparian vegetation and the creation of deep pools;
- Disperses riparian vegetation seed and rooting material from woody cuttings into the riverine system potentially resulting in establishment of riparian vegetation downstream;
- Reduces stream incising by reducing water velocity; and
- Increases the extent of wetland vegetation through capillary action of pooled water, which may also raise the water table on adjacent lands making conditions favorable for additional riparian vegetation.

Elk and mule deer are associated with riparian wetland habitats (KEC 4.1) and free standing water from any source (KEC 4.1.8) for at least part of their life cycle. Riparian wetland habitats provide refugia, water, food, and thermal cover for elk and mule deer. Elk and deer droppings fertilize riparian habitat, which improves soil nutrients for shrubs, trees, and herbaceous vegetation growth. Riparian vegetation shades the water column, which reduces water temperatures that impact fish populations, and provides habitat for terrestrial insects that both birds and fish depend upon.

Large ungulates also create trails through dense riparian vegetation and may alter structural conditions through feeding activities and seed dispersal. Elk, in particular, create free standing water areas (wallows) in both forested and unforested areas.

5.5 Focal Species Salmonid Relationships

The great blue heron is the only focal species that has a direct relationship with salmonids (Table_56). Salmonid relationship data for all Ecoregion wildlife species are listed in Table E-6.

Table 56. Ecoregion focal species salmonid relationships (NHI 2003).

Focal Species	Salmon Relationship	Salmon Stage
Great blue heron	Recurent relationship	Freshwater rearing - fry, fingerling, and parr
Great blue heron	Recurent relationship	Saltwater - smolts, immature adults, and adults

5.6 Other Wildlife Species

The NHI data suggest there are an estimated 400 wildlife species that occur within the Ecoregion (Table E-1). Of these, 16 species are non-native, and two sharp-tailed grouse and bighorn sheep (*Ovis canadensis*) have been reintroduced (Table_57). Ten wildilfe species that occur in the Ecoregion are listed federally and 118 species are listed in the states of Oregon, Idaho, or Washington as threatened, endangered, or a candidate species (Table E-2). A total of 153 bird species are listed as Washington State Partners in Flight priority and focal species (Table E-3). Seventy-three wildlife species are managed as game species in Oregon, Idaho, and Washington (Table E-4). Wildlife species used to conduct wildlife habitat loss assessments associated with the construction and inundation of federal hydroelectric projects on the Lower Snake and Columbia Rivers are included in Table E-5. Table E-6 includes wildlife species associated with salmonids.

Although there is wildlife species redundancy between subbasins, there are some differences as well. Table_58 illustrates species richness throughout the Ecoregion and includes associations with riparian/wetland habitats and/or with salmonids. Differences in species richness can partially be explained as variation in biological potential and quality of habitats, amount/type and juxtaposition of remaining habitats, and robustness of data bases used to establish the species lists.

Of the 400 wildlife species that occur in the Ecoregion, 96 percent (n = 385) occur within the Walla Walla subbasin, while 61 percent occur in the Asotin subbasin Table_58. Other distinctions can also be made. For example, 100 percent of the amphibians (n = 13) and reptiles (n = 16) that occur in the Ecoregion occur in the Palouse subbasin, which may illustrate the significance of microhabitats upon which these species depend. By contrast, the Tucannon and Asotin subbasins contain the lowest percentage of amphibians (61 percent) and reptiles (81 percent).

Wildlife species with close associations to riparian/wetland habitats range from 34 percent in the Asotin subbasin to 40 percent in the Lower Snake subbasin. This underscores the importance of riparian/wetland habitat throughout the Ecoregion. As in other areas within the greater Columbia Plateau, riparian/wetland habitats are used disproportionately by wildlife species relative to the amount of habitat availability.

Table 57. Non-native and reintroduced wildlife species in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Common Name	Oregon Occurrence	Oregon Breeding Status	Washington Occurrence	Washington Breeding Status	Idaho Occurrence	Idaho Breeding Status
Bullfrog	non-native	breeds	non-native	breeds	non-native	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
Sharp-tailed Grouse	reintroduced	breeds	occurs	breeds	occurs	breeds
Wild Turkey	non-native	breeds	non-native	breeds	non-native	breeds
Northern Bobwhite	non-native	breeds	non-native	breeds	non-native	breeds
Rock Dove	non-native	breeds	non-native	breeds	non-native	breeds
European Starling	non-native	breeds	non-native	breeds	non-native	breeds
House Sparrow	non-native	breeds	non-native	breeds	non-native	breeds
Virginia Opossum	non-native	breeds	non-native	breeds	non-native	breeds
Eastern Cottontail	non-native	breeds	non-native	breeds	does not occur	not applicable
Eastern Gray Squirrel	non-native	breeds	non-native	breeds	non-native	breeds
Eastern Fox Squirrel	non-native	breeds	non-native	breeds	non-native	breeds
Norway Rat	non-native	breeds	non-native	breeds	non-native	breeds
House Mouse	non-native	breeds	non-native	breeds	non-native	breeds
Nutria	non-native	breeds	non-native	breeds	non-native	breeds
Mountain Goat	reintroduced	breeds	occurs	breeds	occurs	breeds

6.0 Assessment Synthesis

Assessment information is synthesized in this section for each Ecoregion focal habitat. Historic and current extent of focal habitats and species, percent change, protection status, factors affecting habitats, data quality assessment, working hypothesis statement, management strategies, data, and monitoring and evaluation needs are summarized for focal habitat types. Data quality confidence rankings (similar to precision) and level of certainty qualifiers (analogous to accuracy) are described as follows:

- No confidence/no level of certainty: 0
- Poor confidence/little certainty: 1
- Marginal confidence/some certainty: 2
- Medium confidence/medium certainty: 3
- High confidence/high certainty: 4

Table 58. Species richness and associations for subbasins in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Class	Subbasin										Total (Ecoregion)
	Palouse	% of Total	Lower Snake	% of Total	Tucannon	%of Total	Asotin	% of Total	Walla Walla	% of Total	
Amphibians	13	100	12	92	8	61	8	61	10	77	**13**
Birds	236	84	224	79	183	65	161	57	280	99	**282**
Mammals	83	93	80	90	65	73	64	72	79	89	**89**
Reptiles	16	100	16	100	13	81	13	81	16	100	**16**
Total	**348**	**87**	**332**	**83**	**269**	**67**	**246**	**61**	**385**	**96**	**400**
Association											
Riparian Wetlands	83	100	80	96	65	78	63	76	81	98	**83**
Other Wetlands (Herbaceous and Montane Coniferous)	55	61	52	58	36	40	21	23	57	63	**90**
All Wetlands	138	80	132	76	101	58	84	49	138	80	**173**
Salmonids	79	84	75	80	57	61	48	51	86	91	**94**

ASSESSMENT SYNTHESIS
SOUTHEAST WASHINGTON ECOREGION

FOCAL HABITAT/SPECIES: Ponderosa pine, white-headed woodpecker, flammulated owl, elk

VEGETATION ZONES: Ponderosa pine

FOCAL HABITAT DESCRIPTION/CHANGE:

Ecoregion	Acres	Subbasin	% Change
Historic	211,758	Asotin	-57
Current	124,176	Palouse	-60
Difference	-87,582	Lower Snake	+106
% Change	-41%	Tucannon	-69
		Walla Walla	+115

PROTECTION STATUS:

Status: Ponderosa pine	SUBBASIN					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	19	0	771	0	544	**1,334**
Medium Protection	3,137	0	1,013	212	0	**4,362**
Low Protection	6,481	59	6,971	6,512	11,229	**31,252**
No Protection	38,674	956	1,185	8,332	38,130	**87,277**
TOTAL (Subbasin)	**48,311**	**1,015**	**9,940**	**15,056**	**49,903**	**124,225**

FACTORS AFFECTING FOCAL HABITATS AND SPECIES (from assessment):

1. Timber harvesting has reduced the amount of old growth forest and associated large diameter trees and snags.
2. Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
3. Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
4. Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
5. Invasion of exotic plants has altered understory conditions and increased fuel loads.
6. Fragmentation of remaining tracts has negatively impacted species with large area requirements.
7. Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.
8. The timing (spring/summer versus fall) of restoration/silviculture practices such mowing, thinning, and burning of understory removal may be especially detrimental to single-clutch species.
9. Spraying insects that are detrimental to forest health may have negative ramifications on lepidopterans and other non-target avian species.

DATA QUALITY/LEVEL OF CERTAINTY:

The basis for the assessment is primarily Washington GAP data, NHI data, and ECA data

1. Washington GAP data: quality: 2.5; certainty: 2
2. NHI data: quality: 3; certainty: 2.5
3. ECA data: quality: 3; certainty: 3
4. Focal species assemblage data (average); quality: 3; certainty: 2

PONDEROSA PINE WORKING HYPOTHESIS STATEMENT:

The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to timber harvesting, fire reduction/wildfires, mixed forest encroachment, development, recreational activities, reduction of habitat diversity and function resulting from invasion by exotic species and vegetation and overgrazing. The principal habitat diversity stressor is the spread and proliferation of mixed forest conifer species within ponderosa pine communities due primarily to fire reduction and intense wildfires. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in ponderosa pine habitat obligate wildlife species.

Recommended Range of Management Conditions:

Mature ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 percent and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags greater than 31 inches DBH).

Multiple canopy ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy ponderosa pine sites that are comprised of multiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two layered canopies, tree density of 508 trees/acre (9 foot spacing), basal area of 250 feet^2/acre (McCallum 1994b), and snags greater than 20 inches DBH 3-39 feet tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

Dense canopy closure: Rocky Mountain Elk were selected to characterize ponderosa pine habitat that is greater than 70 percent canopy closure and 40 feet in height.

MANAGEMENT STRATEGIES:

1. Protect extant habitat in good condition through easements and acquisitions; protect poor quality habitat and/or lands with habitat potential adjacent to existing protected lands (avoid isolated parcels/wildlife population sinks.
2. Coordinate with public and private land managers on the use of controlled fire regimens and stand management practices.
3. Restore forest functionality by providing key environmental correlates through prescribed burns and silviculture practices.
4. Fund and coordinate weed control efforts on both public and private lands.
5. Identify and protect wildlife habitat corridors/links.

DATA GAPS AND M&E NEEDS:

1. Habitat quality data e.g., ground truth IBIS data. Assessment data bases do not address habitat quality.
2. Finer resoluction GIS habitat type maps that include structural component and KEC data.
3. GIS soils products
4. Significant lack of local population/distribution data for white-headed woodpeckers and flammulated owls.
5. Current ponderosa pine structural condition/habitat variable data.

ASSESSMENT SYNTHESIS
SOUTHEAST WASHINGTON ECOREGION

FOCAL HABITAT/SPECIES: Shrubsteppe, sage sparrow, Brewer's sparrow, sage thrasher, mule deer

VEGETATION ZONES: Three-tipped Sage, Central Arid, and Big Sage/Fescue

FOCAL HABITAT DESCRIPTION/CHANGE:

Ecoregion	Acres	Subbasin	% Change
Historic	410,180	Asotin	0
Current	195,062	Palouse	-57
Difference	-215,118	Lower Snake	-80
% Change	-52%	Tucannon	0
		Walla Walla	+338

PROTECTION STATUS:

Status: Shrubsteppe	SUBBASIN					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	0	0	0	0	**0**
Medium Protection	0	198	0	0	0	**198**
Low Protection	13,681	930	0	0	1,555	**16,166**
No Protection	145,630	5,381	0	0	27,691	**178702**
TOTAL (Subbasin)	**159,311**	**6,509**	**0**	**0**	**29,246**	**195,066**

FACTORS AFECTING FOCAL HABITATS AND SPECIES (from assessment):

1. Extensive permanent habitat conversions of shrubsteppe habitats resulting in fragmentation of remaining tracts.
2. Degradation of habitat from intensive grazing and invasion of exotic plant species.
3. Fire management, either suppression or over-use, and wildfires.
4. Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.
5. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
6. Conversion of CRP lands back to cropland.
7. Loss of big sagebrush communities to brush control.
8. Human disturbance during breeding/nesting season, parasitism.

DATA QUALITY/LEVEL OF CERTAINTY:

Basis for assessment is primarily Washington GAP data, NHI data, and ECA data

1. Washington Gap Data: quality-3.5; certainty-3
2. NHI Data: quality-3; certainty-3 (after corrections)
3. ECA data: quality-2.5; certainty-3
4. Focal species assemblage data (average): quality-3, certainty-3

SHRUBSTEPPE WORKING HYPOTHESIS STATEMENT:

The near term or major factors affecting this focal habitat type are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and livestock grazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and yellow-star thistle that either supplant and/or radically alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of extant vegetation have resulted in extirpation and or significant reductions in grassland obligate wildlife species.

Recommended Range of Management Conditions:

Sagebrush dominated shrubsteppe: The sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat. Suitable habitat includes 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover (Vander Haegen et al. 2000). Similarly, Brewer's sparrow was selected to represent wildlife species that require sagebrush dominated sites, but prefer a patchy distribution of sagebrush clumps 10-30 percent cover, lower sagebrush height (between 20 and 28 inches), native grass cover 10 to 20 percent (Dobler 1994), non-native herbaceous cover less than 10 percent, and bare ground greater than 20 percent (Altman and Holmes 2000).

Diverse shrubsteppe: Mule deer were selected to represent species that require/prefer diverse, dense (30 to 60 percent shrub cover less than 5 feet tall) shrubsteppe habitats comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld et al. 1973; Sheehy 1975; Jackson 1990; Ashley et al. 1999) with a palatable herbaceous understory exceeding 30 percent cover.

MANAGEMENT STRATEGIES:

1. Protect extant habitat in good condition through easements and acquisitions; protect poor quality habitat and/or lands with habitat potential adjacent to existing protected lands (avoid isolated parcels/wildlife population sinks.
2. Fund and coordinate weed control efforts on both public and private lands.
3. Restore shrubland functionality by providing vegetation structural elements through reestablishment of native plant communities where practical and cost effective.
4. Identify and protect wildlife habitat corridors/links.

DATA GAPS AND M&E NEEDS:

1. Habitat quality data. Assessment data bases do not address habitat quality.
2. Refined habitat type maps including current CRP program/field delineations
3. GIS soils products including wetland delineations.
4. Shrubsteppe obligate species data. Significant lack of local population/distribution data for sparrows and sage thrasher.

FOCAL HABITAT/SPECIES: Eastside (Interior) Grasslands, sharp-tailed grouse, grasshopper sparrow	**VEGETATION ZONES:** Palouse steppe, Blue Mountain steppe, canyon grassland steppe, wheatgrass/fescue steppe

FOCAL HABITAT DESCRIPTION/CHANGE:

Ecoregion	Acres	Subbasin	%Change
Historic	3,850,463	Asotin	-27
Current	1,176,516	Palouse	-77
Difference	-2,673,947	Lower Snake	-56
% change	-69%	Tucannon	-40
		Walla Walla	-84

PROTECTION STATUS:

Status: Eastside (Interior) Grassland	SUBBASIN					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	7,379	1,005	0	1,478	**9,862**
Medium Protection	7,057	7,910	6,617	4,464	0	**26,048**
Low Protection	42,150	34,148	17,692	35,195	16,457	**145,642**
No Protection	307,430	366,767	88,970	95,170	136,674	**995,011**
TOTAL (Subbasin)	**356,637**	**416,204**	**114,284**	**134,829**	**154,609**	**1,176,563**

FACTORS AFFECTING FOCAL HABITATS AND LIMITING FOCAL SPECIES (FROM ASSESSMENT):

1. Extensive permanent habitat conversions of grassland habitats resulting in fragmentation of remaining tracts.
2. Degradation of habitat from intensive grazing and invasion of exotic plant species.
3. Fire management, either suppression or over-use, and wildfires.
4. Invasion and seeding of crested wheatgrass and other introduced plant species which reduces wildlife habitat quality and/or availability.
5. Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities.
6. Conversion of CRP lands back to cropland.
7. Human disturbance during breeding/nesting season.

DATA QUALITY/LEVEL OF CERTAINTY:

Basis for assessment is primarily Washington GAP data, NHI data, and ECA data

1. Washington Gap Data: quality-3; certainty-3.5
2. NHI Data: quality-3; certainty-3 (after corrections)
3. ECA data: quality-3; certainty-3
4. Focal species assemblage data (average): quality-3, certainty-2

EASTSIDE (INTERIOR) GRASSLANDS WORKING HYPOTHESIS STATEMENT:

The proximate or major factors affecting this focal habitat type are direct loss of habitat due primarily to conversion to agriculture, reduction of habitat diversity and function resulting from invasion of exotic vegetation and wildfires, and overgrazing. The principal habitat diversity stressor is the spread and proliferation of annual grasses and noxious weeds such as cheatgrass and yellow-star thistle that either supplant and/or radically alter entire native bunchgrass communities significantly reducing wildlife habitat quality. Habitat loss and fragmentation (including fragmentation resulting from extensive areas of undesirable vegetation) coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in grassland obligate wildlife species.

Recommended Range of Management Conditions:

Grasshopper sparrow and sharp-tailed grouse were selected to represent interior grassland wildlife species. The range of conditions recommended for interior grassland habitat includes:

1. Native bunchgrasses greater than 40 percent cover
2. Native forbs 10 to 30 percent cover
3. Herbaceous vegetation height greater than10 inches
4. Visual obstruction readings (VOR) at least 6 inches
5. Native non-deciduous shrubs less than 10 percent cover
6. Exotic vegetation/noxious weeds less than 10 percent cover

MANAGEMENT STRATEGIES:

1. Protect extant habitat in good condition through easements and acquisitions; protect poor quality habitat and/or lands with habitat potential adjacent to existing protected lands (avoid isolated parcels/wildlife population sinks.
2. Fund and coordinate weed control efforts on both public and private lands.
3. Restore grassland functionality by providing vegetation structural elements through reestablishment of native plant communities where practical and cost effective.
4. Identify and protect wildlife habitat corridors/links.
5. Restore viable populations of grassland obligate wildlife species where possible.

DATA GAPS AND M&E NEEDS:

1. Habitat quality data. Assessment data bases do not address habitat quality
2. Refined habitat type maps including current CRP program/field delineations
3. GIS soils products including wetland delineations
4. Grassland obligate species data. Significant lack of local population/distribution data for grasshopper sparrows.

ASSESSMENT SYNTHESIS
SOUTHEAST WASHINGTON ECOREGION

FOCAL HABITAT/SPECIES: Eastside (Interior) Riparian/Riverine Wetlands; yellow warbler, beaver, great blue heron

VEGETATION ZONES: Riparian

FOCAL HABITAT DESCRIPTION/CHANGE:

Ecoregion	Acres	Subbasin	%Change
Historic	90,033	Asotin	-73
Current	32,518	Palouse	-77
Difference	-57,515	Lower Snake	-85
% Change	-64%	Tucannon	-43
		Walla Walla	-32

PROTECTION STATUS:

Status: Eastside (Interior) Riparian Wetlands	Subbasin					TOTAL (Ecoregion)
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	
High Protection	0	0	0	0	0	**0**
Medium Protection	18	2	707	210	0	**937**
Low Protection	232	151	179	534	421	**1,517**
No Protection	7,672	3,025	3,629	950	14,799	**30,075**
Water	0	0	0	0	0	**0**
TOTAL (Subbasin	**7,922**	**3,178**	**4,515**	**1,694**	**15,220**	**32,529**

FACTORS AFFECTING FOCAL HABITATS AND LIMITING FOCAL SPECIES (FROM ASSESSMENT):

1. Loss of habitat due to numerous factors including riverine recreational developments, innundation from impoundments, cutting and spraying of riparian vegetation for eased access to water courses, gravel mining, etc.
2. Habitat alteration from 1) hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduced stream flows and reduction of overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and 2) stream bank stabilization which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation.
3. Habitat degradation from livestock overgrazing which can widen channels, raise water temperatures, reduce understory cover, etc.
4. Habitat degradation from conversion of native riparian shrub and herbaceous vegetation to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, indigo bush, and Russian olive.
5. Fragmentation and loss of large tracts necessary for area-sensitive species such as yellow-billed cuckoo.
6. Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.
7. High energetic costs associated with high rates of competitive interactions with European starlings for cavities may reduce reproductive success of cavity-nesting species such as Lewis' woodpecker, downy woodpecker, and tree swallow, even when outcome of the competition is successful for these species.
8. Recreational disturbances (e.g., ORVs), particularly during nesting season, and particularly in high-use recreation areas.

DATA QUALITY/LEVEL OF CERTAINTY:

Basis for assessment is primarily Washington GAP data, IBIS data, and ECA data

1. Washington Gap Data: quality-N/A; certainty-N/A
2. IBIS Data: quality-1; certainty-0
3. ECA data: quality-3; certainty-3
4. Focal species assemblage data (average): quality-3, certainty-2

RIPARIAN WETLANDS WORKING HYPOTHESIS STATEMENT:

The proximate or major factors affecting this focal habitat type are direct loss of habitat due primarily to urban/agricultural development, reduction of habitat diversity and function resulting from exotic vegetation, livestock overgrazing, fragmentation and recreational activities. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. This coupled with poor habitat quality of existing vegetation have resulted in extirpation and or significant reductions in riparian habitat obligate wildlife species.

Recommended Range of Management Conditions:

The yellow warbler, beaver, and great blue heron represent wildlife species associated with riverine habitats. Ecoregion wildlife/habitat managers recommend the following ranges of conditions for the specific riparian/riverine habitat attributes described below.

1. Forty to 60 percent tree canopy closure (cottonwood and other hardwood species)
2. Multi-structure/age tree canopy (includes trees less than 6 inches in diameter and mature/decadent trees)
3. Woody vegetation within 328 feet of shoreline
4. Tree groves greater than 1 acre within 800 feet of water (where applicable)
5. Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs)
6. Multi-structured shrub canopy greater than 3 feet in height

MANAGEMENT STRATEGIES:

1. Protect extant habitat in good condition through easements and acquisitions; protect poor quality habitat and/or lands with habitat potential adjacent to existing protected lands (avoid isolated parcels/wildlife population sinks.
2. Work with Conservation Districts, NRCS, Forest Service, landowners, et al., to implement best management practices (BMPs) in riparian areas in conjunction with CRP, CREP, WHIP programs, road abandonments, etc.
3. Restore riparian area functionality with enhancements, livestock exclusions, in-stream structures and bank modifications if necessary (includes removal of structures), and stream channel restoration activities.
4. Fund and coordinate weed control efforts on both public and private lands.
5. Identify and protect wildlife habitat corridors/links.

DATA GAPS AND M&E NEEDS:

1. Updated/fine resolution historic riparian wetland data and GIS products e.g., structural conditions and KEC ground-truthed maps.
2. Habitat quality data. Assessment data bases do not address habitat quality.
3. Refined habitat type maps including current CREP, WHIP program/field delineations.
4. GIS soils products including wetland delineations.
5. Significant lack of local population/distribution data for yellow warbler, and beaver.

The Ecoregion assessment and inventory synthesis cycle is illustrated in Figure_71. Movement through the cycle is summarized below:

1. Document and compare historic and current conditions of focal habitats to determine the extent of change.
2. Review habitat needs of focal wildlife species assemblages to assist in characterizing the "range" of recommended future conditions for focal habitats. Combine species assemblages' habitat needs with desired ecological/habitat objectives to determine recommended future habitat conditions.
3. Determine the factors that affect habitat conditions and species assemblages (limiting factors) and compare to current and recommended future habitat conditions to establish needed future action/direction.
4. Develop objectives to address habitat "needs" and "road blocks" to obtaining biological/habitat goals.
5. Develop strategies to support objectives and compare to existing projects, programs, and regulatory statutes (Inventory) to determine the level at which existing inventory activities address, or contribute towards amelioration of factors that affect habitat conditions and species assemblages.
6. Develop a management plan to address Ecoregion/subbasin needs, factors affecting habitats, and wildlife limiting factors.

Post subbasin planning algorithms are described in 7 through 9 below.

7. Projects are approved, based on management plan objectives and strategies and implemented.
8. Habitat and species response to habitat changes are monitored at the project level and compared to anticipated results.
9. Adaptive management principles are applied as needed, which leads back to the "new" current conditions restarting the cycle.

Strategies, goals, and objectives should be developed at both the Ecoregion and subbasin level; however, this does not preclude the possibility that strategies, goals, and objectives are identical at both levels. Ecoregion and subbasin planners will exercise a "best fit" strategy to determine what subbasin(s) is/are best suited to address a specific need. Similarly, individual subbasins may have strategies, goals, and objectives that compliment and/or are different from Ecoregion needs. In the latter case, differentiated subbasin strategies, goals, and objectives will be addressed at the subbasin level and related back to Ecoregion needs.

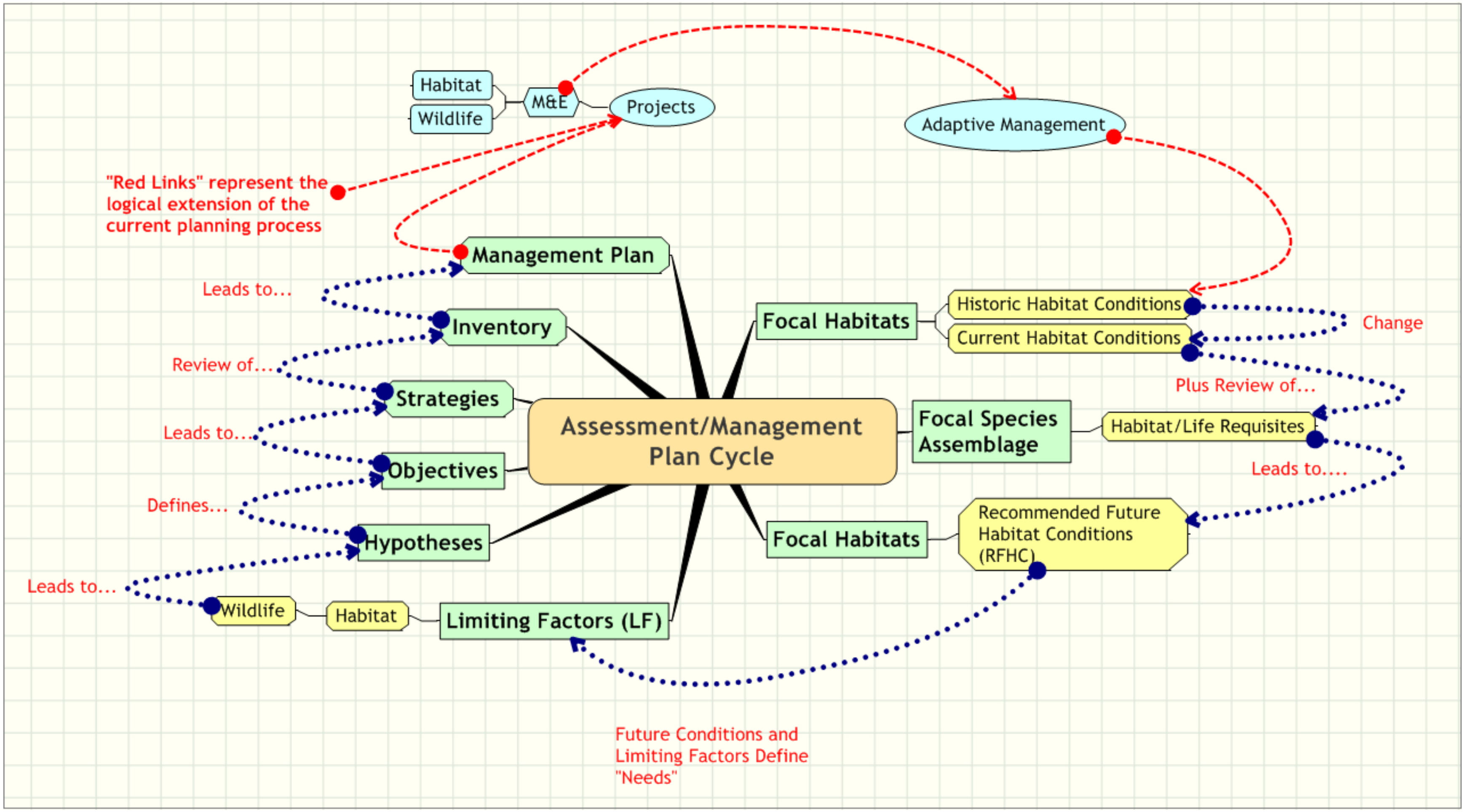

Figure 71. Ecoregion wildlife assessment and inventory synthesis/cycle.

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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].

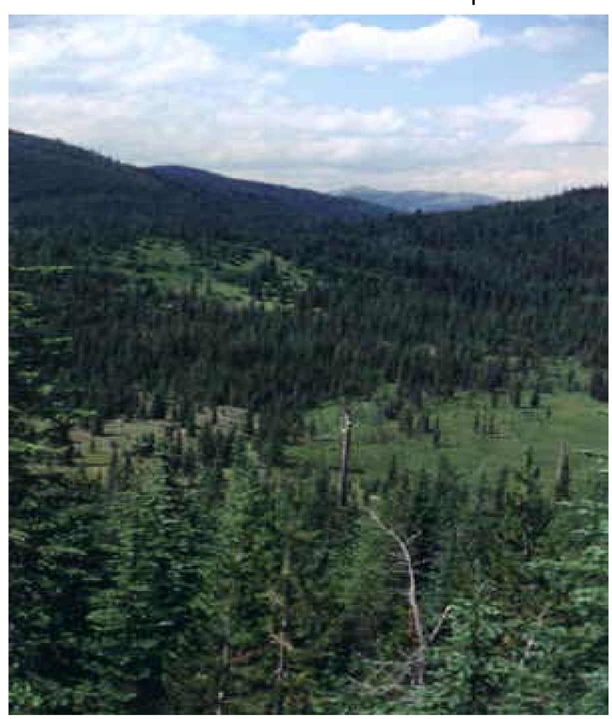
Montane Mixed Conifer Forest

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 ³10,000 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.

Effects 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.

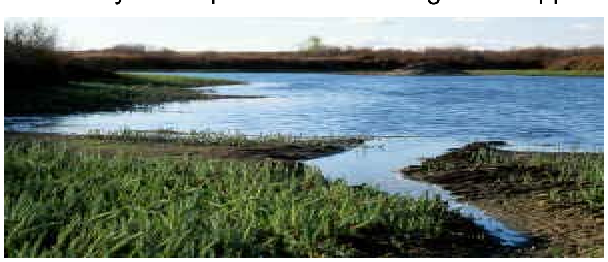
Open Water - Lakes, Rivers, and Streams
Eva L. Greda, David H. Johnson, and Tom O'Neil

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

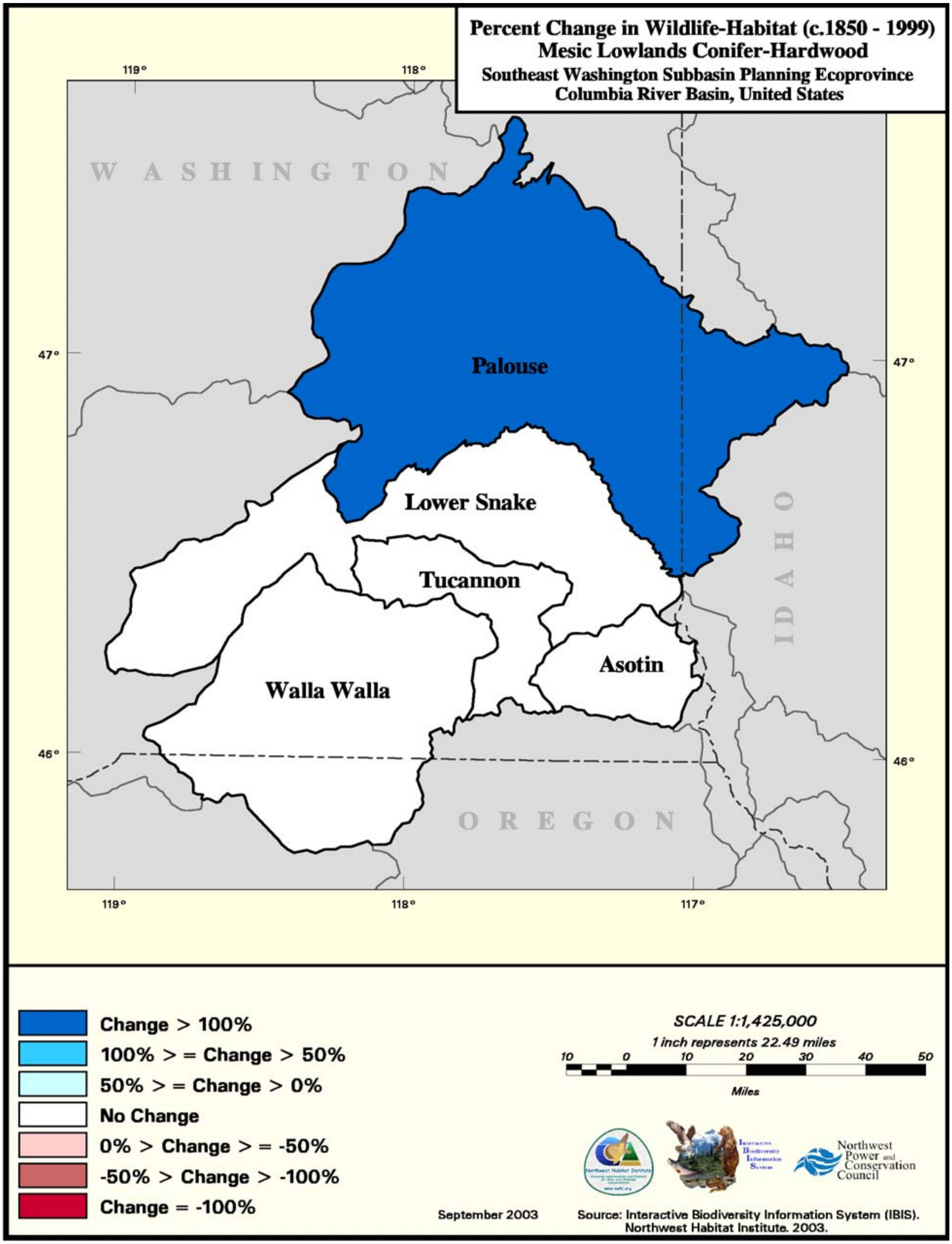

Figure C-1. Percent change in Mesic Lowlands Conifer-Hardwood Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

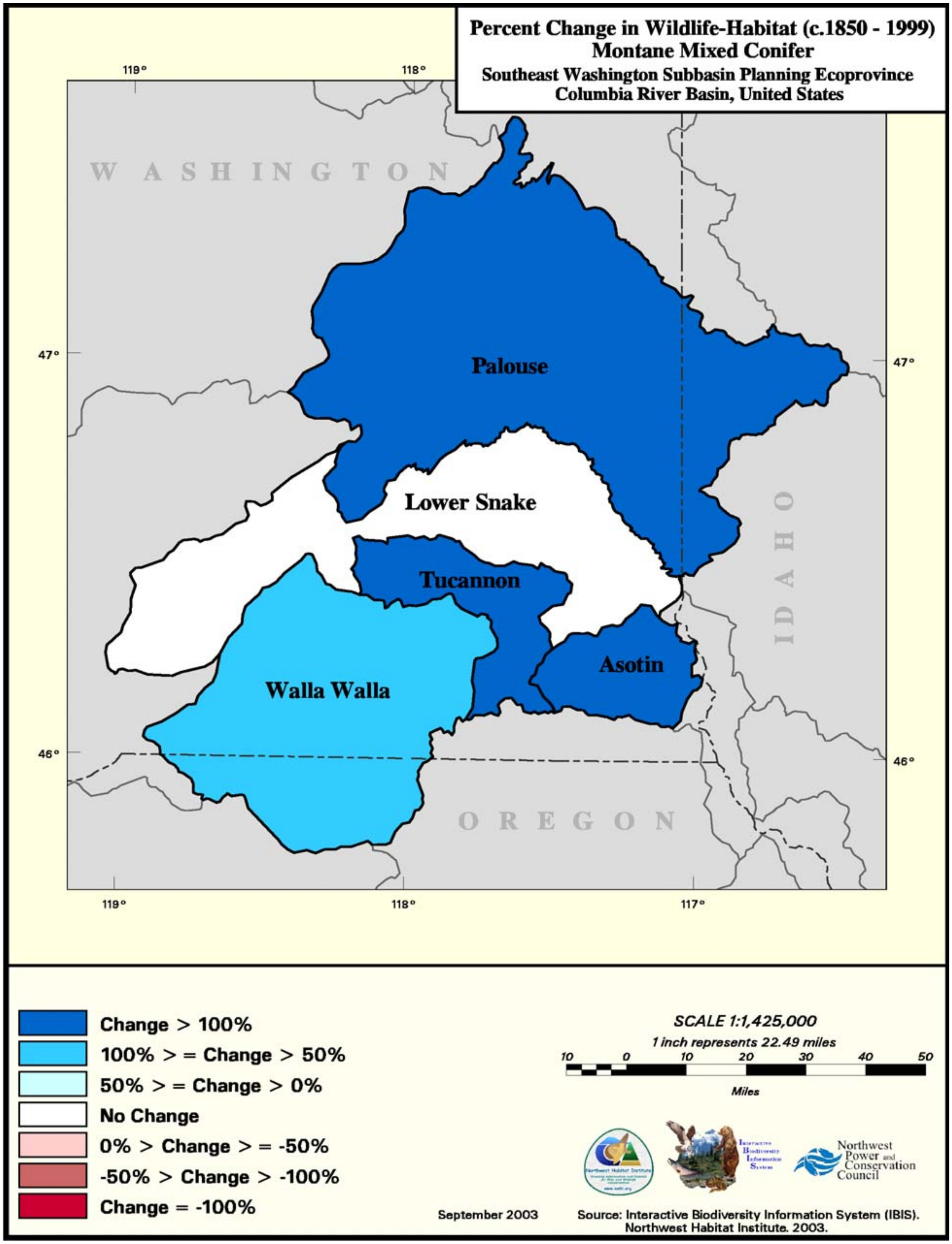

Figure C-2. Percent change in Montane Mixed Conifer Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

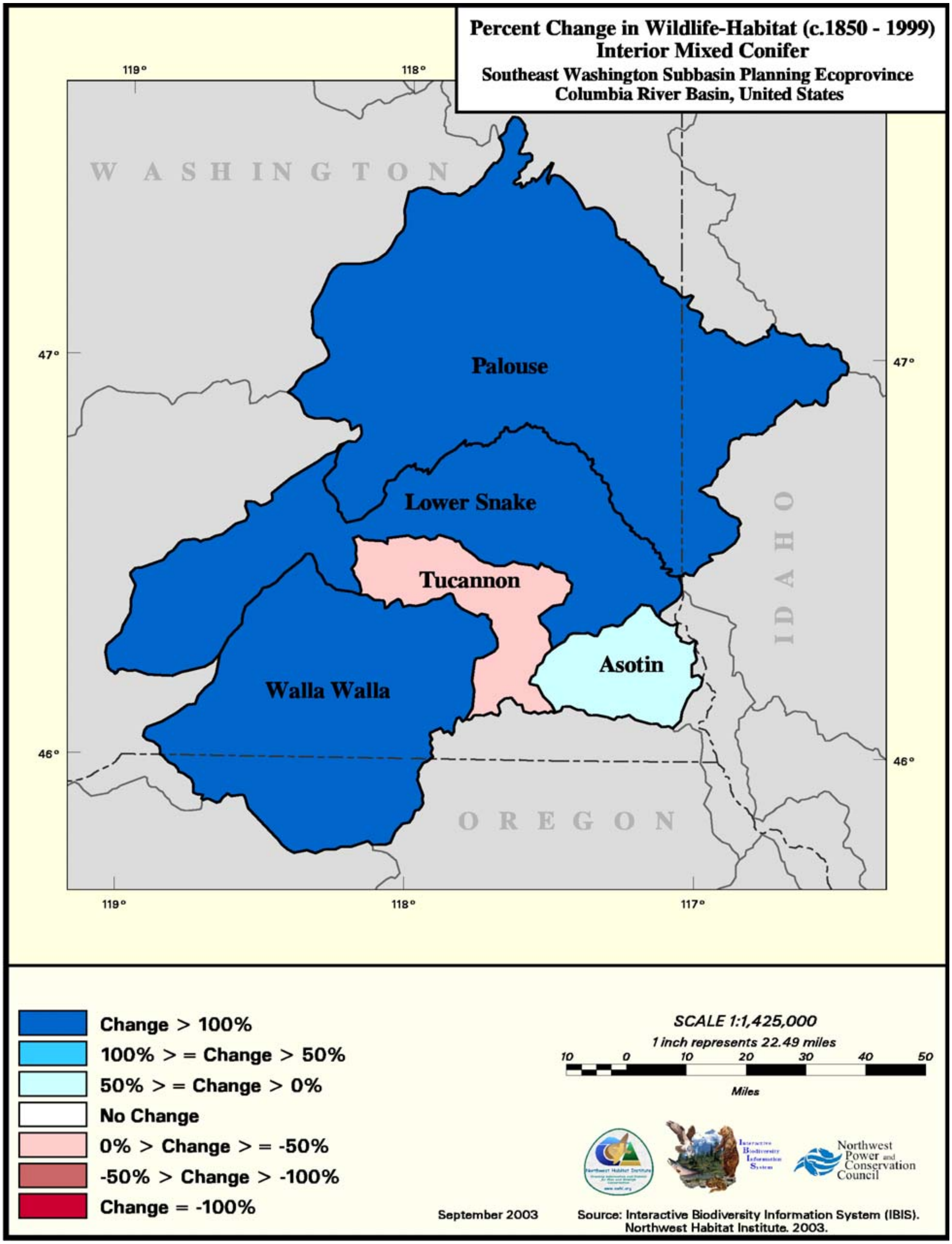

Figure C-3. Percent change in Interior Mixed Conifer Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

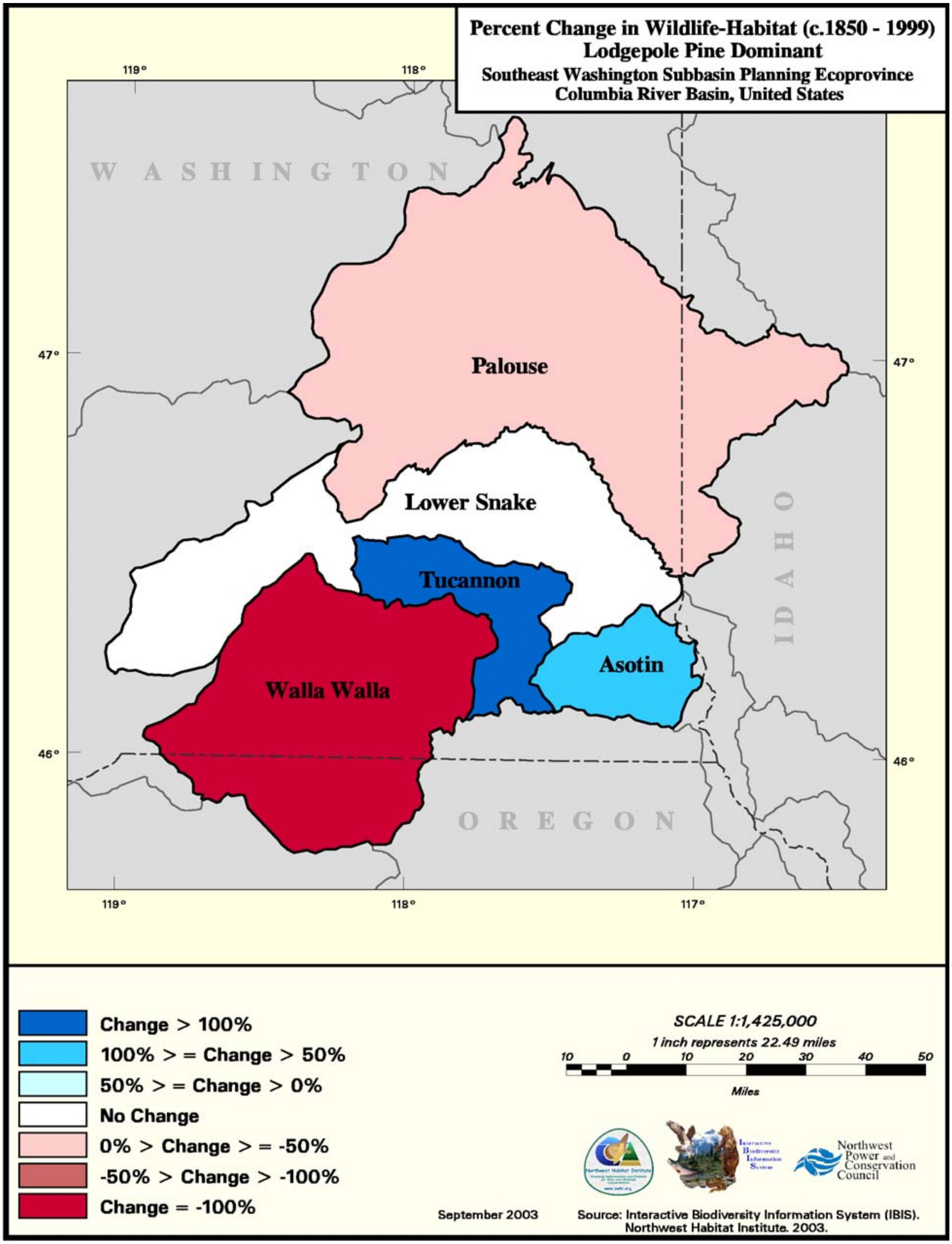

Figure C-4. Percent change in Lodgepole Pine Dominant Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

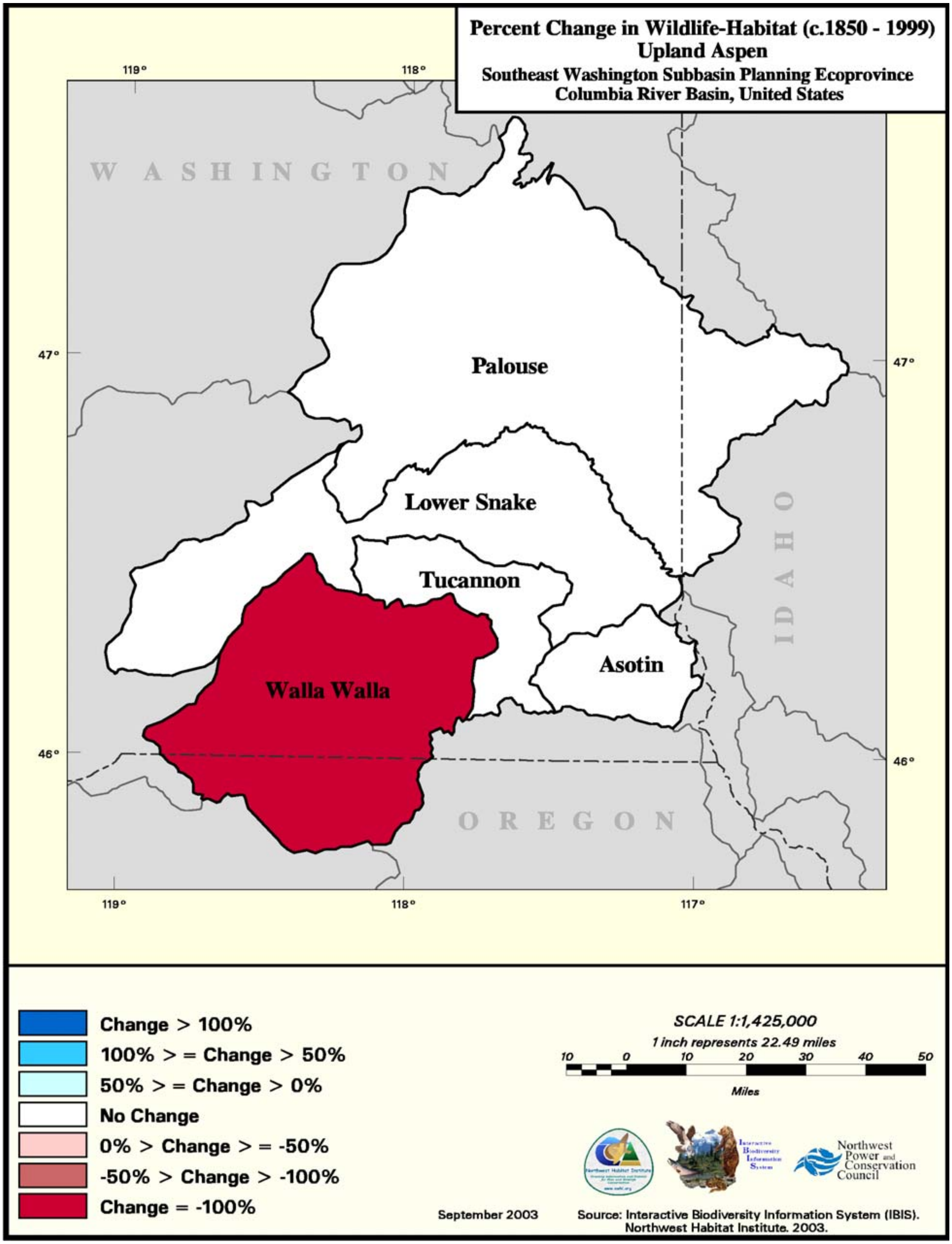

Figure C-5. Percent change in Upland Aspen Forest in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

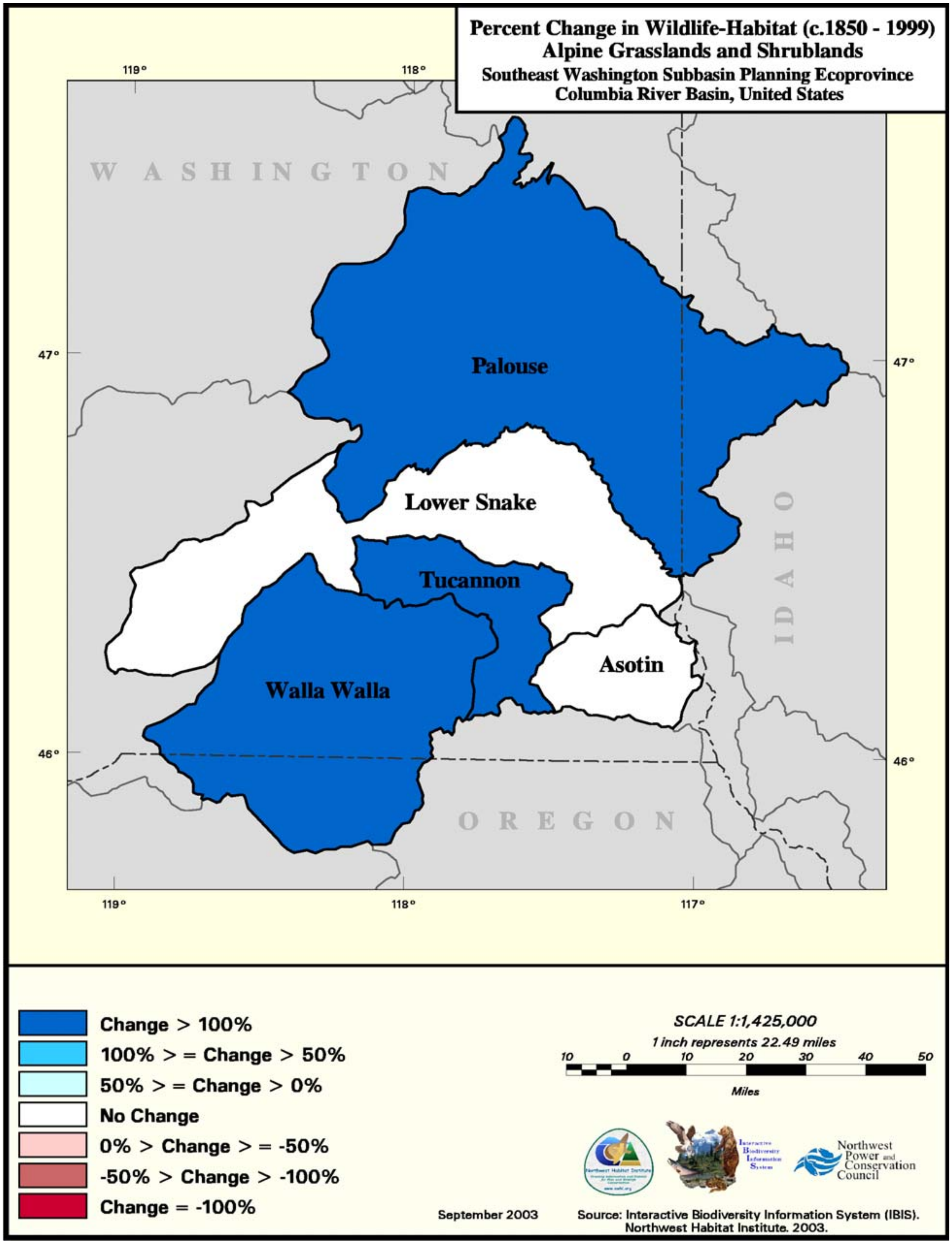

Figure C-6. Percent change in Alpine Grasslands and Shrublands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

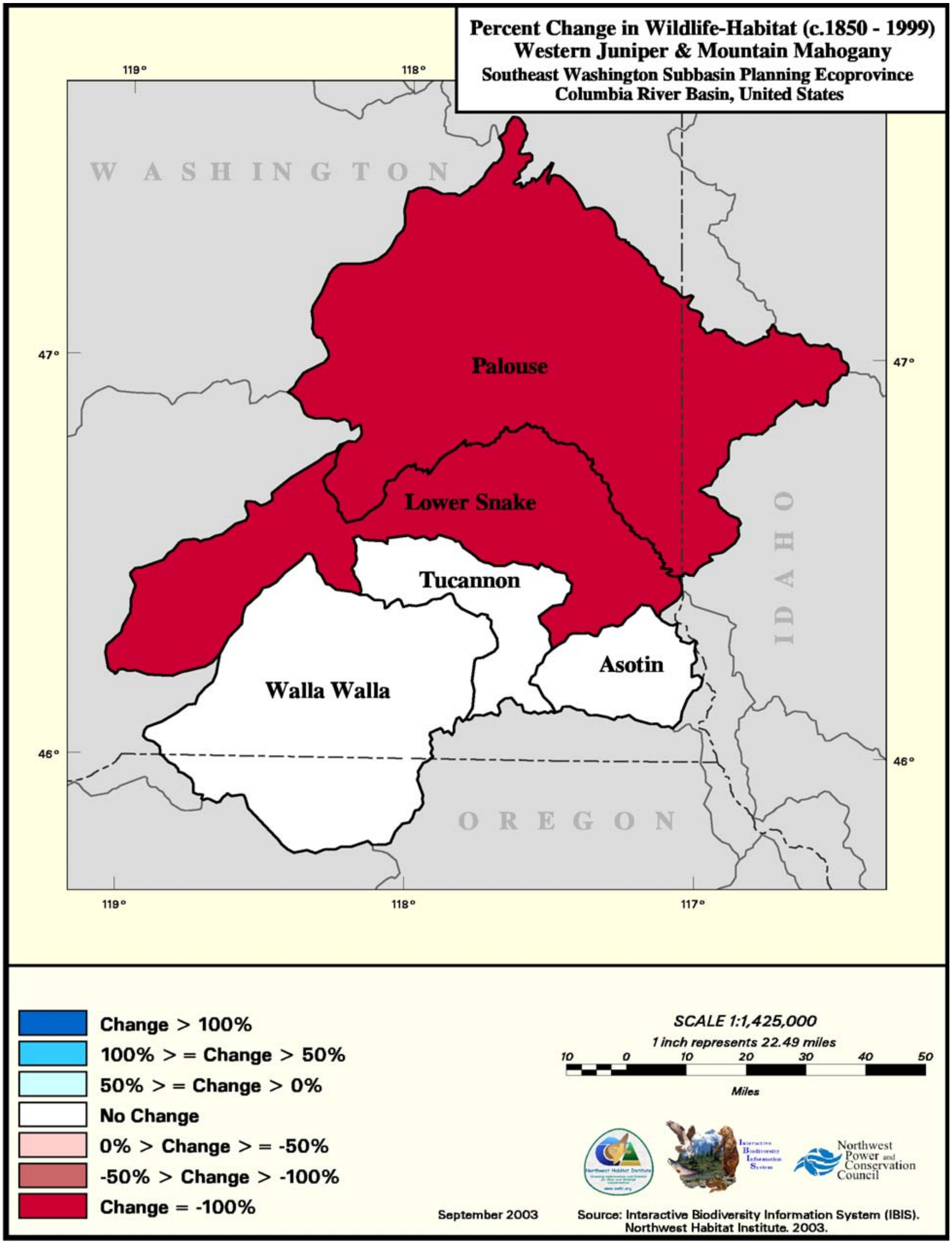

Figure C-7. Percent change in Western Juniper and Mountain Mohogany in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

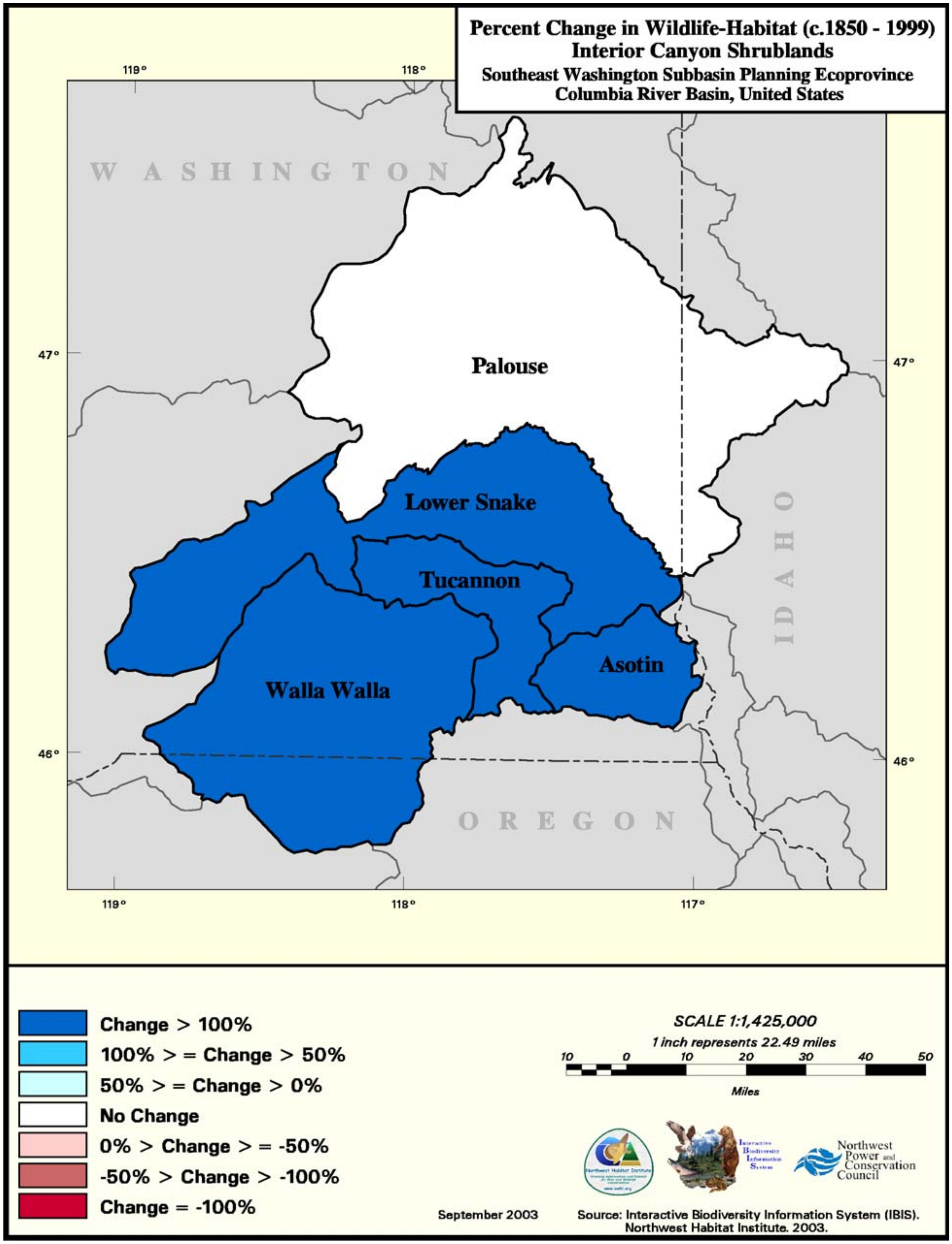

Figure C-8. Percent change in Interior Canyon Shrublands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

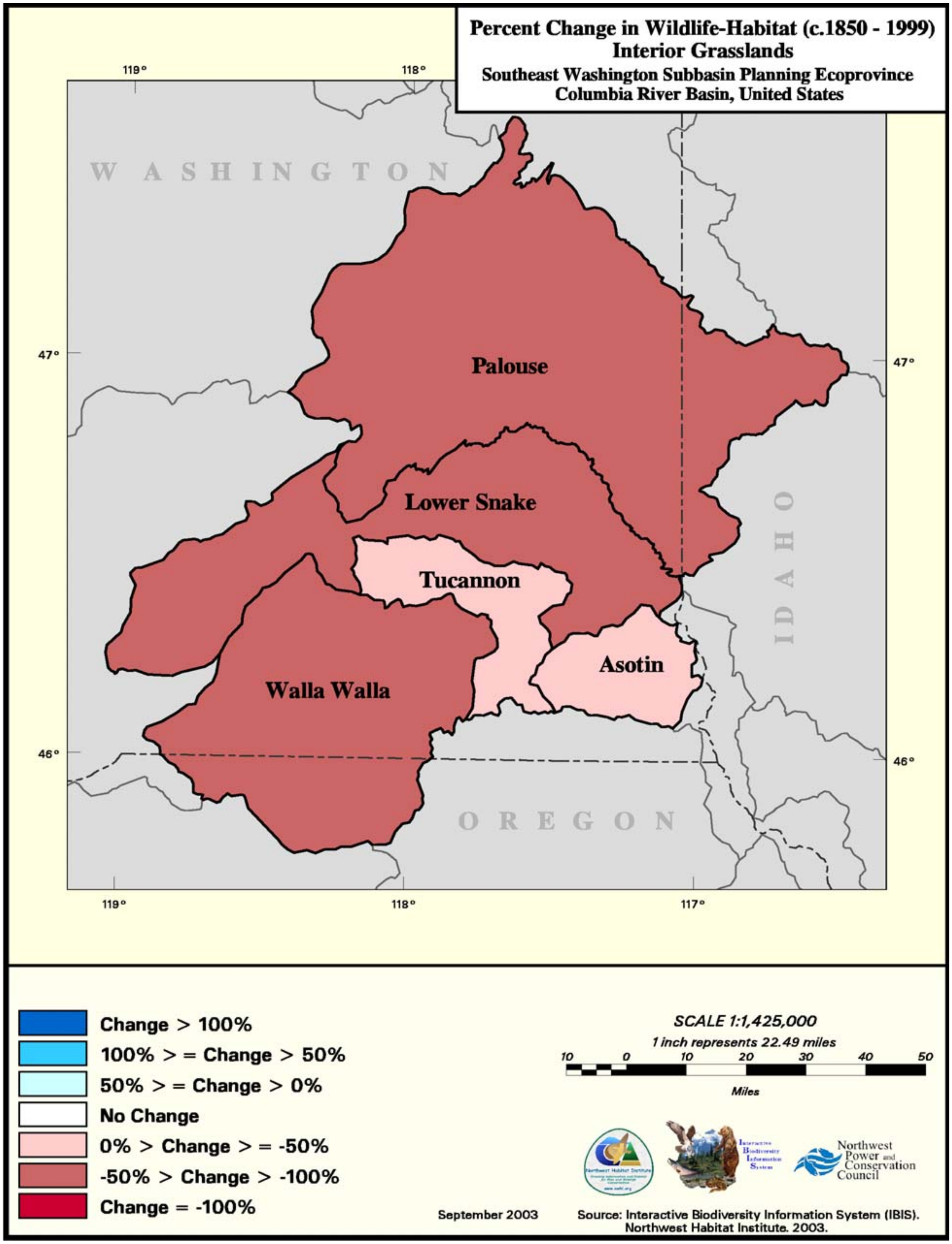

Figure C-9. Percent change in Interior Grasslands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

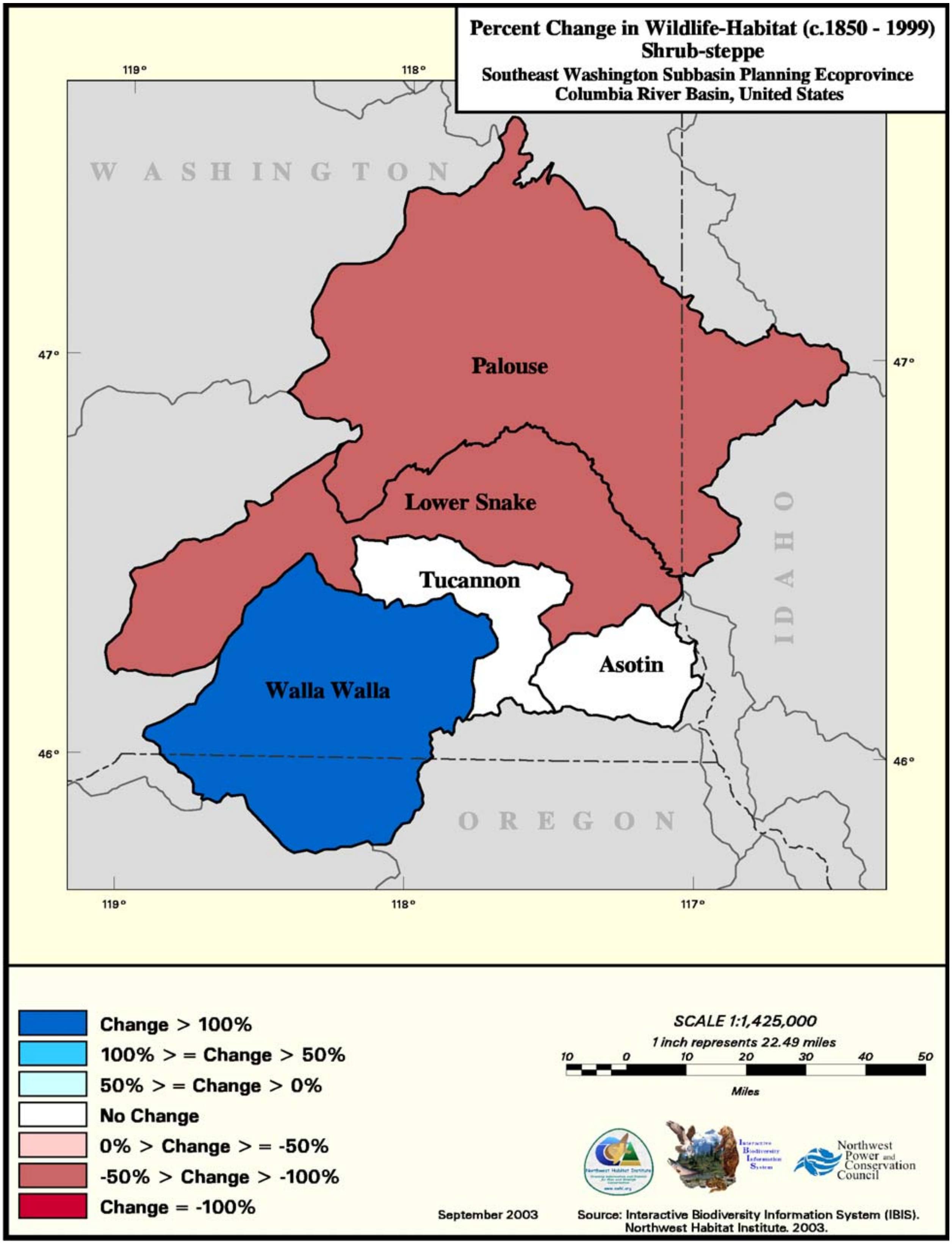

Figure C-10. Percent change in Shrubsteppe in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

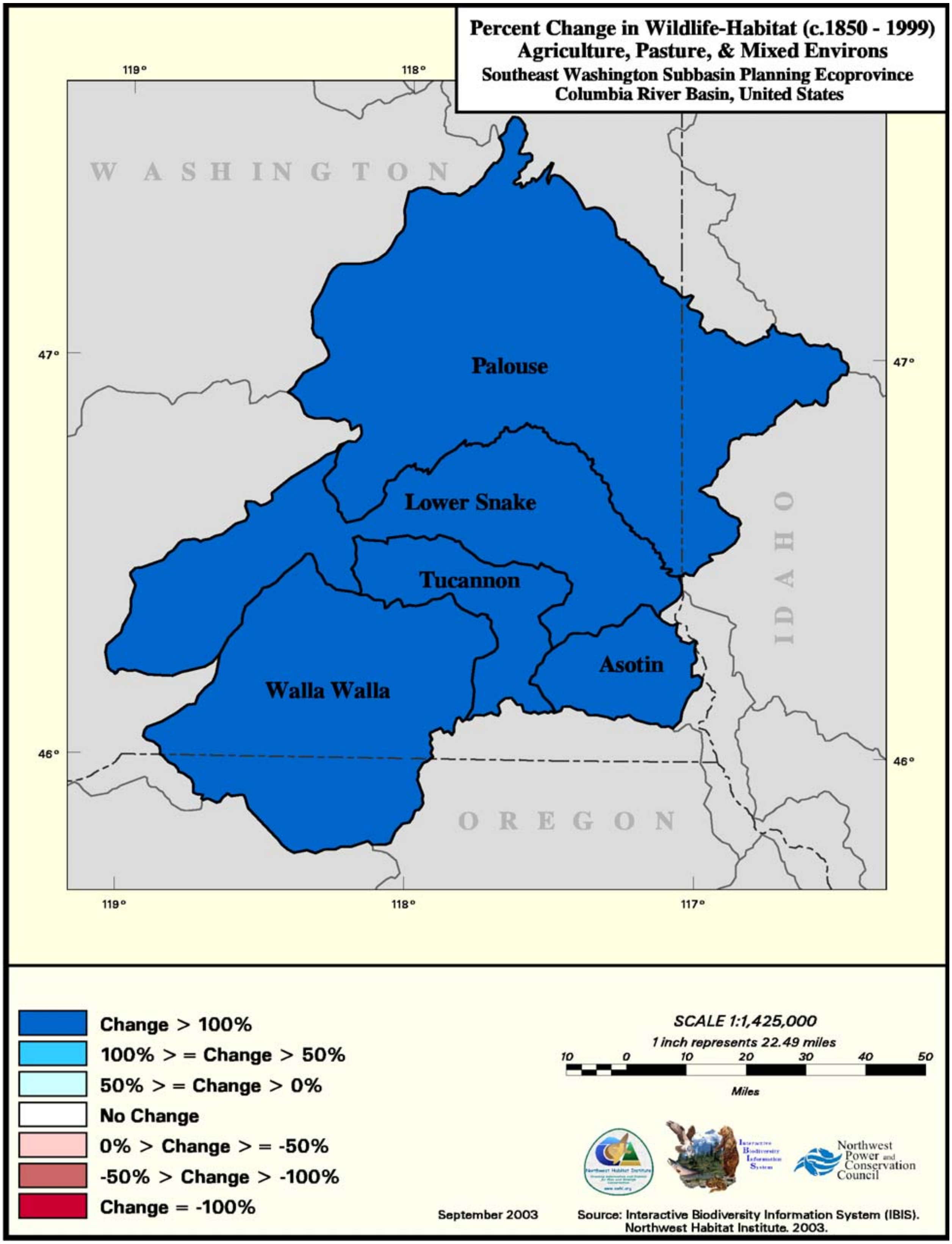

Figure C-11. Percent change in Agriculture, Pasture, and Mixed Environs in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

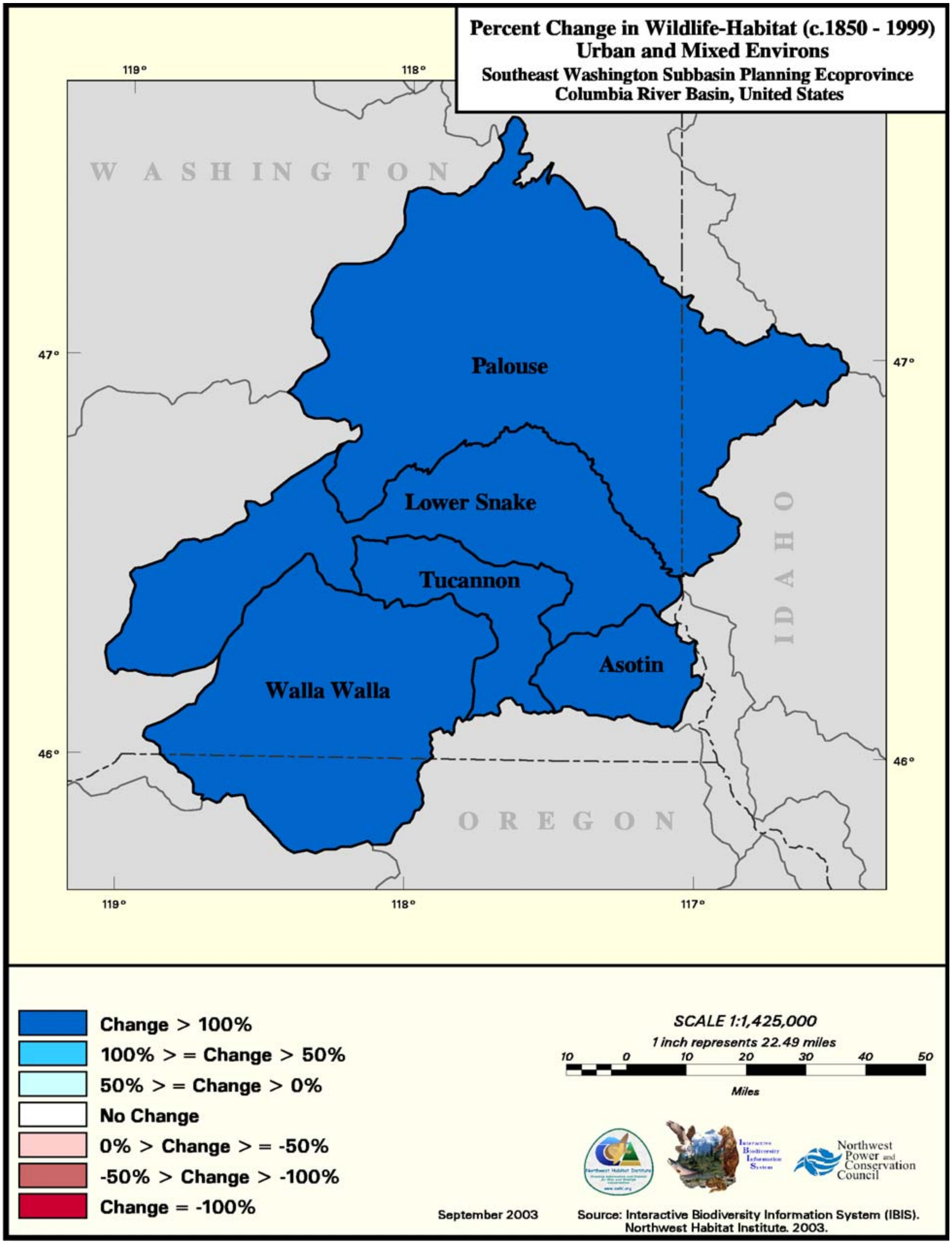

Figure C-12. Percent change in Urban and Mixed Environs in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

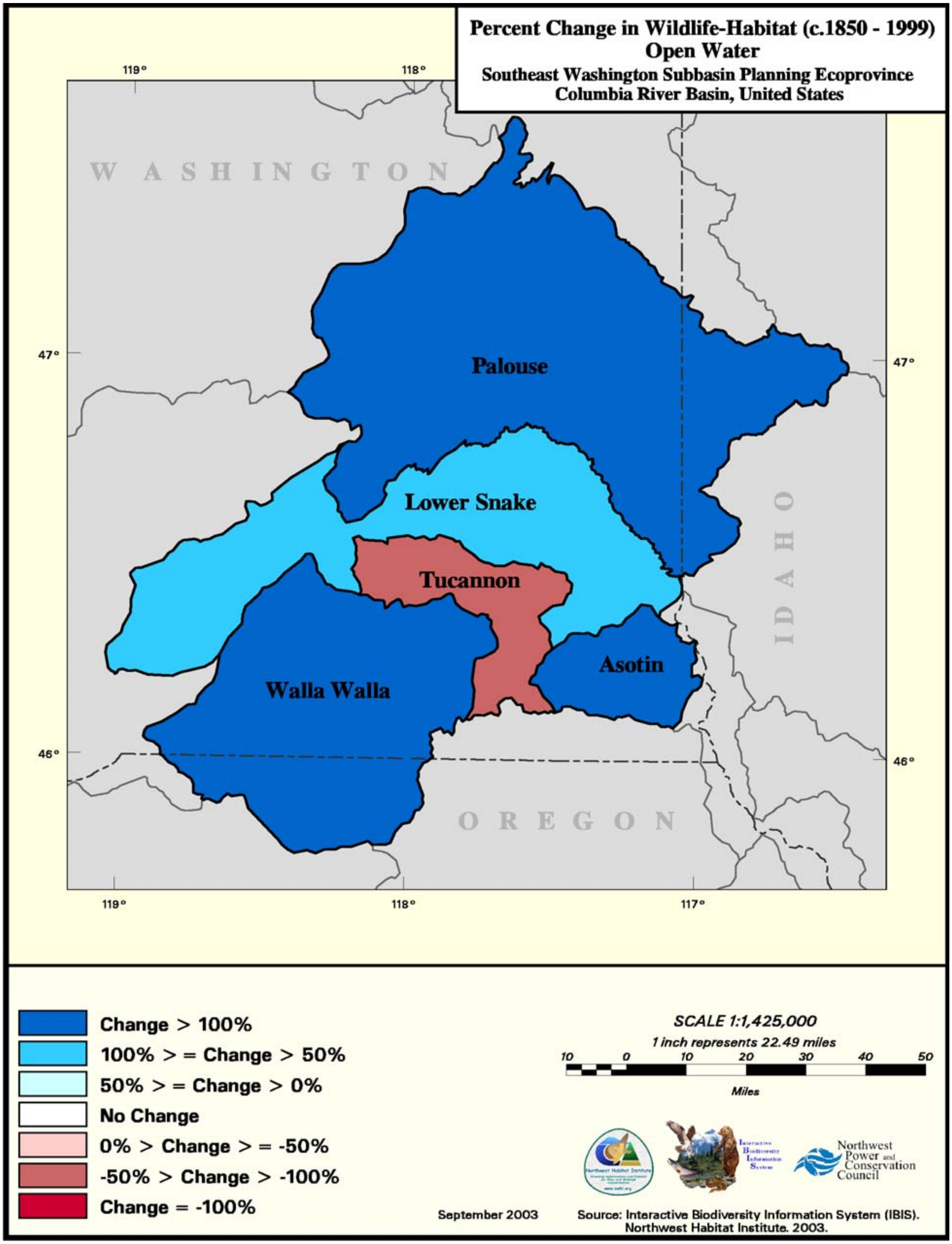

Figure C-13. Percent change in Open Water in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

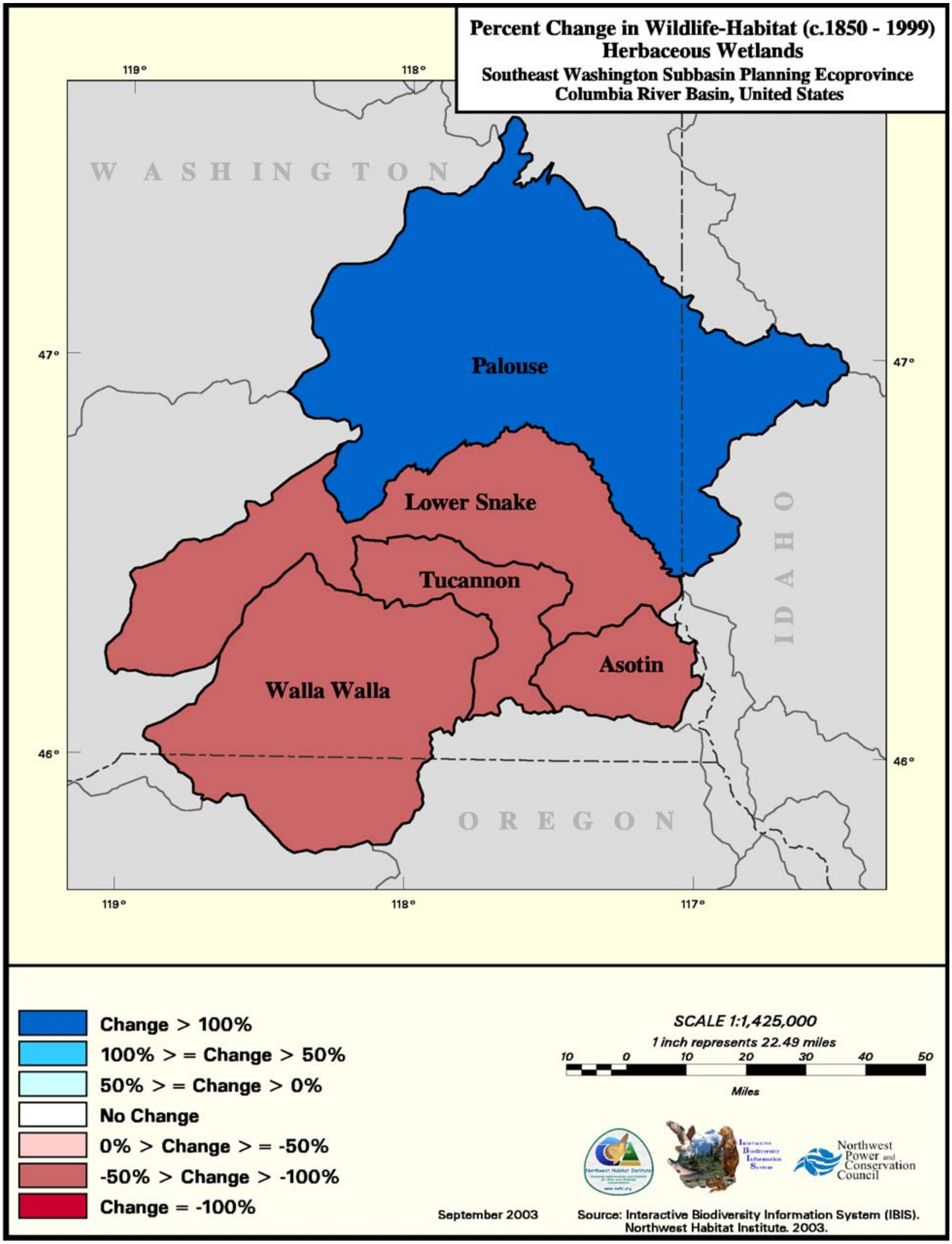

Figure C-14. Percent change in Herbaceous Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

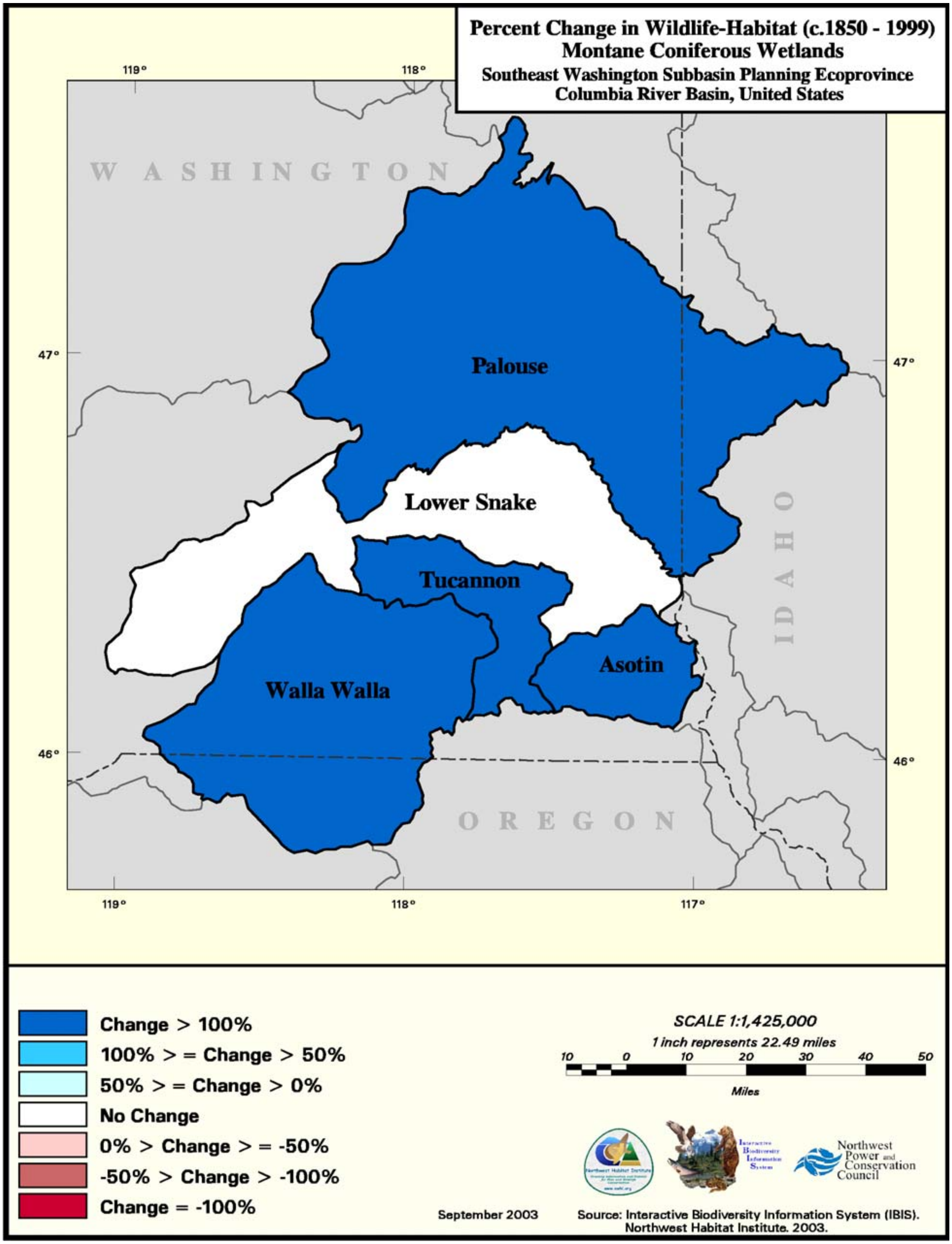

Figure C-15. Percent change in Montane Coniferous Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

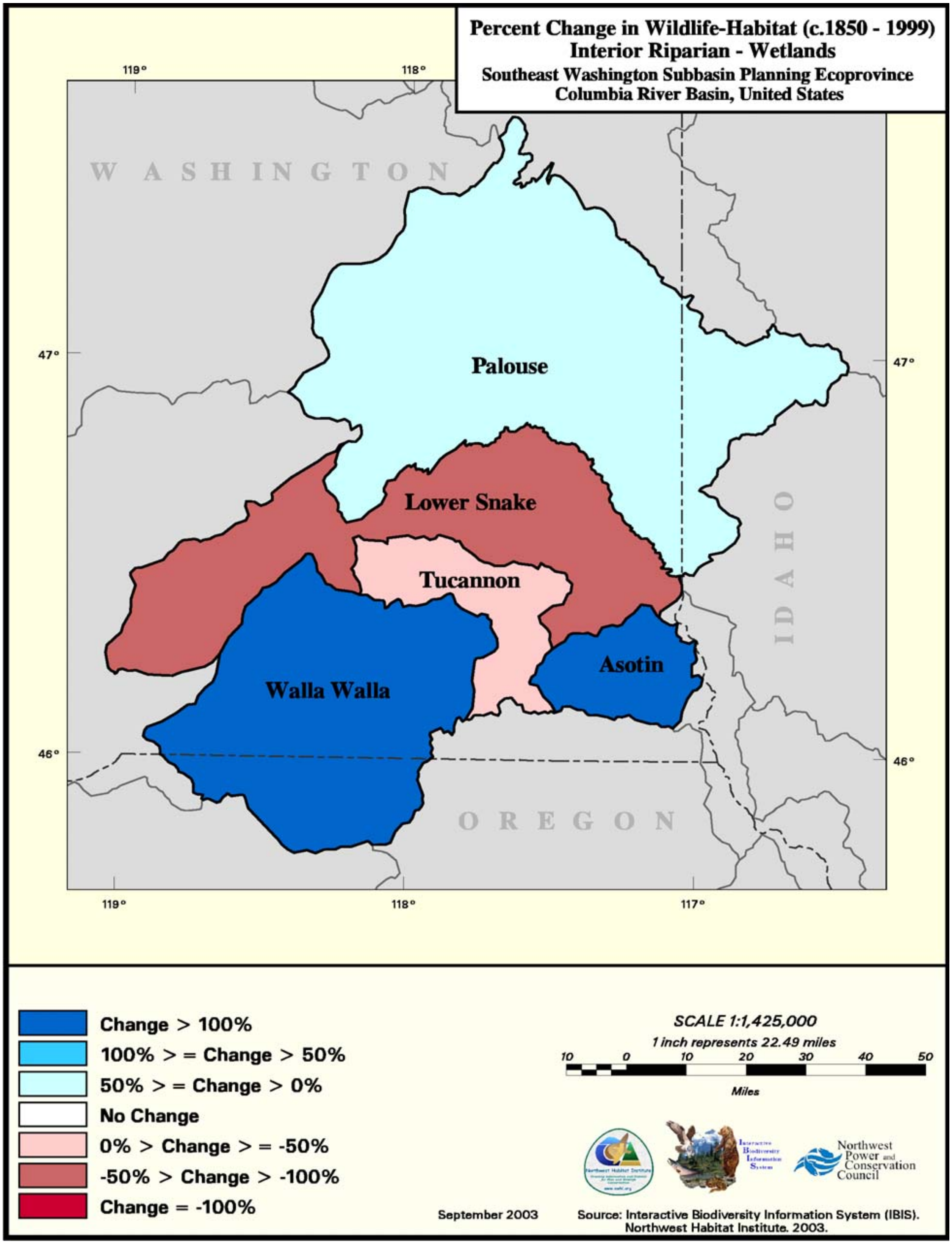

Figure C-16. Percent change in Interior Riparian Wetlands in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

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	reintroduce d	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.

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 1988). 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.

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).

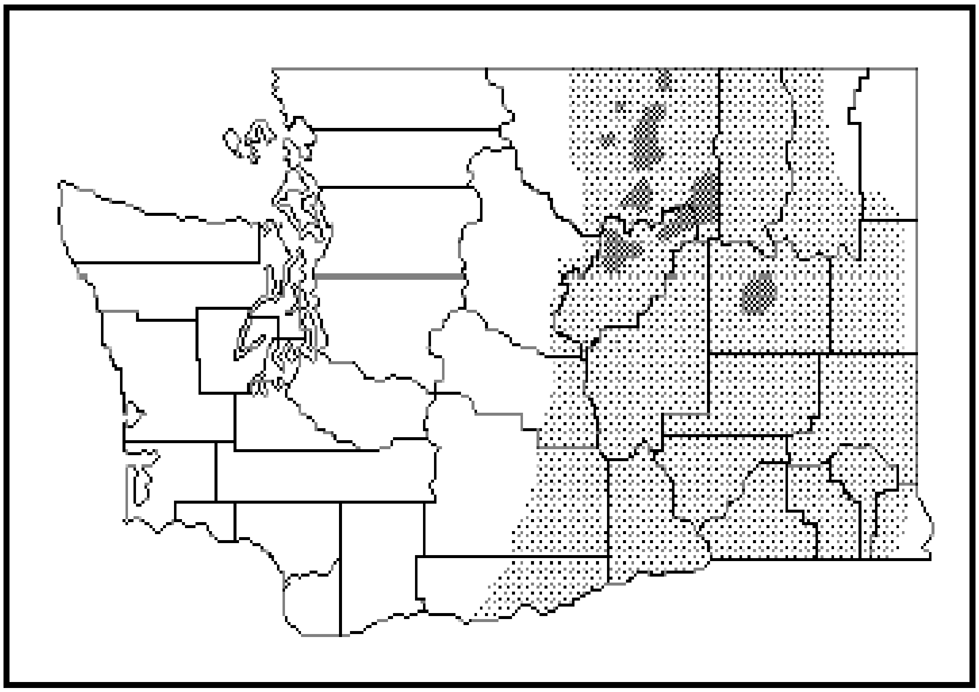

Figure 1. Historic and current distribution of Columbian sharp-tailed grouse in Washington (WDFW 1988).

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).

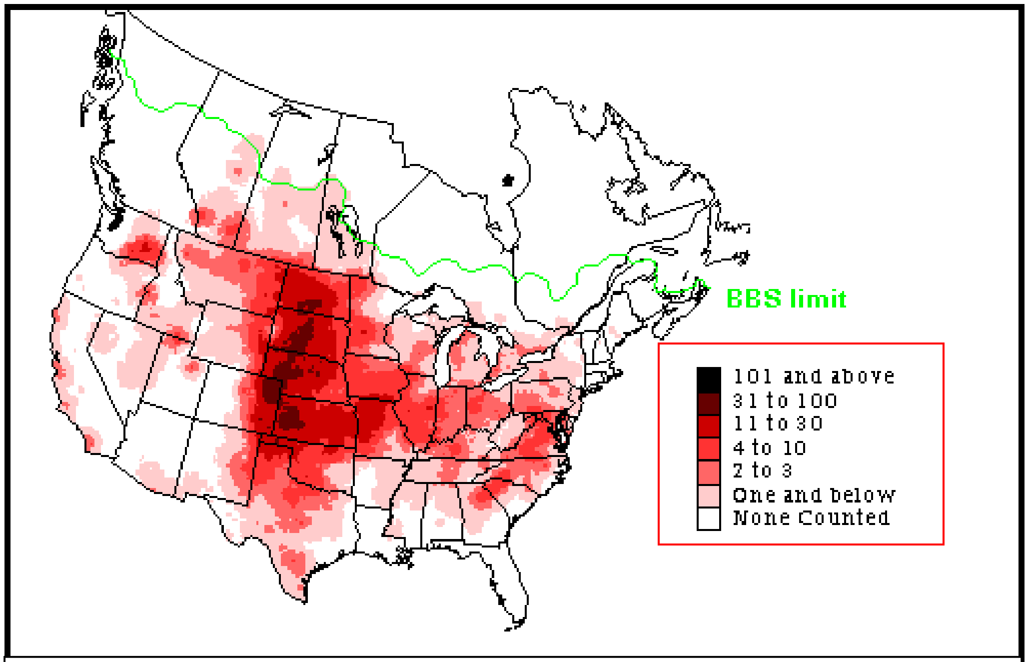

Figure 1. Breeding Range and Abudance of grasshopper sparrow in the U.S. based on Breeding Bird Survey data 1985-2001. Scale represents average number of individuals detected per route per year (Sauer 2003).

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.

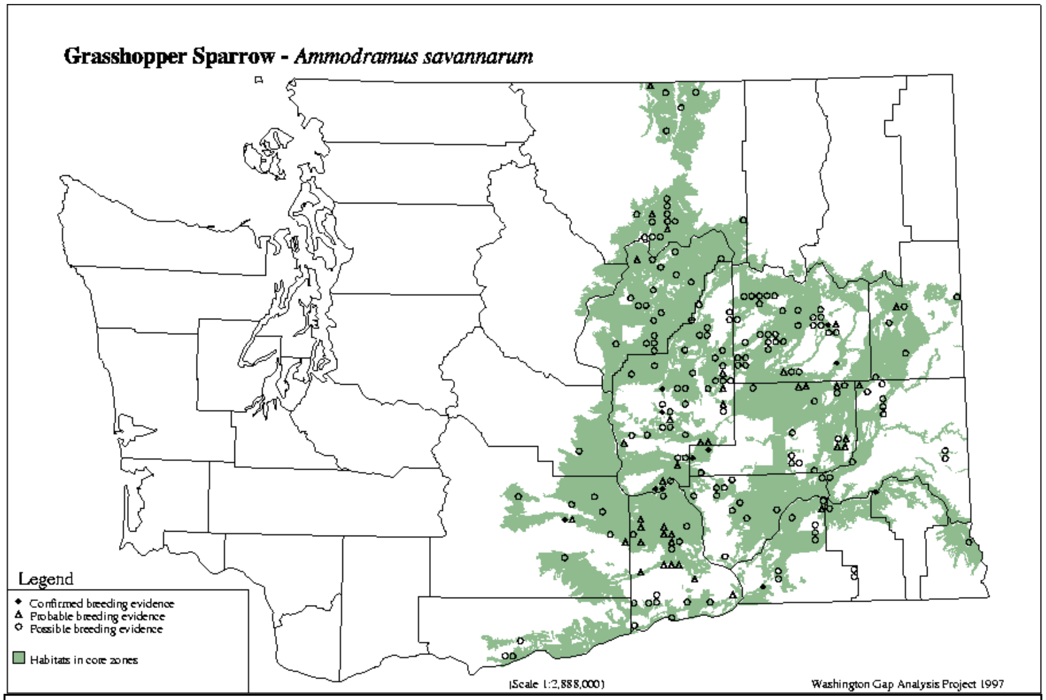

Figure 2. Current distribution of grasshopper sparrow in Washington from GAP analysis (Smith et al. 1997).

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).

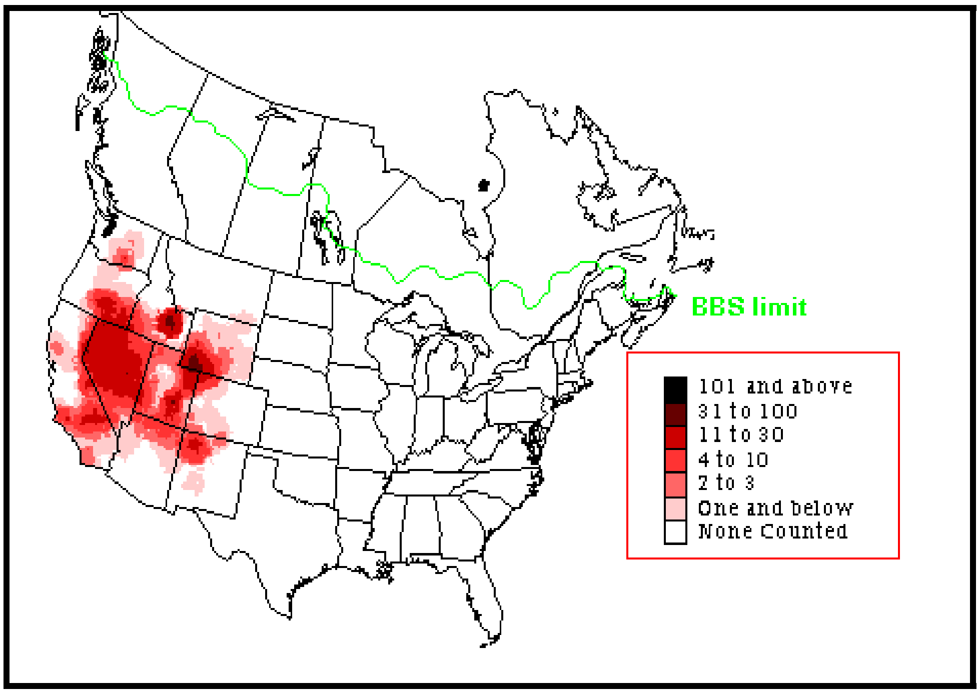

Figure 1. Sage sparrow breeding season abundance from BBS data (Sauer *et al.* 2003).

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).

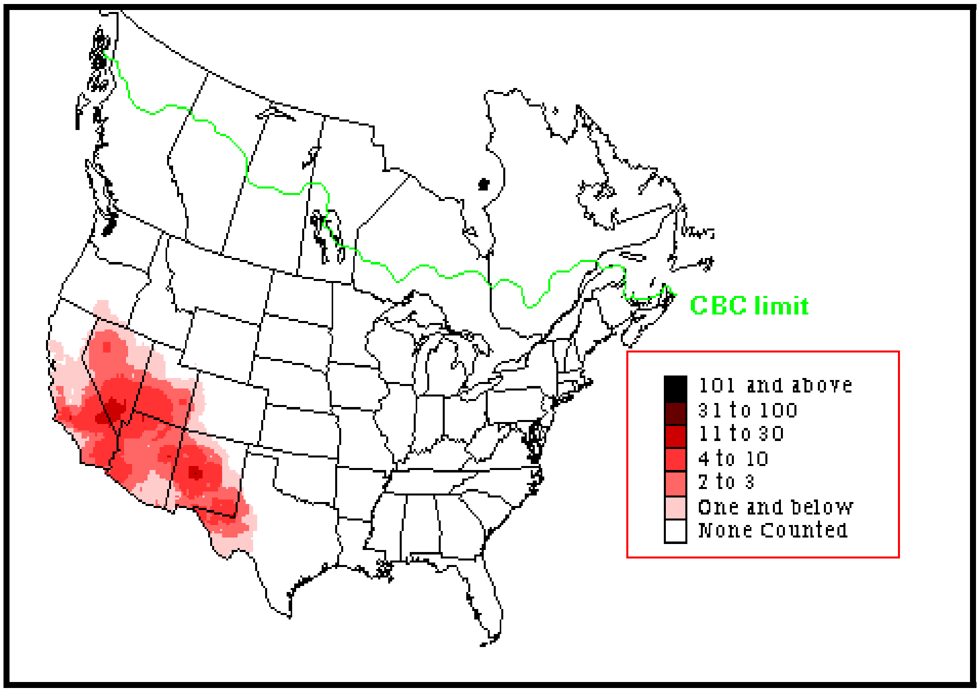

Figure 2. Sage sparrow winter season abundance from CBC data (Sauer *et al.* 2003).

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.

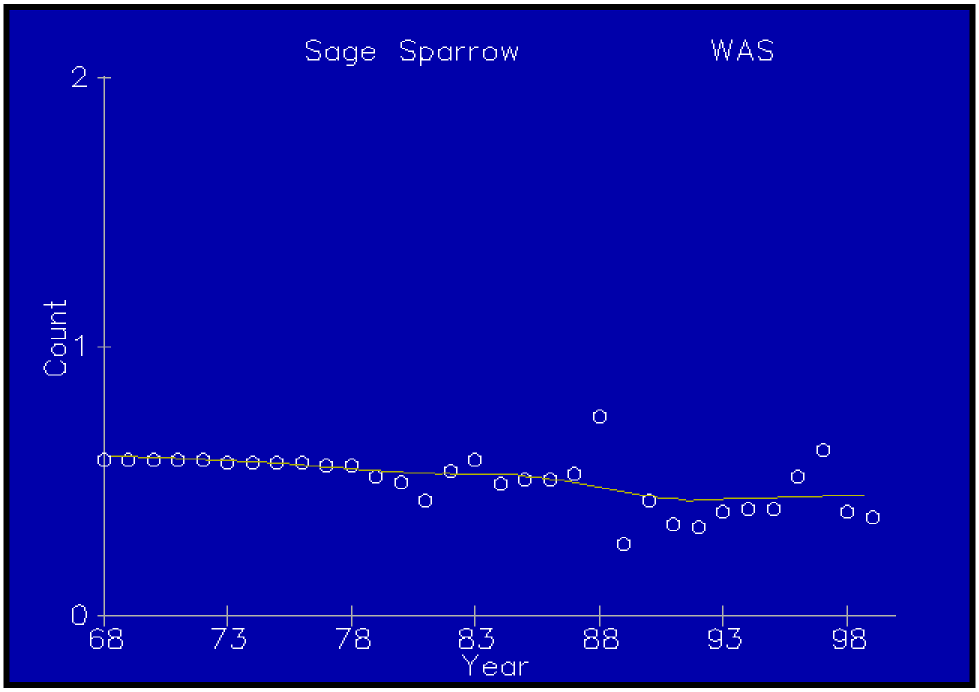

Figure 3. Sage sparrow population trend data from BBS, Washington (Sauer *et al.* 2003).

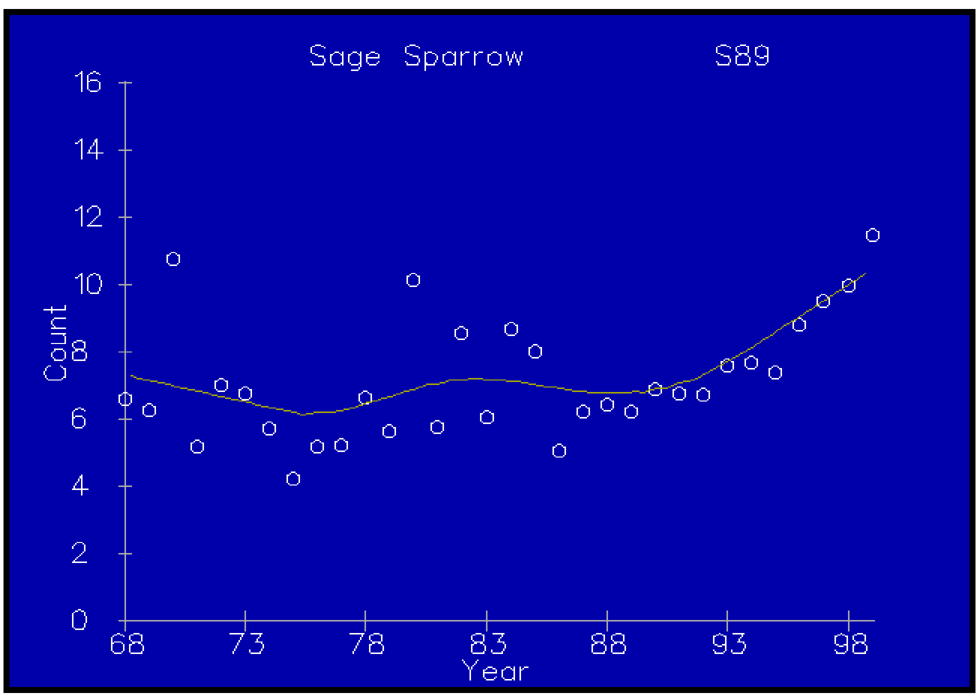

Figure 4. Sage sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

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).

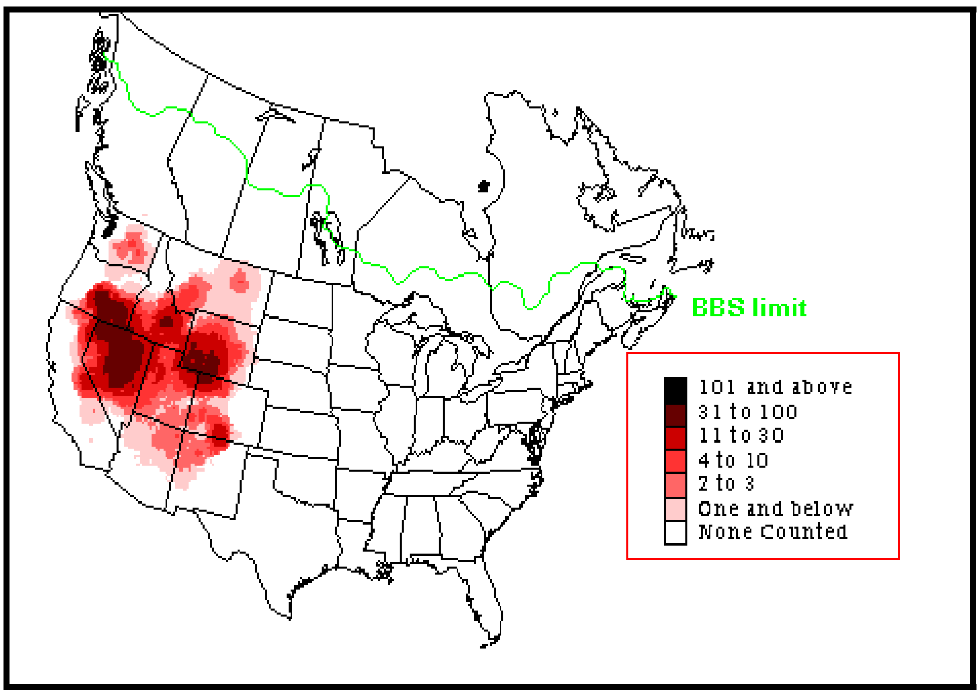

Figure 1. Sage thrasher breeding season abundance from BBS data (Sauer *et al*. 2003).

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).

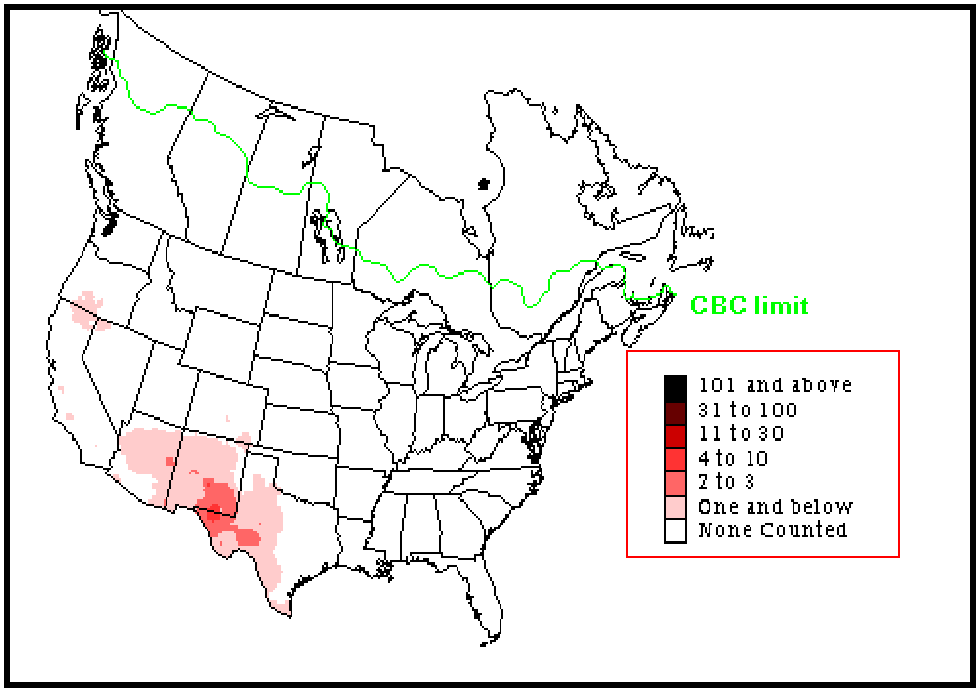

Figure 2. Sage thrasher winter season abundance from CBC data (Sauer *et al*. 2003).

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.

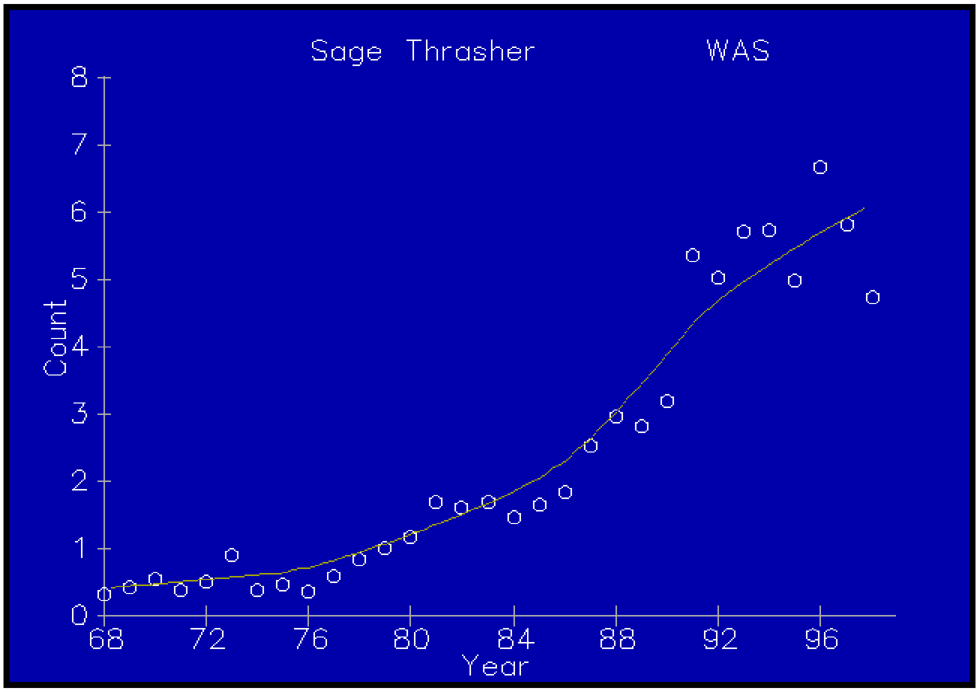

Figure 3. Sage thrasher trend results from BBS data, Washington (Sauer *et al.* 2003).

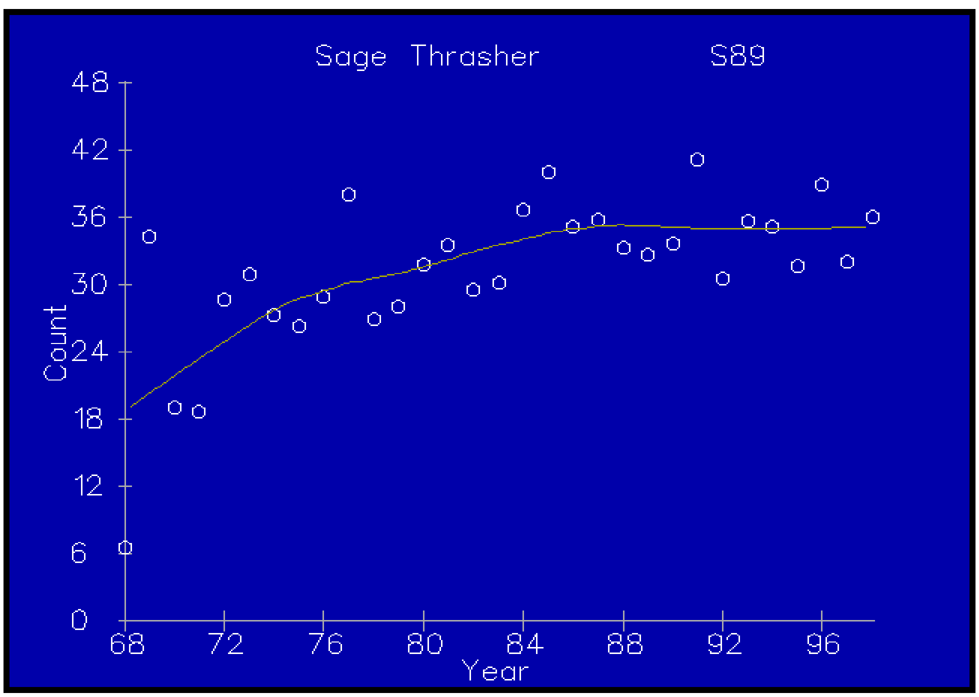

Figure 4. Sage thrasher trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003).

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).

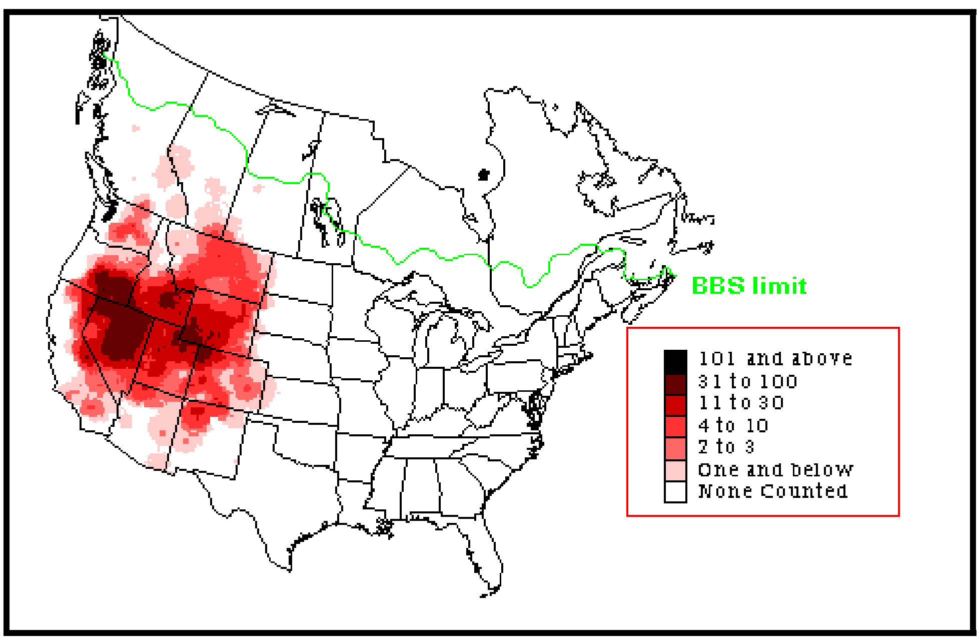

Figure 1. Brewer's sparrow breeding season abundance from BBS data (Sauer *et al.* 2003).

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).

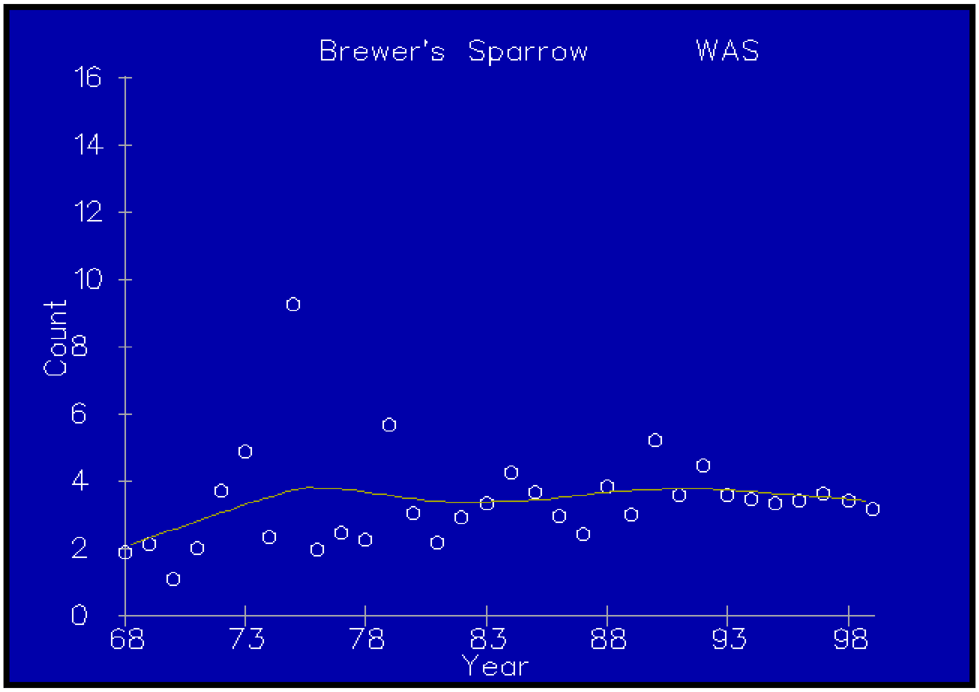

Figure 2. Brewer's sparrow trend results from BBS data, Washington (Sauer *et al.* 2003).

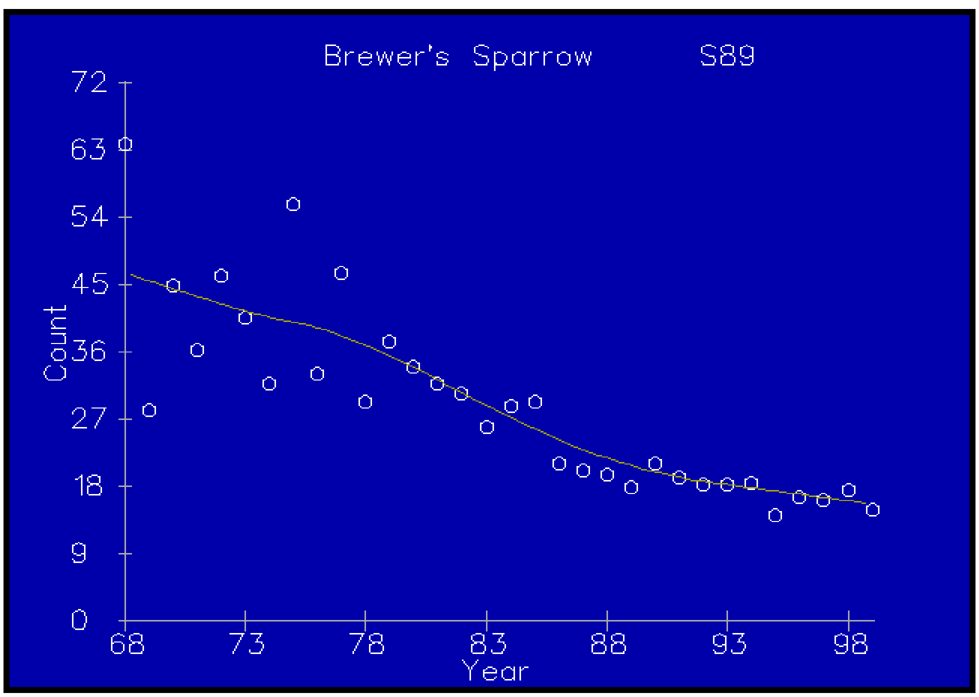

Figure 3. Brewer's sparrow trend results from BBS data, Columbia Plateau (Sauer *et al.* 2003)..

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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Rocky Mountain Mule Deer
(*Odocoileus hemionus hemionus*)

Introduction
Mule deer have been an important member of eastern Washington's landscape, serving as a food and clothing source for Native Americans prior to settlement by Euro-Americans. Today mule deer remain an important component of the landscape, providing recreational opportunities for hunters and wildlife watchers, and tremendous economic benefits to local communities and the state of Washington. Mule deer range throughout southeast Washington, occupying various habitats from coniferous forest at 6,000 feet in the Blue Mountains, to the farmlands and shrub steppe/grassland habitats along the breaks of the Snake River.

Life History and Habitat Requirements
Life History
Mule deer fawns are born from late May through mid June following a gestation of approximately 203 days, with does having 1 to 2 fawns. Does require nutritious forage and water while nursing fawns. Fawns need good hiding cover to protect them from predators. The breeding season occurs in the late fall and early winter (Novemer –early December) across eastern Washington, with mule deer becoming sexually mature as yearlings. During the fall season, high quality forage should be available to allow does to recover from the rigors of nursing fawns and prepare for the leaner winter months. In southeast Washington, late summer/fall rains that create a greenup are very important for mule deer. The fall greenup provides the nutrition necessary to improve body condition for the coming winter, and maintain the fertility of does that breed in late fall. A late summer/fall drought can result in increased winter mortality of adults and fawns, lower fertility rates for does, and poor fawn production and survival. Good spring range conditions are important because they provide the first opportunity for mule deer to reverse the energy deficits created by low quality forage and winter weather. Winter is a difficult time for mule deer; forage quality and availability are limited, and does that are carrying developing fetuses are under significant stress. Ideally, mule deer winter range should be free of disturbance and contain abundant, high quality forage. Poor winter range conditions and sever winter weather in the form of deep snow and cold temperatures can result in high mortality, especially among the old and young.

Diet
Mule deer diets are as varied as the landscapes they inhabit. Kufeld *et al*. (1973) have identified 788 plant species that have been eaten by mule deer; this list includes 202 trees and shrubs, 484 forbs, and 84 grasses, rushes, and sedges. Diets vary by season, age, and sex. Mule deer occupying the farmlands and breaks of the Snake River in southeast Washington rely heavily on the fall greenup of winter wheat and cheatgrass to improve body condition for the winter months, and to provide forage during the winter.

Reproduction
Mule deer in eastern Washington typically mate between late October and December with the peak of the rut occurring in mid November. Bucks are polygamous. Following a gestation of approximately 203 days, single or twin fawns are born (Zeigler. 1978). Mule deer become sexually mature as yearlings. In 1990, a three point regulation and nine day season was implemented in an effort to s improve post-season buck/doe ratios and increase the number of adult bucks available for breeding. From 1990 to 1998, the percentage of adult mule deer bucks in the post-hunt population increased by 600%, compared to the pre-three point era (Bender, 1999).

Migration

Most mule deer that summer at high elevation in the Cascades and Okanogan Highlands migrate to lower elevations to winter (Zeigler 1978). Some mule deer have been observed to migrate considerable distances (up to 80 km) between summer and winter ranges. Mule deer in the Blue Mountains of Washington do not normally migrate long distances to winter range, but move from higher elevations (6,000 ft) to the foothills to winter. Some migration from the foothills or farmland areas to the Snake River breaks may also occur, but no research has been conducted to verify this movement.

Mortality

Observed deaths of mule deer have resulted from a variety of sources. These include legal hunting, poaching, predation by cougars, bobcats, coyotes, and black bears, disease and parasites, starvation, automobiles, and other accidents (Zeigler 1978).

Harvest

The general deer season in the Blue Mountains was historically limited to antlered bucks. In the late 1980's (1987-89) the season length was reduced to nine days in an effort to improve buck survival and post-season buck/doe ratios. After three years of a nine day season, post-season buck/doe ratios did not improve. Three options were developed for improving buck survival; including 1) permit control; 2) spike/two points legal, three point+ by permit; and 3) a general, three point regulation. After considerable study and debate, the three point regulation was adopted in 1990 along with the short nine day season.

Antlerless hunting has generally been restricted by special permit and by Game Management Unit for modern firearm hunters. Archers have only been restricted in areas that may not have general rifle permits, but are allowed to take an antlerless deer during the early and late seasons in most GMUs (WDFW 2002).

Historic

Mule deer were killed by Native Americans but the level of harvest is unknown. Over the last 75 years, mule deer harvests have varied but were probably greater than current harvest levels. Harvest restrictions, which effect harvest levels, for state licensed hunters have varied over the years. There were periods when hunters could harvest mule deer of any sex in areas where mule deer where causing damage to orchards or other agricultural crops. The general season harvest was restricted to bucks with visible antlers, while the antlerless harvest was generally regulated by special permit. Harvests of mule deer have declined throughout much of eastern Washington's mule deer range including eastern Okanogan, Ferry, Stevens, Chelan, and Pend Orielle Counties. In 1990, the general season "any antlered buck" regulation was changed in southeast Washington and hunters were required to harvest mule deer bucks with three or more antler points on one side. This regulation was implemented in order to improve buck surivival and post-season buck to doe ratios. Although the harvest in southeast Washington declined for a couple of years after the three point regulation was implemented, current harvest levels have increased to near historic levels (Table 1) (WDFW 2002).

Current

Current mule deer harvests are limited to bucks with at least 3 antler points on one side. Some antlerless mule deer are being harvested by special permits. The current season in eastern Washingotn ranges from 9-14 days in length. These restrictive seasons are the result of deer managers responding to declining numbers of mule deer across much of eastern Washington, and low post-season buck to doe ratios. There are exceptions to the current, widespread decline, most notably, herds in southeastern Washington and portions of Grant, Douglas, Spokane, and Whitman Counties.

Table 1. Mule deer harvest summary, Blue Mountains (1990 – 2002).

Year	Antlered	Antlerless	Total	% > 4 point*	Antlerless deer:100 Antlered
1990	1209	771	1980	34%	64
1991	1317	1088	2405	38%	64
1992	1588	875	2463	47%	55
1993	2012	766	2778	50%	38
1994	2231	1252	3483	46%	56
1995	1451	930	2381	43%	64
1996	2332	816	3148	52%	35
1997	2418	768	3186	51%	32
1998	2366	591	2957	54%	25
1999	2484	791	3275	53%	32
2000	2750	827	3577	50%	30
2001	2399	1127	3526	50%	47
2002	2599	1150	3749	47%	44

The general buck season in southeast Washington was re-structured in 1990 by combining the nine-day season with a three-point regulation for mule deer. This regulation was implemented for mule deer across eastern Washington in 1997. The three point regulation was expanded to include white-tailed deer in 1991. The objective of this regulation was to improve buck survival and increase the post-season buck to doe ratio, which was extremely low (2-5 bucks/100 does in S.E. Wash.) in many areas. Buck survival and post-season buck ratios for both mule deer and white-tailed deer have improved significantly since the implementation of this regulation.

Mandatory hunter reporting replaced the hunter questionnaire for determining the deer harvest in 2001. From 1994 to 2000, the District 3 buck harvest averaged 2,290 bucks/year and compares favorably with the 1985-89 (pre three-point) average of 2,340 bucks/year. The 2002 buck harvest was 13% above the 1994-2001 average (2304) at 2599 bucks (Table 1).

Three user groups have general seasons in the Blue Mountains, archery, muzzleloader, and modern rifle. Over the last three years, modern firearm hunter numbers have averaged 9,375 for the general season, with an average harvest of 2,251 bucks. Modern firearm hunters harvested 2,382 bucks and 981 antlerless deer in 2002. General season hunters had a success rate of 28%.

Muzzleloader hunter numbers are increasing annually since the general season was established in 2000. The first year, only 118 hunters participated in the new season, but by 2002 that number increased to 372 hunters. The buck harvest increased from 24 in 2000 to 113 in 2002. Muzzleloader hunters also harvested 26 antlerless deer in 2002. Muzzleloaders have the highest success rate of all user groups, at 37%. A success rate this high will definitely result in more interest and increasing numbers of ML hunters.

Archery hunter numbers range between 800 and 1300, and average 1030. Archers harvest an average of 111 bucks per year in the Blue Mountains. In 2002, 900 archers harvested 94 bucks and 143 antlerless deer, for a success rate of 26%, which is almost equal to general season modern firearm hunters (28%).

Species composition of the harvest changes little from year to year, with the 2002 buck harvest consisting of 61% mule deer and 39% white-tailed deer, which is comparable to the long term trend (60% mule deer; 40% white-tailed deer). However, three factors contribute to a higher percentage of white-tailed bucks in the harvest than they occur in the deer population. One, approximately twice as many yearling white-tail bucks are legal under the three-point regulation, compared to yearling mule deer bucks. Two, the permit controlled, late white-tail hunts add approximately 8-10% to the white-tailed buck harvest (Table 2). Three, a change in the late white-tail regulation in 2001 and 2002, allowed hunters to harvest "any white-tail" and increased the percentage of sub-legal (yearling) bucks in the harvest. The whitetail deer population has also increased over the last 10 years, which provides for a higher number of white-tailed bucks in the harvest.

Table 2. Post-hunt mule deer surveys, Blue Mountains, Washington (1989 – 2002).

Year	Bucks		Does	Fawns	Total	Per 100 Does Fawns:100:Bucks
	Adults	Yearlings				
1989	6	23	790	234	1053	30:100:4
1990	15	111	1358	544	2028	40:100:9
1991	17	133	943	455	1548	48:100:16
1992	40	153	1231	431	1868	35:100:17
1993	45	119	995	559	1718	56:100:17
1994	20	163	879	381	1443	43:100:21
1995	43	69	693	264	1069	38:100:16
1996	51	85	993	697	1826	70:100:14
1997	47	157	822	489	1515	60:100:25
1998	81	117	705	460	1363	65:100:28
1999	72	180	1316	796	2364	61:100:19
2000	8	20	98	52	78	53:100:29
2001	71	109	876	471	1529	53:100:21
2002	77	158	1651	581	2465	35:100:14

The antlerless deer harvest fluctuates according to permit levels, and hunter success rates. From 1994 to 2001, the antlerless harvest in southeast Washington averaged 888 per year. Antlerless permits were increased for the 2002 season from 2,685 to 2,835, which resulted in a harvest of 917 antlerless deer. The permit controlled harvest, and general season antlerless harvests totaled 1,150 antlerless deer, which is 30% above the 1994-2001 average (888). Antlerless deer were harvested at a rate of 44 antlerless per 100 bucks. The overall success rate for antlerless permits was 59%, with general permits (mule deer/white-tailed deer) averaging 62%, and "whitetail only" permit success averaging 49%. Approximately 25% of the antlerless permit holders did not hunt (WDFW 2003).

Habitat Requirements

Mule deer need the same basic elements for life as other organisms. However, mule deer occupy a variety of cover types across eastern Washington. Consequently, habitat requirements vary with vegetative and landscape components contained within each herd range. Forested habitats provide mule deer with forage as well as snow intercept, thermal, and escape cover. Mule deer occupying mountain-foothill habitats live within a broad range of elevations, climates, and topography which includes a wide range of vegetation; many of the deer using these habitats are migratory. Mule deer are found in the deep canyon complexes along the major rivers and in the channeled scablands of eastern Washington; these areas are dominated by native bunch grasses or shrub-steppe vegetation. Mule deer also occupy agricultural areas which once where shrub-steppe.

In southeast Washington, the largest populations of mule deer occur in the foothills of the Blue Mountains, farmlands areas, and along the breaks of the Snake River. Agricultural lands are important for mule deer in these areas because croplands and CRP lands provide both food and cover. Since 1986, approximately 284,251 acres of croplands have been converted to CRP land, which has greatly enhanced habitat for mule deer and other wildlife in southeast Washington: County breakdown of CRP land includes Walla Walla 157,298 acres; Columbia 46,095 acres; Garfield 51,225 acres; Asotin 29,633 acres (USDA 2003).

Population and Distribution

Population

Mule deer are distributed throughout southeast Washington, from higher eleveations (6000 ft.) in the mountains, to the lowland farming areas and breaks of the Snake River.

Mule deer populations are at management objective along the breaks of the Snake River and in the foothills of the Blue Mountains. Mule deer populations in the mountains are still depressed, but are improving. Five years of mild winters contributed to low over winter deer mortality, although fall drought is having an impact on fawn production in arid areas along the breaks of the Snake River.

Mule deer populations in the lowlands and along the breaks of the lower Snake River have increased over the last 10 years. Populations have probably peaked and will probably decline slightly if summer/fall drought conditions continue, and winter weather is severe.

Between 1990 and 2001, winter fawn/doe ratios ranged from a low of 35 fawns/100 does to a high of 70 fawns/100 does, and averaged 51 fawns/100 does. Late summer and fall drought has a negative impact on mule deer fawn production and survival. Southeast Washington has been plagued by a late summer/fall drought for the last two years, which has resulted in lower fawn ratios; 2002- 35 fawns/100 does, 2003- 47 fawns/100 does. Lower fawns ratios result from a decline in fertility rates for does the previous fall, and higher fawn mortality due to poor physical condition in does and fawns.

Historic

Historic population levels are unknown but are generally thought to be higher than current mule deer numbers.

Current

No current population estimates are available.

Distribution

Historic

Mule deer were generally thought to have occupied much of what is known as eastern Washington.

Current

Mule deer can be found in every county within eastern Washington.

Status and Abundance Trends

Status

Mule deer populations along the Snake River and in the foothills of the Blue Mountains are at management objective. Mule deer populations south of Clarkston in GMU 181 and in the mountains are improving.

Several factors have contributed to improved deer populations in southeast Washington. Five mild winters contributed to good fawn production and survival, and over 400,000 acres of CRP lands have improved habitat conditions, providing forage, escape cover, and hiding cover for adults and fawns. However, late summer/fall drought is starting to impact fawn production and survival.

Increased hunting opportunity and lower fawn survival along the breaks of the Snake River is putting significant pressure on the mule deer buck population. Lower fawn production/survival in 2002 will result in fewer antlered bucks recruited into the population in 2003, which will result in a lower buck harvest for future hunting seasons. Post-hunt mule deer buck ratios in 2002 declined to 14 bucks per 100 does, which falls below the minimum listed in the Game Management Plan. The average post-hunt ratio for mule deer in 2000 and 2001 was 25 bucks/1100 does. The 10 year average (1992-2001) post-hunt buck ratio for mule deer ranged between 14 – 29 bucks/100 does, and averaged 20.7 bucks/100 does (Table 2).

Trends

Most mule deer herds are currently thought to be stable or declining across much of eastern Washington. There are exceptions to the current, widespread decline, most notably, herds in southeastern Washington and portions of Grant, Douglas, Spokane, and Whitman Counties.

Mule deer populations in southeast Washington vary by Game Management Unit. Along the breaks of the Snake River in GMUs 145 and 149 (Lower Snake), mule deer populations have peaked and may start declining over the next few years, especially if summer/fall drought conditions continue to prevail. Mule deer populations in the mountains have declined significantly over the last 15 years, but appear to be slowly improving. The mule deer population along the breaks of the Snake River in GMU 181 Couse and GMU-186 Grande Ronde have declined from historic levels, and have not improved significantly over the last 15 years. Two factors may be responsible for the lack of recovery in these mule deer populations; noxious weeds and predation. Noxious weeds (yellow-starthistle) have inundated thousands of acres of prime mule deer habitat along the breaks of the Snake and Grande Ronde Rivers. At the same time, mountain lion populations have also increased, putting additional pressure on the mule deer population.

Factors Affecting Mule Deer Population Status

Key Factors Inhibiting Populations and Ecological Processes

Mule deer and their habitats are being impacted in a negative way by dam construction, urban and suburban developement, road and highway construction, over-grazing by livestock, inappropriate logging operations, competition by other ungulates, drought, fire, over-harvest by hunters, predation, disease and parasites.

Weather

Weather conditions can play a major role in the productivity and abundance of mule deer. Drought conditions can have a severe impact on mule deer because forage does not replenish itself on summer or winter range, and nutritional quality is low. Drought conditions during the summer and fall can result in low fecundity in does, and poor physical condition going into the winter months. Severe winter weather can cause result in high mortality depending on severity. Severe weather can result in mortality of all age classes, but the young, old, and mature bucks usually sustain the highest mortality. If mule deer are subjected to drought conditions in the summer and fall, followed by a severe winter, the result can be high mortality rates and low productivity the following year.

Habitat

Habitat conditions in southeast Washington have deteriorated in some areas and improved dramatically in others.

The conversion of shrubsteppe and grassland habitat to agricultural croplands has resulted in the loss of hundreds of thousands of acres of deer habitat in southeast Washington. However, this has been mitigated to some degree by the implementation of the Conservation Reserve Program. Approximately 400,000 acres have been converted to CRP in southeast Washington. Noxious weeds have invaded many areas of southeast Washington resulting in a tremendous loss of good habitat for mule deer. Yellow starthistle has invaded the breaks of the Snake River from Asotin to the Oregon border, greatly reducing the ability of this area to support mule deer populations at historic levels. Yellow starthistle is also a major problem in the Tucannon and Touchet river watersheds.

Fire Suppression

Fire suppression has resulted in a decline of habitat conditions in the mountain and foothills of the Blue Mountains. Browse species need to be regenerated by fire in order to maintain availability and nutritional value to big game. Lack of fire has allowed many browse species to grow out of reach for mule deer (Leege 1968; 1969; Young and Robinette 1939).

Development

Mule deer habitat in the foothills of the Blue Mountains east of Walla Walla has experienced a significant level of land development over the last 20 years. Subdivisions have resulted in the loss of thousands of acres of habitat and mule deer populations in those areas have declined accordingly.

Conservation Reserve Program (CRP)

Approximatley 284,251 acres of CRP have been created in the farmlands of southeast Washington by converting cropland to grassland; Walla Walla, Columbia, Garfield, and Asotin Counties. This has resulted in an improvement in habit for mule deer. CRP lands provide both food and cover where little existed before Conservation Reserve Program was created.

Predation

Mountain lion populations have increased significantly in the Blue Mountains over the last 20 years (P. Fowler, WDFW, personal communication, 2003). During this period, the mule deer population in the mountains has declined to a fraction of historic levels. Cougar predation on mule deer in the mountains could be a major factor contributing to the population decline in that area. Coyote predation on fawns can have a significant impact on the deer population when coyote populations are high, and fawn productivity is low.

Harvest

The deer harvest by licensed hunters is restricted to bucks with a minimum of three points on one side, while the antlerless harvest is generally regulated by special permit. This system allows for harvesting deer at optimum levels, while preventing overharest. However, in order to maintain buck survival at management objective, hunting opportunity needs to be strictly regulated.

Hydroelectric Dams

Four dams were constructed on the lower Snake River during the 1960s and early 1970s; Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The reservoirs created by these dams inundated thousands of acres of prime, riparian habitat that supported many species of wildlife, including mule deer. This riparian zone provided high quality habitat (forage/cover), especially during the winter months. The loss of this important habitat and the impact it has had on the mule deer population along the breaks of the Lower Snake River may never be fully understood.

Agricultural Damage

Mule deer populations in GMUs 145 and 149 have reached levels where landowners are complaining about too many deer on their winter wheat. In response, the WDFW has increased antlerless permits, and in some cases authorized “hotspot” hunts to reduce damage and complaints from landowners.

Competition

White-tailed deer populations have increased in areas where mule deer populations have declined. This is especially true in the foothills of the Blue Mountains from Walla Walla to the Tucannon River. Along the breaks of the Snake River and lowland agricultural areas, whitetail populations fluctuate, but are controlled by disease (P. Fowler, WDFW, personal communication, 2003). Every three to five years, conditions exist that result in an outbreak of Epizootic Hemmoragic Disease (EHD). Whitetail deer are extremely susceptible to EHD and mortality rates can be very high under certain conditions; high population density. As a result of the periodic die-offs created by EHD, whitetail populations are not a significant threat to mule deer in those areas. Although mule deer can contract EHD, they are not as susceptible to this disease as white-tailed deer and the mortality rate for mule deer is usually low.

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White-headed Woodpecker
(*Picoides albolarvatus*)

Introduction

The white-headed woodpecker (*Picoides albolarvatus*) is a year round resident in the Ponderosa pine (*Pinus ponderosa*) forests found at the lower elevations (generally below 950m). White-headed woodpeckers are particularly vulnerable due to their highly specialized winter diet of ponderosa pine seeds and the lack of alternate, large cone producing, pine species.

Nesting and foraging requirements are the two critical habitat attributes limiting the population growth of this species of woodpecker. Both of these limiting factors are very closely linked to the habitat attributes contained within mature open stands of ponderosa pine. Past land use practices, including logging and fire suppression, have resulted in significant changes to the forest structure within the Ponderosa pine ecosystem.

Life History and Habitat Requirements

Life History

Diet

White-headed woodpeckers feed primarily on the seeds of large ponderosa pines. This is makes the white-headed woodpecker quite different from other species of woodpeckers who feed primarily on wood boring insects (Blood 1997; Cannings 1987 and 1995). The existence of only one suitable large pine (ponderosa pine) is likely the key limiting factor to the white-headed woodpecker's distribution and abundance.

Other food sources include insects (on the ground as well as hawking), mullein seeds and suet feeders (Blood 1997; Joe *et al.* 1995). These secondary food sources are used throughout the spring and summer. By late summer, white-headed woodpeckers shift to their exclusive winter diet of ponderosa pine seeds.

Reproduction

White-headed woodpeckers are monogamous and may remain associated with their mate throughout the year. They build their nests in old trees, snags or fallen logs but always in dead wood. Every year the pair bond constructs a new nest. This may take three to four weeks. The nests are, on average 3m off the ground. The old nests are used for overnight roosting by the birds.

The woodpeckers fledge about 3-5 birds every year. During the breeding season (May to July) the male roosts in the cavity with the young until they are fledged. The incubation period usually lasts for 14 days and the young leave the nest after about 26 days. White-headed woodpeckers have one brood per breeding season and there is no replacement brood if the first brood is lost. The woodpeckers are not very territorial except during the breeding season. They are not especially social birds outside of family groups and pair bonds and generally do not have very dense populations (about 1 pair bond per 8 ha).

Nesting

Generally large ponderosa pine snags consisting of hard outer wood with soft heartwood are preferred by nesting white-headed woodpeckers. In British Columbia 80 percent of reported nests have been in ponderosa pine snags, while the remaining 20 percent have been recorded in Douglas-fir snags. Excavation activities have also been recorded in Trembling Aspen, live Ponderosa pine trees and fence posts (Cannings *et al.* 1987).

In general, nesting locations in the South Okanagan, British Columbia have ranged between 450 - 600m (Blood 1997), with large diameter snags being the preferred nesting tree. Their nesting cavities range from 2.4 to 9 m above ground, with the average being about 5m. New nests are excavated each year and only rarely are previous cavities re-used (Garrett *et al.* 1996).

Migration
The white-headed woodpecker is a non-migratory bird.

Habitat Requirements
Breeding
White-headed woodpeckers live in montane, coniferous forests from British Columbia to California and seem to prefer a forest with a relatively open canopy (50-70 percent cover) and an availability of snags (a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees with large diameters with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present.

Highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. They are uncommon or absent in monospecific ponderosa pine forests and stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine).

Where food availability is at a maximum such as in the Sierra Nevadas, breeding territories may be as low as 10ha (Milne and Hejl 1989). Breeding territories in Oregon are 104 ha in continuous forest and 321 ha in fragmented forests (Dixon 1995b). In general, open Ponderosa pine stands with canopy closures between 30 - 50 percent are preferred. The openness however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989). In the South Okanagan, British Columbia, Ponderosa pine stands in age classes 8 -9 are considered optimal for white-headed woodpeckers (Haney 1997). Milne and Hejl (1989) found 68 percent of nest trees to be on southern aspects, this may be true in the South Okanagan as well, especially, towards the upper elevational limits of Ponderosa pine (800 - 1000m).

Population and Distribution
Population
Historic
No data are available.

Current
No data are available.

Distribution
Historic
No data are available.

Current
These woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California and Nevada and Northern Idaho in the United States. The exact population of the white-headed woodpecker is unknown but there are thought to be less than 100 of the birds in British Columbia. See Figures 1-3 for current distribution.

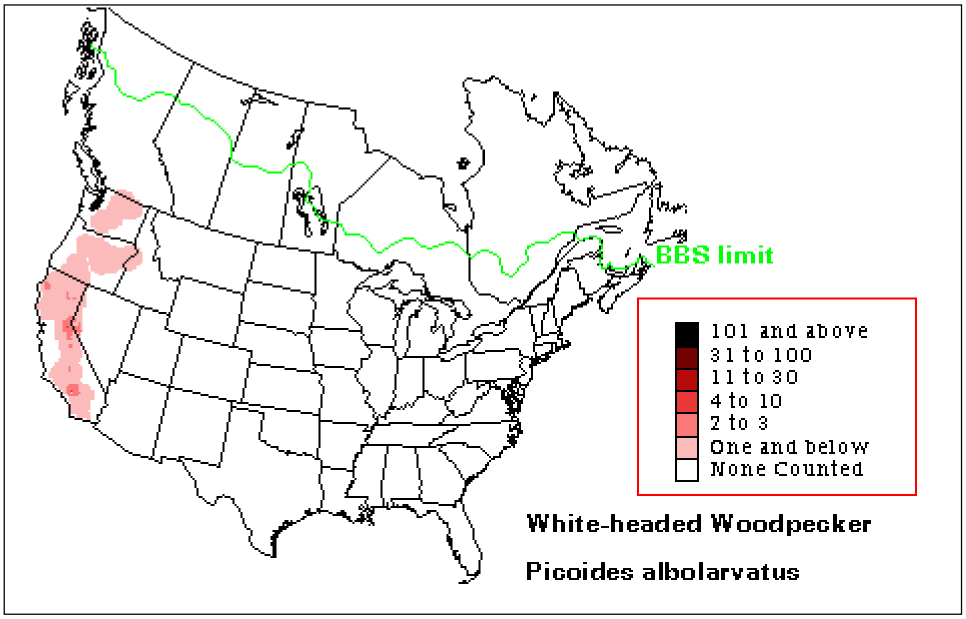

Figure 1. White-headed woodpecker year-round range (Sauer *et al*. 2003).

Woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho and rare in British Columbia. However, they are still common in most of their original range in the Sierra Nevada and mountains of southern California. The birds are non-migratory but do wander out of their range sometimes in search of food.

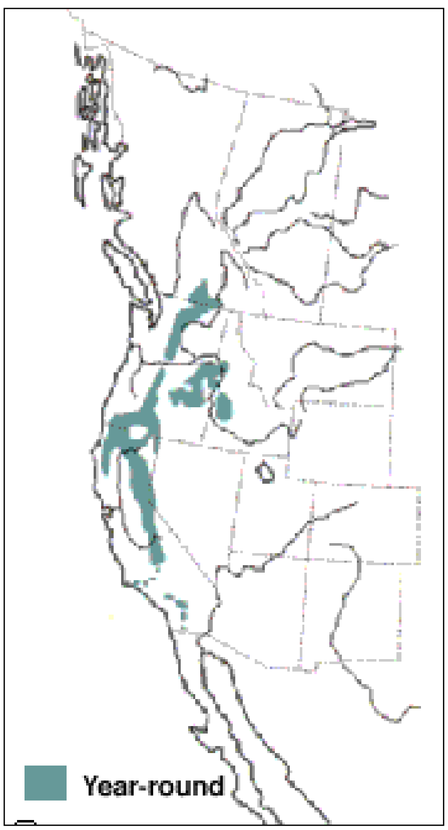

Figure 2. White-headed woodpecker breeding distribution (from BBS data) (Sauer *et al.* 2003).

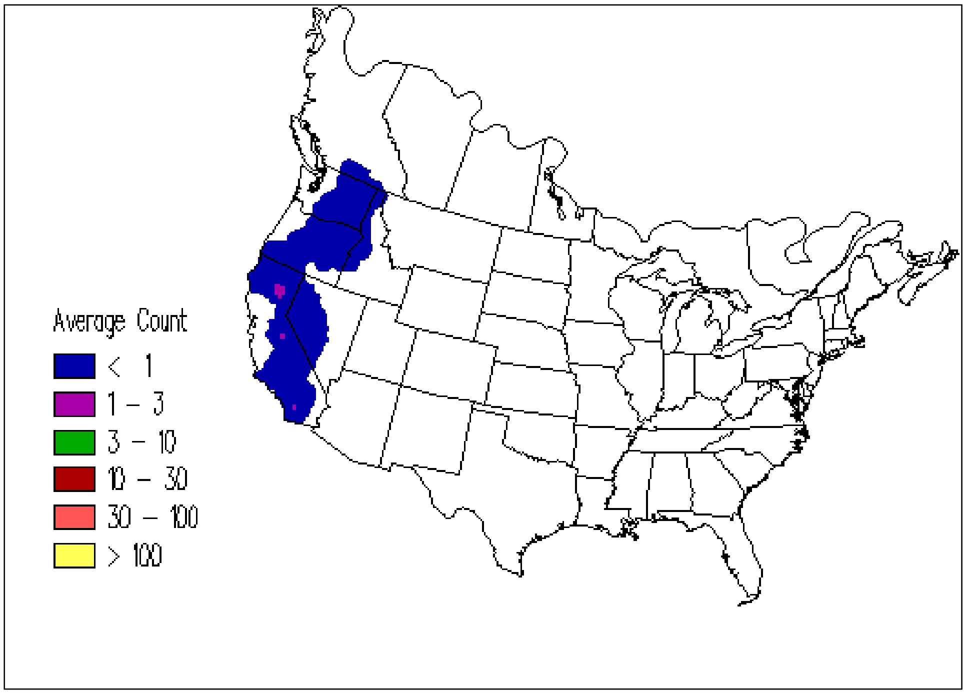

Figure 3. White-headed woodpecker winter distribution (from CBC data) (Sauer *et al.* 2003).

Status and Abundance Trends

Status

Although populations appear to be stable at present, this species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations.

Trends

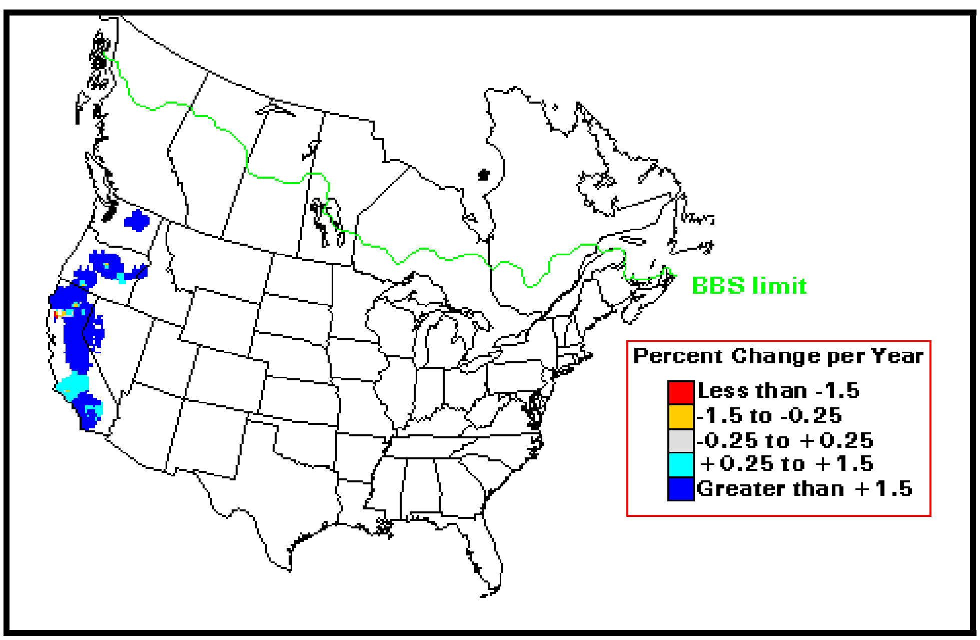

Figure 4. White-headed woodpecker BBS population trend: 1966-1996 (Sauer *et al.* 2003).

Factors Affecting White-headed Woodpecker Population Status

Key Factors Inhibiting Populations and Ecological Processes

Logging

Logging has removed much of the old cone producing pines throughout the South Okanagan. Approximately 27, 500 ha of ponderosa pine forest remain in the South Okanagan and 34.5 percent of this is classed as old growth forest (Ministry of Environment Lands and Parks 1998). This is a significant reduction from the estimated 75 percent in the mid 1800s (Cannings 2000). The 34.5 percent old growth estimate may in fact be even less since some of the forest cover information is incomplete and needs to be ground truthed to verify the age classes present. The impact from the decrease in old cone producing ponderosa pines is even more exaggerated in the South Okanagan because there are no alternate pine species for the white-headed woodpecker to utilize. This is especially true over the winter when other major food sources such as insects are not available. Suitable snags (DBH>60cm) are in short supply in the South Okanagan.

Fire Suppression

Fire suppression has altered the stand structure in many of the forests in the South Okanagan. Lack of fire has allowed dense stands of immature ponderosa pine as well as the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads resulting in more severe stand replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These dense stands of immature trees has also led to increased competition for nutrients as well as a slow change from a Ponderosa pine climax forest to a Douglas-fir dominated climax forest.

Predation

There are a few threats to white-headed woodpeckers such as predation and the destruction of its habitat. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers. There is also predation by the great horned owl on adult white-headed woodpeckers. However, predation does not appreciably affect the woodpecker population.

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Flammulated Owl
(*Otus flammeolus*)

Introduction

The flammulated owl is a Washington State Candidate species. Limited research on the flammulated owl indicates that its demography and life history, coupled with narrow habitat requirements, make it vulnerable to habitat changes. The flammulated owl is a species dependent on large diameter Ponderosa pine forests (Hillis *et al.* 2001). The mature and older forest stands that are used as breeding habitat by the flammulated owl have changed during the past century due to fire management and timber harvest.

Life History and Habitat Requirements

Life History

Diet

Flammulated owls are entirely insectivores; nocturnal moths are especially important during spring and early summer (Reynolds and Linkhart 1987). As summer progresses and other prey become available, lepidopteran larvae, grasshoppers, spiders, crickets, and beetles are added to the diet (Johnson 1963; Goggans 1986). The flammulated owl is distinctively nocturnal although it is thought that the majority of foraging is done at dawn and dusk.

Reproduction

Males arrive on the breeding grounds before females. In Oregon, they arrive at the breeding sites in early May and begin nesting in early June (Goggans 1986; E. Bull, personal communication). They call to establish territories and to attract arriving females. Birds pair with their mates of the previous year, but if one does not return, they often pair with a bird from a neighboring territory. The male shows the female potential sites from which she selects the one that will be used, usually an old pileated woodpecker or northern flicker hole.

Nesting

The laying of eggs happens from about mid-April through the beginning of July. Generally 2 - 4 eggs are laid and incubation requires 21 to 24 days, by female and fed by male. The young fledge at 21 -25 days, staying within about 100 yards of the nest and being fed by the adults for the first week. In Oregon, young fledge in July and August (Goggans 1986; E. Bull, personal communication). The young leave the nest around after about 25 days but stay nearby. In Colorado, owlets dispersed in late August and the adults in early October (Reynolds and Linkhart 1987).Sometimes the brood divides, with each parent taking one or two of the young. Adults and young stay together for another month before the young disperse.

Migration

The flammulated owl is one of the most migratory owls in North America. Flammulated owls are presumed to be migratory in the northern part of their range (Balda *et al.* 1975), and winter migrants may extend to neotropical areas in Central America. Flammulated owls can be found in Washington only during their relatively short breeding period. They migrate at night, moving through the mountains on their way south but through the lowlands in early spring.

Mortality

Although the maximum recorded age for a wild owl is only 8 years, 1 month, their life span is probably longer than this.

Habitat Requirements

General

The flammulated owl occurs mostly in mid-level conifer forests that have a significant Ponderosa pine component (McCallum 1994b) between elevations of 1,200 feet to 5,500 feet in the north, and up to 9,000 feet in the southern part of its range in California (Winter 1974). Flammulated owls are typically found in mature to old, open canopy yellow pine (Ponderosa pine [*Pinus ponderosa*] and Jeffrey pine [*Pinus jeffreyi*]), Douglas-fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis*) (Bull and Anderson 1978; Goggans 1986; Howie and Ritchie 1987; Reynolds and Linkhart 1992; Powers *et al.* 1996). In central Colorado, Linkhart and Reynolds (1997) reported that 60 percent of the habitat within the area defended by territorial males consisted of old (200-400 year) Ponderosa pine/Douglas-fir forest.

Flammulated owls are obligate secondary cavity nesters (McCallum 1994b), requiring large snags in which to roost and nest.

Nesting

Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner *et al.* 1990). The owls selectively nest in dead Ponderosa pine snags, and prefer nest sites with fewer shrubs in front than behind the cavity entrance, possibly to avoid predation and obstacles to flight. Flammulated owls will nest only in snags with cavities that are deep enough to hold the birds, and far enough off the ground to be safe from terrestrial predators. The cavity is typically unlined, 11 to 12 in. deep with the average depth being 8.4 in. (McCallum and Gehlbach 1988). California black oak may also provide nesting cavities, particularly in association with ridge tops and xeric mid-slopes, with two layered canopies, tree density of 1270 trees/2.5 acres, and basal area of 624 feet^2/2.5acres (McCallum 1994b). The nest is usually 3-39 feet above the ground (Zeiner *et al.* 1990) with 16 feet being the average height of the cavity entrance (McCallum and Gehlbach 1988).

Territories most consistently occupied by breeding pairs (>12 years) contained the greatest (>75 percent) amount of old Ponderosa pine/Douglas-fir forest. Marcot and Hill (1980) reported that California black oak (*Quercus kellogii*) and Ponderosa pine occurred in 67 percent and 50 percent, respectively, of the flammulated owl nesting territories they studied in northern California. In northeastern Oregon, Bull and Anderson (1978) noted that Ponderosa pine was an overstory species in 73 percent of flammulated owl nest sites. Powers *et al.* (1996) reported that Ponderosa pine was absent from their flammulated owl study site in Idaho and that Douglas-fir and quaking aspen (*Populus tremuloides*) accounted for all nest trees.

The owls nest primarily in cavities excavated by flickers (*Colates spp*.), hairy woodpeckers (*Picoides villosus*), pileated woodpeckers (*Dryocopus pileatus*), and sapsuckers (*Sphyrapicus spp*.) (Bull *et al.* 1990; Goggans 1986; McCallum 1994b). Bull *et al.* (1990) found that flammulated owls used pileated woodpecker cavities with a greater frequency than would be expected based upon available woodpecker cavities. There are only a few reports of this owl using nest boxes (Bloom 1983). Reynolds and Linkhart (1987) reported occupancy in 2 of 17 nest boxes put out for flammulated owls.

In studies from northeastern Oregon and south central Idaho, nest sites were located 16-52 feet high in dead wood of live trees, or in snags with an average diameter at breast height (DBH) of >20 in. (Goggans 1986; Bull *et al.* 1990; Powers *et al.* 1996). Most nests were located in snags. Bull *et al.* (1990) found that stands containing trees greater than 20 in. DBH were used more often than randomly selected stands. Reynolds and Linkhart (1987) suggested that stands with trees >20 in. were preferred because they provided better habitat for foraging due to the open nature of the stands, allowing the birds access to the ground and tree crowns. Some stands containing larger trees also allow more light to the ground that produces ground vegetation, serving as food for insects preyed upon by owls (Bull *et al.* 1990).

Both slope position and slope aspect have been found to be important indicators of flammulated owl nest sites (Goggans 1986, Bull *et al.* 1990). In general, ridges and the upper third of slopes were used more than lower slopes and draws (Bull *et al.* 1990). It has been speculated that ridges and upper slopes may be preferred because they provide gentle slopes, minimizing energy expenditure for carrying prey to nests. Prey may also be more abundant or at least more active on higher slopes because these areas are warmer than lower ones (Bull *et al.* 1990).

Breeding

Breeding occurs in mature to old coniferous forests from late April through early October. Nests typically are not found until June (Bull *et al.* 1990). The peak nesting period is from mid-June to mid-July (Bent 1961). Mean hatching and fledging dates in Idaho were 26 June and 18 July, respectively (Powers *et al.* 1996).

In Oregon, individual home ranges averaged about 25 acres (Goggans 1986). Territories are typically found in core areas of mature timber with two canopy layers present (Marcot and Hill 1980). The uppermost canopy layer is formed by trees at least 200 years old. Core areas are near, or adjacent to clearings of 10-80 percent brush cover (Bull and Anderson 1978, Marcot and Hill 1980). Linkhart and Reynolds (1997) found that flammulated owls occupying stands of dense forest were less successful that owls whose territories contain open, old pine/fir forests.

Foraging

Flammulated owls prefer to forage in older stands that support understories, and need slightly open canopies and space between trees to facilitate easy foraging. The open crowns and park-like spacing of the trees in old growth stands permit the maneuverability required for hawk and glean feeding tactics (USDA 1994a).

In Colorado, foraging occurred primarily in old Ponderosa pine and Douglas-fir with an average tree age of approximately 200 years (Reynolds and Linkhart 1992). Old growth Ponderosa pine was selected for foraging, and young Douglas-firs were avoided. Flammulated owls principally forage for prey on the needles and bark of large trees. They also forage in the air, on the ground, and along the edges of clearings (Goggans 1986; E. Bull, personal communication; R. Reynolds, personal communication). Grasslands in and adjacent to forest stands are thought to be important foraging sites (Goggans 1986). However, Reynolds (personal communication) suggests that ground foraging is only important from the middle to late part of the breeding season, and its importance may vary annually depending upon the abundance of ground prey. Ponderosa pine and Douglas-fir were the only trees selected for territorial singing in male defended territories in Colorado (Reynolds and Linkhart 1992).

A pair of owls appear to require about 2-10 acres during the breeding season, and substantial patches of brush and understory to help maintain prey bases (Marcot and Hill 1980). Areas with edge habitat and grassy openings up to 5 acres in size are beneficial to the owls (Howle and Ritcey, 1987) for foraging.

Population and Distribution

Population

Historic

No data are available.

Current

There is only one recognized race of flammulated owl. There are several races described although they have not been verified. Some of these that may come about are: the longer winged population in the north part of the range, separated as *idahoensis*, darker birds from Guatemala as rarus, (winter specimen thus invalid), *meridionalis* from S. Mexico and Guatemala, *frontalis* from Colorado and borealis from central British Columbia to northeastern California.

Distribution

Historic

No data are available

Current

Flammulated owl distribution is illustrated in Figure 1. Flammulated owls are uncommon breeders east of the Cascades in the ponderosa pine belt from late May to August. There have been occasional records from western Washington, but they are essentially an east side species. Locations where they may sometimes be found include Blewett Pass (straddling Chelan and Kittitas Counties), Colockum Pass area (Kittitas County), and Satus Pass (Klickitat County) (Figure 2).

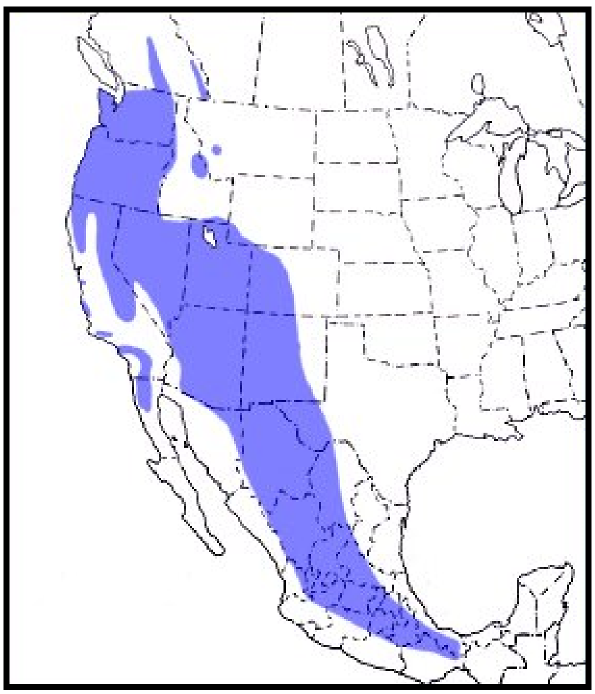

Figure 1. Flammulated owl distribution (Kaufman 1996).

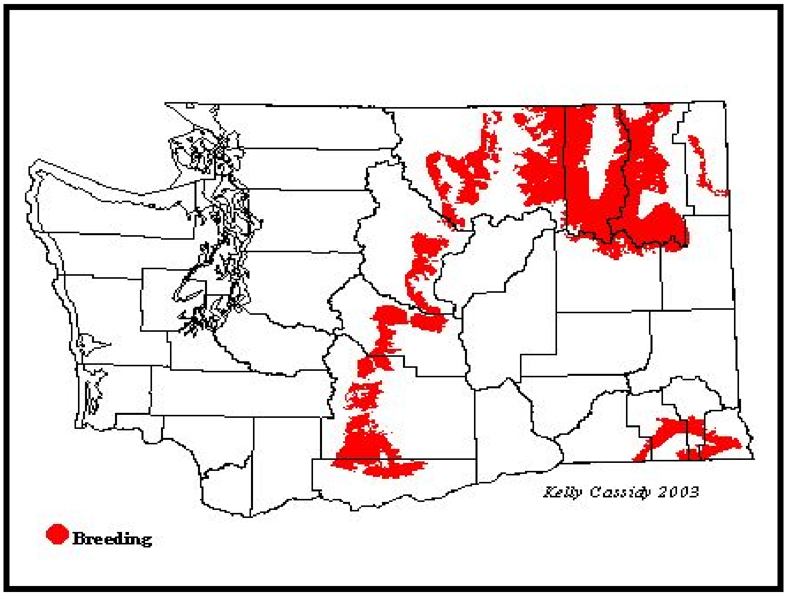

Figure 2. Flammulated owl distribution, Washington (Kaufman 1996).

Except for migration, this species is restricted to montane elevations with seasonally temperate climates. Climate may influence the distribution of the species indirectly through the prey base, (primarily nocturid moths) rather than directly through thermoregulatory abilities as this species tends to forage at night when the temperatures are lowest for the day (McCallum 1994b).

This owl species is present throughout the northern Blue Mountains above 700 meters and below 1,400 meters on dryer south and west facing slopes with a mix of mature ponderosa pine and a mosaic pattern of dense small diameter stem stands of ponderosa pine and larch.

These owls are first detected in May as insect numbers increase and nocturnal temperatures moderate. In Columbia, Garfield, and Asotin Counties, these owls nest in cavities in dead and living mature ponderosa pine and larch.

Status and Abundance Trends

Status

Flammulated owls are candidates for inclusion on the Washington Department of Fish and Wildlife endangered species list and are considered a species-at-risk by the Washington GAP Analysis and Audubon-Washington.

Because old-growth ponderosa pine is rarer in the northern Rocky Mountains than it was historically, and little is known about the local flammulated owl distribution and habitat use, the USFS has listed the flammulated owl as a sensitive species in the Northern Region (USDA 1994b). It is also listed as a sensitive species by the USFS in the Rocky Mountain, Southwestern, and Intermountain Regions, and receives special management consideration in the States of Montana, Idaho, Oregon, and Washington (Verner 1994).

Trends

So little is known about flammulated owl populations that even large scale changes in their abundance would probably go unnoticed (Winter 1974). Several studies have noted a decline in flammulated owl populations following timber harvesting (Marshall 1939; Howle and Ritcey 1987). However, more and more nest sightings occur each year, but this is most likely due to the increase in observation efforts.

Factors Affecting Flammulated Owl Population Status

Key Factors Inhibiting Populations and Ecological Processes

Disturbance

The owls have been shown to prefer late seral forests, and logging disturbance and the loss of breeding habitat associated with it has a detrimental effect on the birds (USDA 1994a). Timber harvesting is often done in preferred flammulated owl habitat, and some of the species' habitat and range may be declining as a result (Reynolds and Linkart 1987b, Bull *et al.* 1990). Several studies have shown a decline in flammulated owl numbers following timber harvesting (Marshall 1957; Howle and Ritcey 1987).

A main threat to the species is the loss of nesting cavities as this species cannot create its own nest and relies on existing cavities. Management practices such as intensive forest management, forest stand improvement, and the felling of snags and injured or diseased trees (potential nest sites) for fire wood effectively remove most of the cavities suitable for nesting (Reynolds *et al.* 1989). However, the owls will nest in stands that have been selectively logged, as long as they contain residual trees (Reynolds *et al.* 1989).

The suppression of wildfires has allowed many ponderosa pines to proceed to the more shade resistant fir forest types, which is less suitable habitat for these species (Marshall 1957; Reynolds *et al.* 1989). Encroachment of conifers along ridgetops can also negatively impact the black oak component in the stand through competition of resources and shading resulting in loss of potential nest cavities for flammulated owls in live hardwood trees. Roads and fuelbreaks are often placed on ridgetops and the resultant removal of snags and oaks for hazard tree removal can result in the loss of existing and recruitment nest trees.

Flamulated owls are most susceptible to disturbance during the peak of their breeding season (June and July), which corresponds to the time when they are the most vocal. Clark (1988) cautions against the extensive use of taped calls, stating that they can disrupt coutship behavior. McCallum (1994b) mentions that owls are tolerant of humans, nesting close to occupied areas and tolerating observation by flashlight at night while feeding young. Wildlife viewing, primarily bird watching and nature photography has the potential to disrupt species activity and increase their risk of exposure to predation especially during the nesting season (Knight and Gutzwiller 1995) when birds are most vocal and therefore easier to locate.

The effects of mechanical disturbance have not been assessed, but moderate disturbance may not have an adverse impact on the species. Whether a nesting pair would tolerate selective harvesting during the breeding season is not known, however, mechanical disturbance that flushes roosting birds may be a threat to adult survival in October when migrating accipiters may be more common than in June, when the possibility of lost reproduction is greater (McCallum 1994b).

Pesticides

Aerial spraying of carbaryl insecticides to reduce populations of forest insect pests may affect the abundance of non-target insects important in the early spring diets of flammulated owls (Reynolds *et al.* 1989). Although flamulated owls rarely take rodents as prey, they could be at risk, like other raptors, of secondary poisoning by anticoagulant rodenticides. Possible harmful doses could cause hemmorhaging upon the ingestion of anticoagulants such as Difenacoum, Bromadiolone, or Brodifacoum (Mendenhall and Pank 1980).

Predators/Competitors

Predators include spotted and other larger owls, accipiters, long-tailed weasels (Zeiner *et al.* 1990), felids and bears (McCallum 1994b). Nest predation has also been documented by northern flying squirrel in the Pacific Northwest (McCallum 1994a).

As flammulated owls come late to breeding grounds, competitors may limit nest site availability (McCallum 1994b). Saw-whet owls, screech owls, and American kestrels compete for nesting sites, but flammulated owls probably have more severe competition with non-raptors, such as woodpeckers, other passerines, and squirrels for nest cavities (Zeiner *et al.* 1990, McCallum 1994b). Birds from the size of bluebirds upward are potential competitors. Owl nests containing bluebird eggs and flicker eggs suggest that flammulated owls evict some potential nest competitors (McCallum 1994b). Any management plan that supports pileated woodpecker and northern flicker populations will help maintain high numbers of cavities, thereby minimizing this competition (Zeiner *et al.* 1990).

Flammulated owls may compete with western screech-owls and American kestrels for prey (Zeiner *et al.* 1990) as both species have a high insect component in their diets. Common poorwills, nighthawks, and bats may also compete for nocturnal insect prey especially in the early breeding season (April and May) when the diet of the owls is dominated by moths. (McCallum 1994b).

Exotic Species

Flicker cavities are often co-opted by European starlings, reducing the availability of nest cavities for both flickers and owls (McCallum 1994a). Africanized honey bees will nest in in tree cavities (Merrill and Visscher 1995) and may be a competitor where natural cavities are limiting, particulary in southern California where the bee has expanded its range north of Mexico.

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Rocky Mountain Elk
(*Cervus elaphus nelsoni*)

Introduction
The Blue Mountains are located in the southeast Washington and northeast Oregon. The Blue Mountains elk herd in Washington is distributed over an area of approximately 900 square miles. The primary elk range is divided into ten Game Management Units (GMUs) (Figure 1).

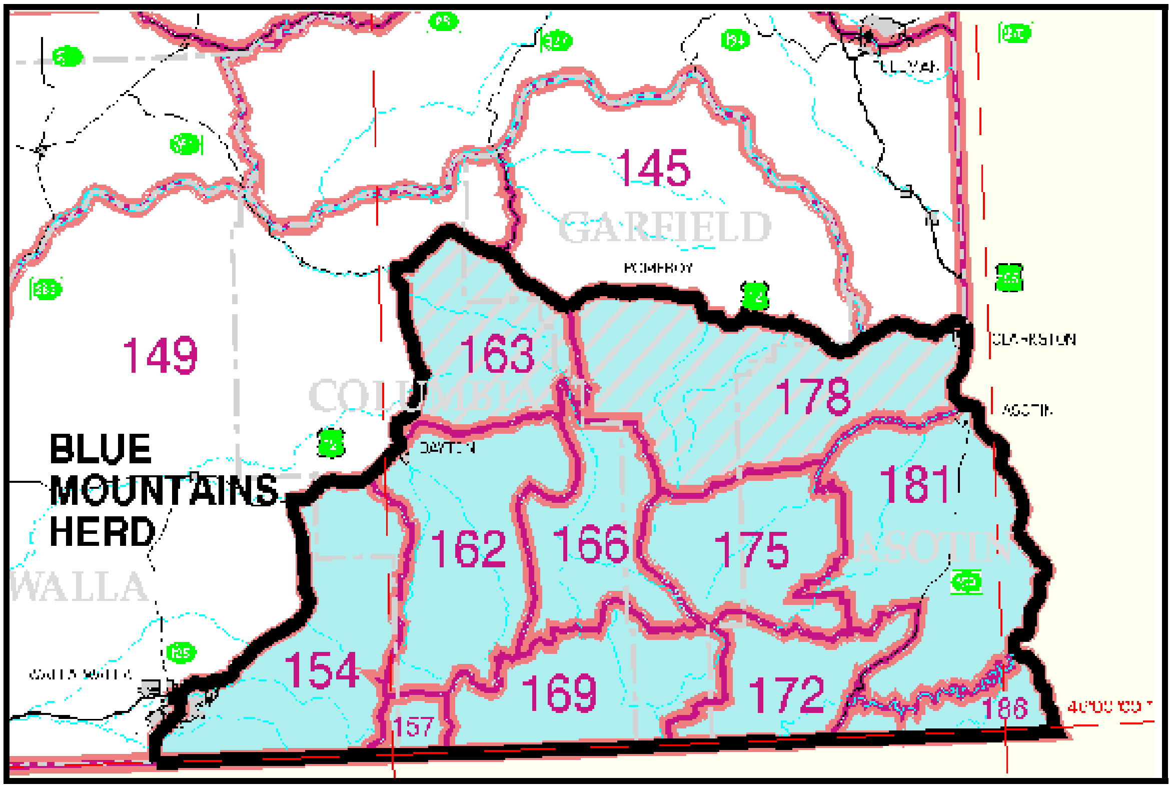

Figure 1. Game Management Units, Blue Mountains, Washington (Fowler 2001).

Ownership between public and private lands varies by GMU, but approximately 63% (565 mi^2) of the elk range is public land, whereas 37% (335 mi^2) of the area is private land.

Rocky Mountain elk are a common game species associated with forested habitats in the foothills and mountainous areas of the Blue Mountains of Washington and Oregon. Much discussion has occurred about the origin of the Blue Mountains elk herd. Elk have been present in the Columbia Basin and Blue Mountains for at least 10,000 years, and were an important source of food for Native Americans. Unregulated subsistence and market hunting by Euro-American immigrants, along with habitat changes resulting from livestock grazing and land cultivation, nearly extirpated elk from the Blue Mountains by the late 1880's (McCorquodale 1985, ODFW 1992). Transplants of elk from Yellowstone Park in the early 1900s, and changing habitat conditions allowed the Blue Mountains elk population to grow, providing a tremendous amount of consumptive and non-consumptive recreation, and economic benefits for the people of Washington and Oregon (Bolon 1994).

Life History and Habitat Requirements

Life History

Elk calves are born from mid-May to mid-June after a gestation period of 8-8.5 months. Calves weigh approximately 29-32 pounds at birth. Single calves are the norm, with twins being very rare. Cows usually calve in the transition zone between summer and winter range, and usually select brushy draws adjacent to grassy areas and water. The cows re-group 3-4 weeks after calving, and can form groups as large 150 elk.

On the summer range, adult bulls can usually be found alone or in small groups. Antler growth is usually complete by mid-August, and the velvet is shed from the antlers at that time. The breeding season, or rut, starts in early September. Prime age bulls form harems of cows and defend them against other adult and sub-adult bulls. The breeding season peaks in the third week of September and is usually complete by the second week of October, although some cows may breed later if they do not conceive during the first estrus. After the rut, adult bulls separate from the cows to regain weight lost during the rut, and prepare for the rigors of winter. During winter bulls may be found in bachelor groups of up to 20 in number (Schmidt *et al*. 1978).

Elk form winter herds in late fall as snow and weather drive them onto the winter range. Winter herds normally consist of cows, calves, and yearling bulls, and can hold as many as 150-200 elk, but usually range from 10-50. Adult bulls usually form small groups of from 2-20 bulls, and normally winter in areas separate from cow calf groups. In late winter (Feb.-March), elk tend to concentrate on areas where forage is beginning to green up.

Diet

Elk are herbivores and year around main food sources can be categorized into three basic plant types; browse, grasses, and forbs. On predominately grass ranges, up to 90% of the summer diet can consist of grasses or grass like plants, (Boyd 1970). In agricultural areas, elk are fond of peas, wheat, garbonzo beans, and oats, causing problems for farmers and wildlife personnel.

Reproduction

The elk rut, or breeding season, occurs in September to early October, with the peak of breeding in healthy populations occurring about the third week of September. Adult bull elk form harems and defend them against other adult and sub-adult bulls.

The gestation period for cow elk lasts from 245-262 days, with most calves born between mid-May and mid-June. Cow elk leave the main herds in early May and tend to select transitional range between the spring and summer range for calving. In years of abnormal weather cow elk may calve above or below their traditional calving areas. Cow elk normally select areas in the ecotone, where escape cover is available, and water is within 400 feet. Areas selected by cows are usually gentle (20-30%) slopes, with adequate brush, trees, or ground debris to provide hiding cover the calf (Thomas *et al.* 1982).

In the Blue Mountains of Washington, low pregnancy rates (65-68%) were recorded in the late-1980s and may have been the result of few adult bulls in the population and low bull ratios (2-5 bulls:100 cows) and poor physical condition in cow elk as a result of drought (Fowler 1988). In 1989, a new harvest management strategy was implemented allowing hunters to harvest only spike bull elk, and the hunting of branch-antlered bulls was controlled by permit. The goal of this strategy was to increase post-season bull ratios to a minimum of 15 bulls:100 cows and to improve breeding effectiveness by increasing the number of adult bulls in the population (Noyes *et al*.1996). Within 2 years, post-season bull ratios increased to 16 bulls:100 cows, and pregnancy rates measured in 1992-1993 had increased to an average of 90% (P. Fowler, WDFW, personal communication, 2003).

Breeding effectiveness improved dramatically as adult bull numbers increased in the elk population. Earlier breeding, smaller harem size, and more intense rutting activity were observed as the number of adult bulls increased in the elk population (Fowler per.com.). Prior to the increase in adult bulls, average mean conception dates occurred later than normal; September 30 in 1987 and October 9 in 1988, respectively. By 1992 and 1993, the average conception date for cow elk in the Blue Mountains occurred one to two weeks earlier; September 24, and September 18, respectively (Figure 2). The date of conception is important because calves that are born early have a greater chance of surviving (Thorne *et al*. 1976).

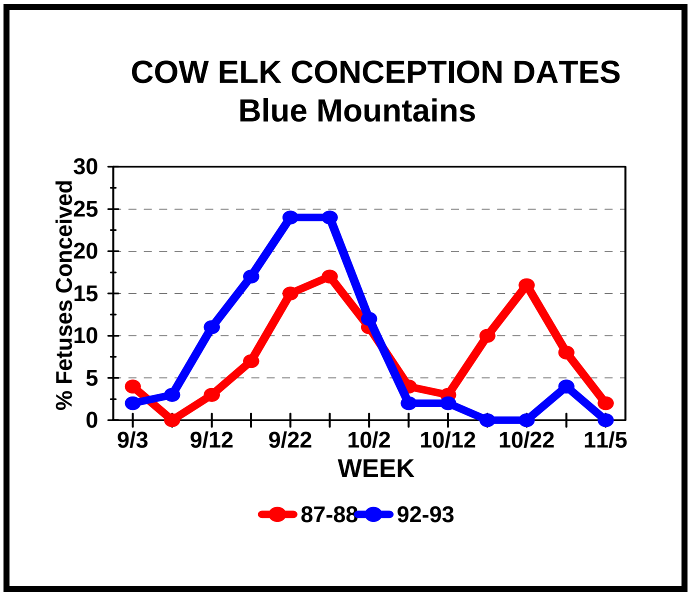

Figure 2. Cow elk conception date distribution before and after adult bull numbers were increased (Fowler 1988, 1993).

Although pregnancy rates, conception dates, and early summer calf ratios have improved to 50+ calves\100 cows, annual calf survival remains below management objective, mostly due to heavy predation by mountain lion and black bear. Survival of adult cows is also crucial for maintenance of the Blue Mountains elk herd.

Migration

Elk in the Blue Mountains of Washington do not migrate great distances. Most of the migratory elk within the east and west Blue Mountains sub-herds occur on public land, and have a short migration from summer to winter range at lower elevations (1400-4,000 feet), which may only be 2-10 air miles. Elk that spend much of their time on private land tend to be resident or semi-migratory (Myers *et. al.* 1999).

Mortality

The majority of adult elk mortality is a result of hunting. Of the known mortalities 50% of all adult mortality is due to hunting by both state licensed and Native Americans hunters. Predation accounted for 16% of the deaths, and poaching accounted for 8%. Twenty two percent of the adult elk deaths could not be classified to cause. (Myers *et al.*1999).

Mortality of calf elk during the first year of life has been a great concern to wildlife managers and the public over the last 15 years. Investigations into calf mortality were conducted between 1992-1998. Annual calf elk survival rates averaged 47% from 1993-1998, with a minimum of 78% of the mortality due to predation (Myers *et al.* 1999)

Harvest

The first hunting season for elk in the Blue Mountains of Washington was opened in 1927 for branched antlered bulls, and the first either-sex hunt was held in 1934. A combination of hunting season strategies has occurred over time, from bull only seasons, to either-sex hunts on private land. Generally, hunting seasons have consisted of bull only general seasons, with the antlerless harvest regulated by permit. In 1989, the general bull elk season was changed from “any bull” to “spike only” in order to increase the number of adult bulls in the elk population. The non-tribal elk harvest has ranged from a high of 2500 in 1974, to a low of 209 in 1998 (Table 1).

Table 1. Elk harvest history – Blue Mountains, Washington (WDFW 2001).

Year	Bulls	Cows	Total	Hunters	Days
1960	760	802	1562		
1961	731	699	1430		
1962	760	690	1450		
1963	626	530	1156		
1964	1062	641	1703		
1965	1009	673	1682		
1966	935	1297	2232		
1967	817	970	1787		
1968	1052	730	1782		
1969	925	760	1685		
1970	981	331	1312		
1971	1068	333	1401		
1972	1226	434	1660		
1973	1320	1040	2360		
1974	1278	1230	2508		
1975	1065	710	1775		
1976	1230	890	2120		
1977	1200	770	1970		
1978	1280	770	2050		
1979	1240	660	1900		
1980	1610	535	2145		
1981	1451	710	2161		
1982	1176	606	1782		
1983	1032	562	1594		
1984	813	548	1361	11506	48217
1985	831	391	1222	13452	51857
1986	701	436	1137	11763	51439
1987	799	688	1487	12581	53717
1988	614	481	1095	12131	51586
1989	358	583	941	10174	41291
1990	307	436	743	9602	NA
1991	242	281	523	9395	41386
1992	356	243	599	10023	39664
1993	269	212	481	9583	40996
1994	305	167	472	9788	36290
1995	235	15	250	6265	24586
1996	208	107	315	6463	23226
1997	380	57	437	6151	26053

Year	Bulls	Cows	Total	Hunters	Days
1998	148	61	209	5501	21769
1999	208	28	236	6039	29269
2000	243	30	273	5097	24694
2001	222	122	344	3707	17965

Two Native American tribes (Nez Perce and Umatilla Tribes) have hunting rights in the Blue Mountains of Washington. The Nez Perce Tribe holds hunting rights in ceded areas east of the Tucannon River. The Umatilla Tribe holds hunting rights in ceded areas west of the Tucannon River. The Nez Perce Tribe maintains a hunting season year around with no bag limit for tribal members. The Umatilla Tribe establishes hunting seasons for tribal members, with various restrictions on the sex and age of elk that can be taken by hunters during specific time periods. No harvest information is available from the Tribes.

Historic

Historically, the non-tribal general hunting season has been for any bull elk, with antlerless harvest by permit only. During some years, when agricultural damage was extensive, large numbers of anlterless permits were issued, or hunters were allowed to harvest either-sex elk on private lands to alleviate the problem. Some of these hunts had a significant impact on the elk population in those areas.

Current

The general bull elk hunting season was changed to a spike-only management program in 1989 after research determined conception rates for cow elk were lower than normal (65%), and post-season bull to cow ratios were 2 to 5 bulls:100 cows. Only 2% of the bull population consisted of bulls > 4 years of age prior to spike-only management. Few adult bulls existed in the population. The program was designed to improve breeding efficiency by increasing the number and age of adult bulls in the post-hunt population.

The bull harvest has declined approximately 67 % since 1985. Hunters harvested 831 bull elk in 1985, compared to a five-year average bull harvest of 243 since 1995. The reduction in the bull harvest is due to a marked decline in elk populations in GMUs 166, 169, 172, and 175, and poor calf survival, which results in fewer yearling bulls available for harvest. Low calf survival and very cold conditions during the hunting season contributed to the decline in the bull harvest.

Adult bulls are harvested under permit control. Only 28 permits were issued in 2002 for rifle, muzzleloader, and archery hunters. Permit holders harvested 15 bulls, for any overall success rate of 68%; rifle-91%, ML-50%, archery-43%. Bull permit holders can still look forward to a very high quality hunt. Six point or larger bulls comprised 87% of the 2002 harvest (P. Fowler, WDFW, personal communication, 2003) Nez Perce Tribe does not restrict the hunting of adult bulls, and tribal hunters harvest adult bulls in GMU-175 and the eastern portion of GMU-166, but no harvest data is available. The Umatilla Tribe closed GMU-162 to hunting of branched antlered bulls in 2002, in cooperation with the Washington Dept. of Fish and Wildlife, in order maintain adult bull numbers.

Habitat Requirements

The vegetative communities of the Blue Mountains are a mixture of forests and bunch-grasses on the ridges. The lowlands comprise mostly agricultural crops and range land. This combination of habitats is very attractive to elk. The Blue Mountains in Washington consist of the following forest types as described by Kuchler (1964) for the United States: Western spruce (*Picea* spp.)-fir (*Abies* spp.) forest, western ponderosa (*Pinus ponderosa*) forest, and grand fir (*A. grandis*)-Douglas fir (*Pseudotsuga menziesii*) Forest.

Two major soil types, vitrandepts and argixerolls, cover the area. Vitrandepts are of volcanic origin and are found at moderate to high elevations; these soils are formed under forested vegetation. Argixerolls are developed from loess and igneous rock and are found at lower elevations. Argixerolls support grassland, mainly bunch grasses (*Agropyron* spp.), and shrub/grass vegetation. Vegetative associations have been previously described by Daubenmire and Daubenmire (1968), Daubenmire (1970), and Franklyn and Dyrness (1973). Higher elevations are characterized by heavy conifer forests on the north slopes and in the canyons, whereas south slopes are open with scattered conifers and patches of brush. As elevation decreases, the steppe habitat type becomes more prominent and south slopes are more open, with bunch grass and low shrubs comprising the dominant vegetation. Riparian zones are dominated by deciduous trees and shrubs.

Elk are highly adaptable animals, occupying variable habitats throughout western North American, from deserts in some areas to mountains at over 10,000 feet in elevation. In the Blue Mountains of Washington, elk inhabit the foothills and mountainous regions, ranging in elevation from approximately 1,400 feet to over 6,400 feet.

As with most species, elk require food, water, and cover. Thomas (1979) defined various habitat components and how they should be managed to maximize elk use. Optimum elk habitat is arranged in such a way that forage and cover receive the maximum proper use of the maximum possible area (forage/cover ratio). In optimum habitat, cover/forage ratios should be arranged in such a way that elk make maximum use of the area in an efficient manner.

Optimum elk habitat consists of a forage cover ratio of 60% forage area and 40% cover (Thomas *et al.* 1979). Cover quality is defined in two ways; satisfactory and marginal. Satisfactory cover consists stands of coniferous trees that are > 40 feet tall, with a canopy closure of > 70%. Marginal cover is defined as coniferous trees > 10 feet tall with a canopy closure of > 40%. Cover provides protection from weather and predators. Forage areas are all areas that do not fall into the definition of cover. Optimal elk use of forage areas occurs within 600 feet of cover areas (Reynolds 1962; Harper 1969; Kirsch 1962; Hershey and Leege 1976; Pedersen 1974; Leckenby 1984).Proper spacing of forage and cover areas is very important in order to maximize use of these areas by elk (Thomas *et al.* 1979).

Land managers should strive to meet the habitat needs of elk, and do so by following guidelines that will provide good forage/cover ratios that allow elk to maximize use of the area, and to maintain or improve cover and forage conditions to optimal levels.

In order for elk to maximize use of available habitat, the area must be secure from frequent human disturbance. Elk use of good habitat can be greatly reduced by human activity (Perry *et al.* 1977) (Lyndecker 1994). Areas of good habitat should be secure from high levels of human disturbance, especially during sensitive periods, such as breeding areas in September, winter ranges, and calving areas. Several area closures have been implemented on winter ranges and calving areas in the Blue Mountains of Washington.

Population and Distribution

Population

Between 1993-2002, the Blue Mountains elk population in Washington averaged 4,500 elk (range: 4,300 - 4,700 90% C.I.). This estimate is based on the number of elk observed (n = 3652), adjusted for sightability (Unsworth *et al.*1994). Surveys in 2003 produced a population estimate of 4750 elk. Based upon estimated habitat carrying capacity and historic population levels, the elk population management objective for the Blue Mountains of Washington is 5,600 (WDFW 2001).

Three major sub populations have been identified in the Blue Mountains of Washington. These sub herds are located in the eastern Blue Mtns. (GMUs 172, 175, 181, 186, and that portion of the Tucannon unit east of the Tucannon River), west Blue Mtns. (GMUs 154, 157, 162, and 166 west of the Tucannon River), and the Wenaha-Tucannon Wilderness. Six sub-populations were identified within the east and west Blue Mountains sub-herds (Myers. *et. al*. 1999).

In GMU 154-Blue Creek (Walla Walla sub-basin), elk migrate into Washington from Oregon during periods of severe weather, which causes the wintering elk population in Washington to fluctuate dramatically. Elk from GMU 157-Watershed also winter in GMU 154. The number of elk counted during surveys over the last ten years (1994-2003) has ranged from 623 to 1063, and averaged 843. In 2003, 669 elk counted in GMU's 154 and 157.

The number elk counted during surveys of GMU 162-Dayton (Walla Walla subbasin) over the last ten years has ranged from 591 to 1028, and averaged 782. In 2003, 751 elk were counted in GMU-162. Antlerless permits have been increased dramatically to alleviate agricultural damage problems on private land, and as a result the population on private land is declining. The number of elk counted during surveys in GMU 166-Tucannon (Tucannon subbasin) over the last ten years has ranged from 369 to 521, and averaged 431. In 2003, 444 elk were counted. Adult bull survival in the Tucannon herd has also declined significantly over the last six years, due to poaching and treaty hunting by the Nez Perce Tribe.

The elk population north of the Wenaha River in GMU 169 Wenaha (Grande Ronde subbasin) has declined by approximately 1500 elk since the 1980's. Surveys conducted in the mid-1980s documented 2,500 elk wintering north of the Wenaha; only 500 elk were estimated (453 elk counted-ODFW) based on spring surveys in 2003. Several factors are thought to have contributed to the observed decline in elk numbers, including: documented low calf survival for many years; and, harvest of cow elk during antlerless hunts in adjacent units of Oregon and Washington (GMU 172). Changes in the vegetative communities resulting from fire suppression within the Wenaha Wilderness may have reduced the carrying capacity for elk, causing elk to move further south into Oregon to find adequate winter range. This exposed them to late-season antlerless hunts in Oregon. Between 1995 and 1999 Oregon responded by reducing and/or eliminating antlerless permits in units that are below management objectives.

The number of elk counted during surveys over the last ten years in GMU 172-Mountain View (Grande Ronde subbasin) has ranged from 290 to 671, and averaged 425 elk. In 2003, 671 elk were counted in GMU 172. However, the 2003 count may have been inflated by approximately 250 elk due to intense shed antler hunting activity in GMU 169, which may have re-distributed elk into GMU 172. The population decline that occurred in the mid 1990s was a direct result of low calf survival and cow elk lost to antlerless permits issued for damage control prior to 1995. Since 1995, management action was taken to reduce the loss of cow elk to damage control.

The number of elk counted during surveys over the last ten years in GMU 175 Lick Creek (Asotin subbasin) has ranged from 539 to 791, and averaged 661. In 2003, 701 elk counted in GMU 175. Low calf survival and the loss of antlerless elk from the population have been identified as factors that negatively impact this elk herd. Adult bull survival in GMU 175 is the lowest of any GMU in the Blue Mountains at 1ad.bull/100 cows, compared to an average of 10 ad.bulls/100 cows for all other units. Adult bull survival in the Lick Creek herd has never improved, while herds in other GMU's have shown significant improvement.

While GMU 178 Peola (Tucannon subbasin) is not managed to encourage elk, poor maintenance of the elk fence and a continuous loss of elk to damage control prior to 1997 contributed significantly to declining elk numbers in adjacent elk units (GMUs 166, 175). The installation of one-way gates in the elk fence has greatly reduced the loss of elk to damage control in this unit.

Neither GMU 181 Couse nor GMU 186 Grande Ronde contain major elk populations. Elk numbers in GMU 181 have ranged from 10-150 during surveys. The resident elk population in GMU 186 varies between 50 and 150 elk. Elk from Oregon move into GMU 186 during the winter months, increasing the elk population by 250 to 550 elk, depending on the severity of winter conditions.

Historic

Historically, elk were common throughout the Blue Mountains and Columbia Basin, but were almost extirpated during the late 1800s and early 1900s. Transplants from Yellowstone Park in the early 1900s provided breeding stock to supplement the low density populations that existed at that time. The transplants, along with habitat changes that occurred through the mid 1900s allowed the elk population to grow to approximately 6,500 head in Washington (McCorquodale 1985; ODFW 1992).

Current

Elk are distributed throughout the foothills and higher elevations of the Blue Mountains. The density of the elk population in the Blue Mountains of Washington varies among the ten Game Management Units (GMUs). Major wintering populations occur in GMUs 154, 157, 162, 166, 169, 172, and 175. Smaller populations occur in GMUs 178, 181, and 186. The lowland areas and portions of the foothills have been taken over by agriculture, and conflicts occur when elk move into these areas.

Transplants/Introductions

Several transplants of elk have occurred in the Blue Mountains, three in the early 1900s, and one in 2000.

Historic

The elk population in the Blue Mountains was at a very low level in the early 1900s. To help recover the elk population, farmer-ranchers-sportsmen's groups in southeast Washington initiated transplants of elk from Yellowstone National Park. Twenty-eight elk were released from Pomeroy in 1911; 50 elk from Walla Walla in 1919; and 26 elk from Dayton 1931 (Urness 1960). The first season for branched-antlered bull elk was held in 1927, and the first either-sex season in 1934 to reduce elk numbers and control damage on private lands in the Charley (Asotin Creek drainage) and Cummings Creek (Tucannon drainage) drainages.

Current

On March 7 and 8, 2000, seventy-two elk from the Hanford Site (DOE) were released in GMU-175 Lick Creek (Asotin subbasin) in an effort to improve productivity and increase the population to management objective. Approximately 80% of the elk released migrated to the north and west, leaving the unit within three months. As a result, small groups of elk have established themselves in lowland agricultural areas, which may pose a major problem in the near future (P. Fowler, WDFW, personal communication, 2003).

Status and Abundance Trends

Status

Elk populations in the Blue Mountains have declined by approximately 1500-2000 animals since 1985. Aerial surveys are conducted annually in March to determine herd composition and population trend (Table 2). Since 1995, the elk population has remained fairly stable, ranging from a low of 3,902 to a high of 4750. The 2003, late winter elk population is estimated at 4,750. Sub-populations in GMU 169 Wenaha, GMU 175 Lick Creek, the eastern portion of GMU 166

Tucannon, and GMU 172 Mt. View are below population management objectives by approximately 1,000 elk. The goal is to increase elk populations that are below management objective in units containing primarily public land, with an overall population management objective of 5,600 elk (WDFW 2001).

Table 2. Elk composition and-population trend surveys for the Blue Mountains, March 1987-2003 (WDFW 2002).

Year	Bulls:100 Cows	Adult Bulls:100 Cows	Calves:100 Cows	Sample Size
1987	7	2	35	2060
1988	6	1	32	2962
1989	5	3	22	4196
1990	8	3	25	3706
1991	11	7	28	4072
1992	16	10	18	3560
1993	13	8	19	4092
1994	14	10	18	3161
1995	17	13	20	3689
1996	14	11	15	3656
1997	13	9	24	3405
1998	11	8	23	3118
1999	13	10	23	3615
2000	12	9	17	3628
2001	10	7	21	3874
2002	13	7	21	3795
2003	12	9	29	3740

Trends

Table 3. Elk survey trends (1993-2000) and population objectives (WDFW 2001)

GMU	Mean No. Elk Counted 1993-2000	Population Objective	Average Bull Ratio 1993-2000	Bull Ratio Objective
154-157 Blue Creek-Watershed	813	800	15	15
162 -Dayton	757	800	14	15
166 -Tucannon	423	700	11	15
169 -Wenaha	476	1,400	24	20
172 -Mountain View	404	700	20	15
175 -Lick Creek	623	1,000	6	15
178 -Peola	N\A	30	—	—
181 -Couse	35	≤50	—	—
186 -Grande Ronde	62	≤150	—	15
Total	**3,593**	**5,600**	**—**	**—**

Factors Affecting Population Status

Key Factors Inhibiting Populations and Ecological Processes

Recent studies (Myers *et. al.* 1999) have documented how road densities, forage:cover ratios, stand composition, amount of edge, and opening size influence seasonal elk use, especially in the eastern Blue Mountains. In some units of National Forest land, elk face problems from high road densities, and habitat deterioration from long term fire suppression and past logging practices. Many habitat improvement projects have been developed and completed by WDFW, USFS, RMEF, and Blue Mountain elk Initiative to improve habitat for elk on National Forest lands, and reduce elk damage on private lands.

Habitat Deterioration

Fire suppression has reduced long-term habitat effectiveness on National Forest land by reducing the quality of the elk habitat in many areas of the Blue Mountains, and especially in GMUs 157, 162, 166, 169, 172, and 175. Lack of fire has allowed timber stands to accumulate fuel (dead, down trees) loads that inhibit forage growth and movement by elk. Browse species, such as Mtn. Maple grow to heights that prevent elk from utilizing browse as forage. Fire prevents fuel levels and blow downs from accumulating and keeps browse species regenerating at levels that provide forage for elk and other big game. The USFS's new Fire Management Policy will improve habitat conditions for elk through the use of prescribed and controlled natural fires. This policy will affect the National Forest lands within the Pomeroy Ranger District (Walla Walla, Tucannon, Asotin subbasins), and will hopefully allow fire to play its natural role in maintaining habitat conditions in this area. WDFW will work with USFS to improve habitat conditions through the use of fire.

Road Densities

The use of off-road vehicles on developed trail systems on USFS land in GMUs 162 and 166 could result in increased harassment of elk and decreased use by elk in prime habitat areas. This problem is especially acute when trails are constructed through known elk calving areas and high-use summer habitat. WDFW will continue to work closely with the USFS on Travel and Access Management Plans in order to minimize this impact.

WDFW and USFS have initiated motorized access closures on winter range to reduce harassment to wintering elk. Area closures have also been implemented around major elk calving areas. Violations of the closures continue to be an ongoing problem. WDFW has worked closely with the USFS to improve habitat effectiveness for elk by reducing road densities in important elk habitat. In GMU 162, road closures have been initiated on the Walla Walla and Pomeroy Ranger Districts. However, some of these closures allow ATV (4-wheeler-motorcycle) use, which is incompatible with the objective of increasing elk use of these areas. In GMU 166, increased road building is a problem, and a road closure program has been implemented on the Pomeroy Ranger District; however, better enforcement and control of firewood cutting is needed to improve elk utilization in many areas. Increased vehicle traffic due to firewood cutting from summer-fall reduces elk use of areas near roads (Perry and Overly 1977).

In GMU 175 (Lick Creek), high road densities on USFS land combined with uncontrolled firewood cutting reduce summer range habitat effectiveness for elk. A winter range closure and calving area closures have been initiated in this unit. However, based on field observations, violations of these closures appear to be increasing.

Noxious Weeds

The spread of noxious weeds continues to be a major problem in many areas; noxious weeds can out-compete and replace plant communities used by elk, resulting in a reduction in available elk forage. WDFW has implemented weed control programs on its lands, and continues to work with USFS to identify and control noxious weeds on USFS lands. In GMU 166, noxious weeds are a problem on elk winter range. A weed control program was initiated on the Wooten Wildlife Area in GMU 166; however, noxious weeds on adjacent private lands threaten to compromise weed control efforts on the Wildlife Area. Habitat conditions on private lands in GMUs 154, 157, and 162 continue to deteriorate due to noxious weeds, such as the yellow starthistle.

In GMU 162 (Dayton) forage enhancement and water development projects involving the RMEF have been completed on Robinette and Eckler mountains (Rainwater Wildlife Area –CTUIR Lands). These projects have been successful in attracting elk onto these areas, and should be maintained.

Silvicultural Practices

Silvicultural treatment, especially clear cutting adjacent to open roads, has impacted elk habitat in many areas in the Blue Mountains. Numerous clear cuts reduce the amount of security and thermal cover available for elk, and associated road development increases vulnerability. Elk have shown preference for areas with large tracts providing security cover, smaller sized openings, and edge areas (Myers *et al.*1999). In GMUs 166 and 175, increased logging, open roads, and uncontrolled firewood cutting have contributed to declining elk use in areas of important summer habitat.

Grazing

In GMU 172 (Mountain View), range conditions on USFS lands appear to be good, but many private land parcels appear to be over-grazed, a condition that dramatically increases the risk of a noxious weed problem. Habitat conditions on public land in GMU 186 (Grande Ronde) are fair. Trespass cattle on the Chief Joseph Wildlife Area continue to be an annual nuisance. Grazing permits on the Asotin Wildlife Area have been terminated, with the exception of the Weatherly parcel. Forage enhancement projects, controlled burns, water developments, and area closures have been initiated in the Blue Mountains.

Development

The sale and sub-division of large tracts of land also contributes to the loss of elk habitat in some areas. Habitat conditions in GMU 154 continue to deteriorate due to subdividing of land into smaller parcels for residential construction.

Agricultural Damage

Elk damage to crops and fences is a continuing problem on the lowlands of the Blue Mountains elk herd area. The WDFW Enforcement Program has maintained recent records of damage complaints and claims for damage (Table 4). Elk damage complaints reported to WDFW in 1995, 1998 and 1999 ranged between 36 and 47. Elk damage appears to occur more frequently during the period April through September. During winters with heavy snowfall, damage to hay stacks may also be a problem.

Agricultural damage and landowner intolerance continue to be a significant elk management problem in GMU 154 (Blue Creek). However, the development and implementation of the Blue Mountains Elk Control Plan (Fowler *et al.* 1991) has improved landowner/WDFW relations.

In GMU 162 (Dayton), agricultural damage is historical on northern Robinette Mountain and in the upper Hately Gulch-Patit areas of Eckler Mountain. The use of hot-spot hunts and landowner preference permits have improved landowner/WDFW relations, but complaints of elk damage continue.

Within GMU 172 (Mountain View), landowner/elk conflicts occur on both agricultural crop lands and private range land because elk compete with domestic livestock on native range. This has forced the WDFW to maintain elk numbers below their potential. In GMU 172, a program

Table 4. Elk damage claims (1996-1999), Blue Mountains, Washington (WDFW 2001).

County	Date	Species	Crop	Claim	Paid	Status
Asotin	10-01-96	Elk	Unk.	Unk.	N/A	Rejected
Garfield	11-24-96	Elk	wheat	$620.50	.10.50	Paid
Asotin	1-24-97	Elk	hay stack	$200.00	$150.00	Paid
Asotin	1-27-97	Elk-Deer	hay stack	$216.00	$216.00	Paid
Asotin	1-25-97	Elk	barley	$3,750.40	$2,800.00	Paid
Asotin	8-28-97	Elk	barley	$454.50	$454.50	Paid
Asotin	10-20-97	Elk	wheat	$364.12	$331.12	Paid
Asotin	10-14-97	Elk	hay	$103.68	$103.68	Paid
Columbia	9-12-97	Elk-Deer	wheat	$29,600.00	$1,872.00	Paid
Columbia	9-12-97	Elk-Deer	wheat	$10,800.00	$8,075.68	Paid
Columbia	7-25-97	Elk-Deer	peas	$6,360.24	$6,360.24	Paid
Columbia	7-25-97	Elk-Deer	peas	$990.18	$990.18	Paid
Garfield	9-29-97	Elk	wheat	$1,185.00	$1,185.00	Paid
Walla Walla	11-3-97	Elk	wheat	$6,868.00		Rejected
Walla Walla	11-3-97	Elk	peas	$8,300.00		Rejected
Asotin	3-18-98	Elk-Deer	alfalfa	$1,000.00	$427.50	Paid
Columbia	8-17-98	Elk-Deer	wheat	$200.00	$200.00	Paid
Columbia	8-26-98	Elk	wheat	$500.00	$500.00	Paid
Columbia	8-31-98	Elk	wheat-oat	$2,500.00	$2,037.80	Paid
Columbia	8-31-98	Elk	barley	$1,000.00	$407.74	Paid
Columbia	10-08-98	Elk	Unk.	Unk.		Rejected
Walla Walla	9-13-98	Elk	barley	$266.66	$206.66	Paid
Walla Walla	8-28-98	Elk				Rejected
Asotin	9-10-99	Elk	hay	$543.00		
Columbia	8-02-99	Elk	wheat	Unk.		Rejected
Columbia	8-02-99	Elk	barley	Unk.		Rejected
Columbia	8-16-99	Elk	peas	$4,985.79		
Columbia	9-20-99	Elk-Deer	wheat	$5,000.00		
Columbia	9-20-99	Elk-Deer	barley	$3,000.00		
Garfield	9-27-99	Elk	wheat	$1,304.60		
Garfield	9-06-99	Elk	wheat	$1,914.00	$1,914.00	
Walla Walla	9-03-99	Elk-Deer	wheat	$3,000.00		
Walla Walla	8-23-99	Elk	peas	$4,125.00		

involving land purchases, forage enhancement programs, and landowner compensation is needed to increase landowner tolerance of elk.

A 27-mile long elk fence forms the entire southern border of GMU 178 (Peola). The fence extends from the Wooten Wildlife Area on the Tucannon Road, east to USFS land on the Mountain Road, then east to the edge of the Asotin Wildlife Area on Tam Tam Ridge in GMU175. This fence was designed to prevent large numbers of elk from moving north onto agricultural lands in GMU 178. However, elk damage complaints from a few landowners have been a continuous problem for many years. Failure to adequately maintain the elk fence and the inadequate length of the fence has resulted in large numbers of elk accessing private land and causing damage. Approximately 1,206 cow elk have been harvested in this unit using either-sex seasons between 1975-1994. From 1994 to 1997, permits have been issued to control the harvest of elk in this unit. Excessive kills in this unit provides a major drain on elk numbers in GMUs 166 and 175 and is one of the reasons these populations are below population management objectives.

The solution to damage problems in GMU 178 lies in the implementation of several programs. In fall 1997, 12 one-way gates were placed at strategic points along the fence to allow elk that are outside the fence to cross back through, thus eliminating the loss of large numbers of elk trapped outside the fence. These one-way gates appear to be working, allowing elk trapped outside the elk fence in GMU 178 to move back through the fence into GMU's 166 and 175. In addition, the elk fence must receive higher priority in the capital budget and a maintenance schedule must be implemented that maintains and repairs the fence throughout the year. The elk fence should be extended for approximately two miles along its eastern boundary to stop elk from going around the fence during the winter. Lastly, the Program with damage control responsibilityshould prioritize at least $3,000/year for helicopter time to herd elk back inside the fence when necessary.

The elk in the Schumaker Grade-Ten Mile area in GMU 181 (Couse) tend to cause landowner damage complaints if numbers exceed 25-50 elk. The number of elk wintering in this unit has increased dramatically from1992 to elk in 1996, with as many as 150 elk moving into the area. This shift in elk distribution is due to two factors. First, a late cow hunt in GMU 172 was held from 1989 to 1994 to address landowner complaints but was terminated in 1995 due to declining elk numbers. Hunter pressure from this season forced elk to move westward into GMU 181 to avoid hunting pressure, causing a redistribution of elk over time. Second, range conditions in GMU 172 are poor due to overgrazing by domestic livestock, which contributes to elk moving to the west, across the Rattlesnake Grade, during periods of severe weather. Early- and late-muzzleloader seasons were implemented in 1997 to encourage these elk to stay east of the Rattlesnake Grade. Only 26 cow elk have been harvested during this muzzleloader season, and the number of elk counted in GMU-181 Couse during post-season surveys has dropped from 150 in 1996, to 26 in 1997, to zero in 1998. The number of elk counted in GMU-172 Mountain View during this same period has increased by 119.

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Yellow Warbler
(*Dendroica petechia*)

Introduction

The yellow warbler (*Dendroica petechia*) is a common species strongly associated with riparian and wet deciduous habitats throughout its North American range. In Washington it is found in many areas, generally at lower elevations. It occurs along most riverine systems, including the Columbia River, where appropriate riparian habitats have been protected. The yellow warbler is a good indicator of functional subcanopy/shrub habitats in riparian areas.

Life History and Habitat Requirements

Life History

Diet

Yellow warblers capture and consume a variety of insect and arthropod species. The species taken vary geographically. Yellow warblers consume insects and occasionally wild berries (Lowther *et al.* 1999). Food is obtained by gleaning from subcanopy vegetation; the species also sallies and hovers to a much lesser extent (Lowther *et al.* 1999) capturing a variety of flying insects.

Reproduction

Although little is known about yellow warbler breeding behavior in Washington, substantial information is available from other parts of its range. Pair formation and nest construction may begin within a few days of arrival at the breeding site (Lowther *et al.* 1999). The reproductive process begins with a fairly elaborate courtship performed by the male who may sing up to 3,240 songs in a day to attract a mate. The responsibility of incubation, construction of the nest and most feeding of the young lies with the female, while the male contributes more as the young develop. In most cases only one clutch of eggs is laid; renesting may occur, however, following nest failure or nest parasitism by brown-headed cowbirds (Lowther *et al.* 1999). The typical clutch size ranges between 4 and 5 eggs in most research studies of the species (Lowther *et al.* 1999). Egg dates have been reported from British Columbia, and range between 10 May and 16 August; the peak period of activity there was between 7 and 23 June (Campbell *et al.* in press). The incubation period lasts about 11 days and young birds fledge 8-10 days after hatching (Lowther *et al.* 1999). Young of the year may associate with the parents for up to 3 weeks following fledging (Lowther *et al.* 1999).

Nesting

Results of research on breeding activities indicate variable rates of hatching and fledging. Two studies cited by Lowther *et al.* (1999) had hatching rates of 56 percent and 67 percent. Of the eggs that hatched, 62 percent and 81 percent fledged; this represented 35 percent and 54 percent, respectively, of all eggs laid. Two other studies found that 42 percent and 72 percent of nests fledged at least one young (Lowther *et al.* 1999); the latter study was from British Columbia (Campbell *et al.* in press).

Migration

The yellow warbler is a long-distance neotropical migrant. Spring migrants begin to arrive in the region in April. Early dates of 2 April and 10 April have been reported from Oregon and British Columbia, respectively (Gilligan *et al.* 1994, Campbell *et al.* in press). Average arrival dates are somewhat later, the average for south-central British Columbia being 11 May (Campbell *et al.* in press). The peak of spring migration in the region is in late May (Gilligan *et al.* 1994). Southward migration begins in late July, and peaks in late August to early September; very few migrants remain in the region in October (Lowther *et al.* 1999).

Mortality

Little has been published on annual survival rates. Roberts (1971) estimated annual survival rates of adults at 0.526 ±0.077 SE, although Lowther *et al.* (1999) felt this value underestimated survival because it did not account for dispersal. The oldest yellow warbler on record lived to be nearly 9 years old (Klimkiewicz *et al.* 1983).

Yellow warblers have developed effective responses to nest parasitism by the brown-headed cowbird (*Molothrus ater*). The brown-headed cowbird is an obligate nest brood parasite that does not build a nest and instead lays eggs in the nests of other species. When cowbird eggs are recognized in the nest the yellow warbler female will often build a new nest directly on top of the original. In some cases, particularly early in the incubation phase, the female yellow warbler will bury the cowbird egg within the nest. Some nests are completely abandoned after a cowbird egg is laid (Lowther *et al.* 1999). Up to 40 percent of yellow warbler nests in some studies have been parasitized (Lowther *et al.* 1999).

Habitat Requirements

The yellow warbler is a riparian obligate species most strongly associated with wetland habitats and deciduous tree cover. Yellow warbler abundance is positively associated with deciduous tree basal area, and bare ground; abundance is negatively associated with mean canopy cover, and cover of Douglas-fir (*Pseudotsuga menziesii*), Oregon grape (*Berberis nervosa*), mosses, swordfern (*Polystuchum munitum*), blackberry (*Rubus discolor*), hazel (*Corylus cornuta*), and oceanspray (*Holodiscus discolor*) (Rolph 1998).

Partners in Flight have established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: >70 percent cover in shrub layer (<3 m) and subcanopy layer (>3 m and below the canopy foliage) with subcanopy layer contributing >40 percent of the total; shrub layer cover 30-60 percent (includes shrubs and small saplings); and a shrub layer height >2 m. At the landscape level, the biological objectives for habitat included high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches; and a low percentage of agricultural land use (Altman 2001).

Nesting

Radke (1984) found that nesting yellow warblers occurred more in isolated patches or small areas of willows adjacent to open habitats or large, dense thickets (i.e., scattered cover) rather than in the dense thickets themselves. At Malheur National Wildlife Refuge, in the northern Great Basin, nest success 44 percent (n = 27), however, cowbird eggs and young removed; cowbird parasitism 33 percent (n = 9) (Radke 1984).

Breeding

Breeding yellow warblers are closely associated with riparian hardwood trees, specifically willows, alders, or cottonwood. They are most abundant in riparian areas in the lowlands of eastern Washington, but also occur in west-side riparian zones, in the lowlands of the western Olympic Peninsula, where high rainfall limits hardwood riparian habitat. Yellow warblers are less common (Sharpe 1993). There are no BBA records at the probable or confirmed level from subalpine habitats in the Cascades, but Sharpe (1993) reports them nesting at 4000 feet in the Olympics. Numbers decline in the center of the Columbia Basin, but this species can be found commonly along most rivers and creeks at the margins of the Basin. A local breeding population exists in the Potholes area.

Non-Breeding

Fall migration is somewhat inconspicuous for the yellow warbler. It most probably begins to migrate the first of August and is generally finished by the end of September. The yellow warbler winters south to the Bahamas, northern Mexico, south to Peru, Bolivia and the Brazilian Amazon.

Population and Distribution

Population

Historic

No historic data could be found for this species.

Current

No current data could be found for this species.

Distribution

Historic

Jewett *et al.* (1953) described the distribution of the yellow warbler as a common migrant and summer resident from April 30 to September 20 in the deciduous growth of Upper Sonoran and Transition Zones in eastern Washington and in the prairies and along streams in southwestern Washington. They describe its summer range as north to Neah Bay, Blaine, San Juan Islands, Monument 83; east to Conconully, Swan Lake, Sprague, Dalkena, and Pullman; south to Cathlamet, Vancouver and Bly, Blue Mts., Prescott, Richland, and Rogersburg; and west to Neah Bay, Grays Harbor, and Long Beach. Jewett *et al. (*1953) also note that the yellow warbler was common in the willows and alders along the streamsof southeastern Washington and occurs also in brushy thickets. They state that its breeding range follows the deciduous timber into the mountains, where it porbably nests in suitable habitat to 3,500 or perhaps even to 4,000 feet – being common at Hart Lake in the Chelan region around 4,000 feet. They noted it was a common nester along the Grande Ronde River, around the vicinity of Spokane, around Sylvan Lake, and along the shade trees along the streets of Walla Walla.

Current

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998). Browning (1994) recognized 43 subspecies; two of these occur in Washington, and one of them, *D.p. brewsteri*, is found in western Washington. This species is a long-distance migrant and has a winter range extending from western Mexico south to the Amazon lowlands in Brazil (AOU 1998). Neither the breeding nor winter ranges appear to have changed (Lowther *et al.* 1999).

The yellow warbler is a common breeder in riparian habitats with hardwood trees throughout the state at lower elevations. It is a locally common breeder along rivers and creeks in the Columbia Basin, where it is declining in some areas. Core zones of distribution in Washington are the forested zones below the subalpine fir and mountain hemlock zones, plus steppe zones other than the central arid steppe and canyon grassland zones, which are peripheral. Figure 1 shows the distribution of the yellow warbler in Washington (Smith *et al.* 1997).

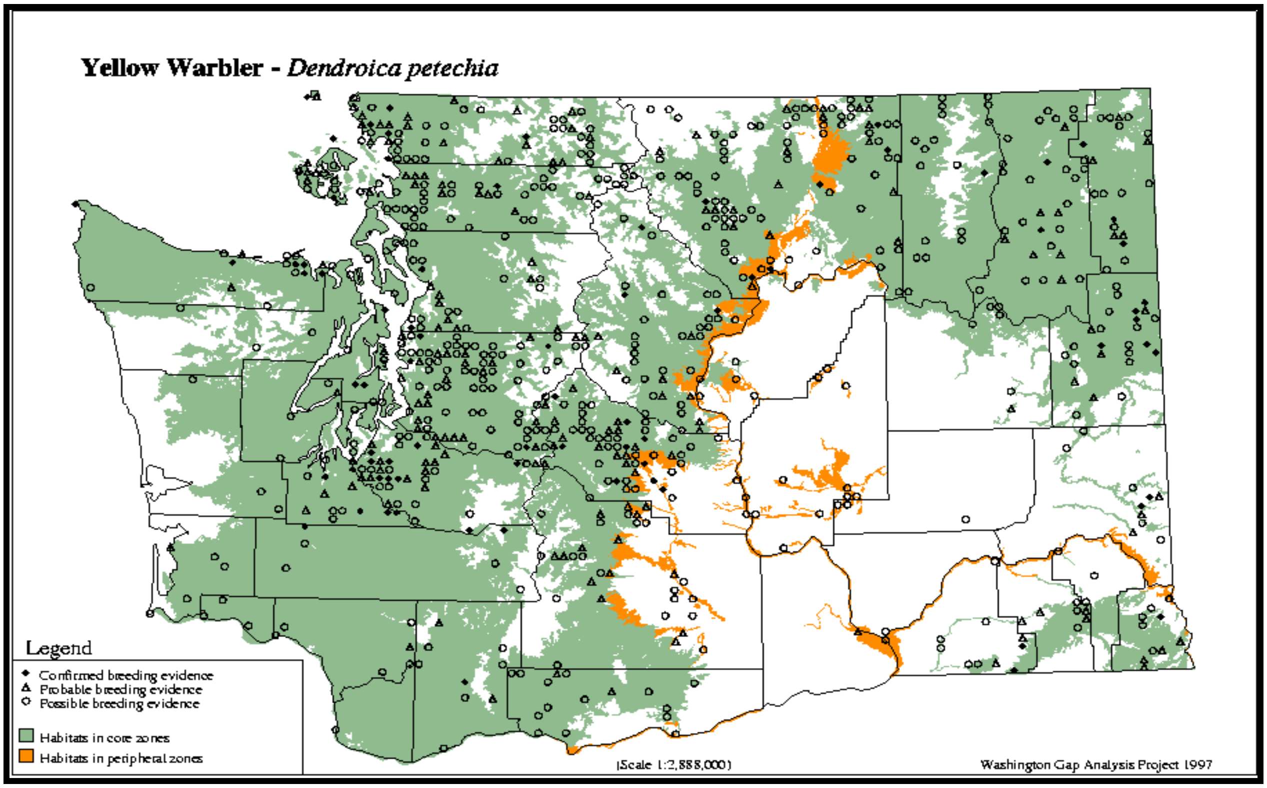

Figure 1. Breeding bird atlas data (1987-1995) and species distribution for yellow warbler (Washington GAP Analysis Project 1997).

Breeding

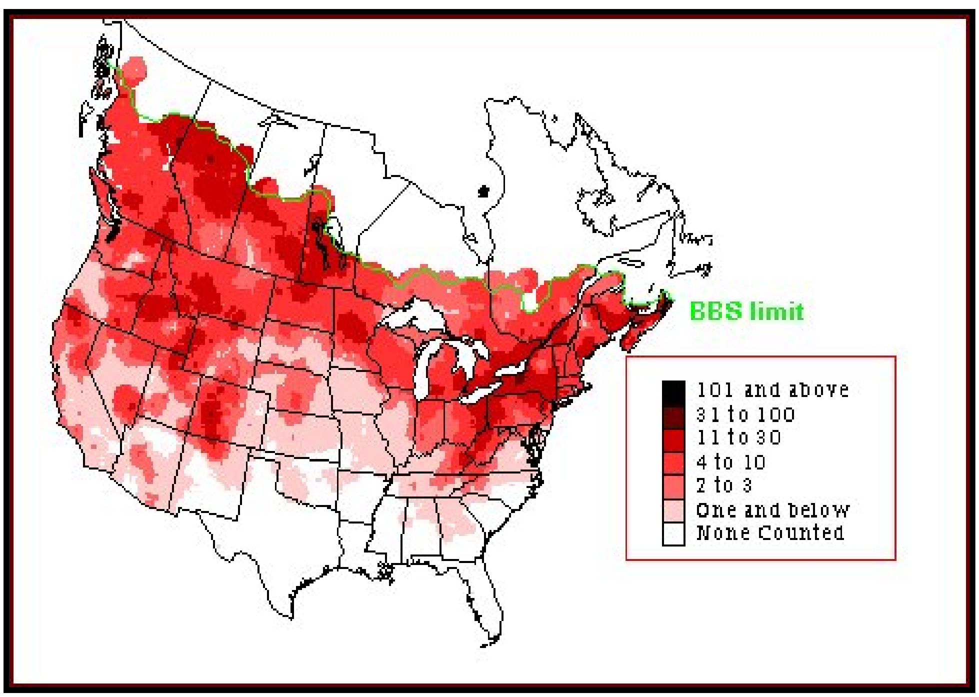

Figure 2 Yellow warbler breeding season abundance from BBS data (Sauer *et al.* 2003).

The yellow warbler breeds across much of the North American continent, from Alaska to Newfoundland, south to western South Carolina and northern Georgia, and west through parts of the southwest to the Pacific coast (AOU 1998) (Figure 2).

Non-Breeding

This data is not readily available; however, the yellow warbler is a long-range neotropical migrant. Its winter range is from Northern Mexico south to Northern Peru.

Status and Abundance Trends

Status

Yellow warblers are demonstrably secure globally. Within the state of Washington, yellow warblers are apparently secure and are not of conservation concern (Altman 1999).

Trends

Yellow warbler is one of the more common warblers in North America (Lowther *et al.* 1999). Information from Breeding Bird Surveys indicates that the population is stable in most areas. Some subspecies, particularly in southwestern North America, have been impacted by degradation or destruction of riparian habitats (Lowther *et al.* 1999). Because the Breeding Bird Survey dates back only about 30 years, population declines in Washington resulting from habitat loss dating prior to the survey would not be accounted for by that effort (Figure 3).

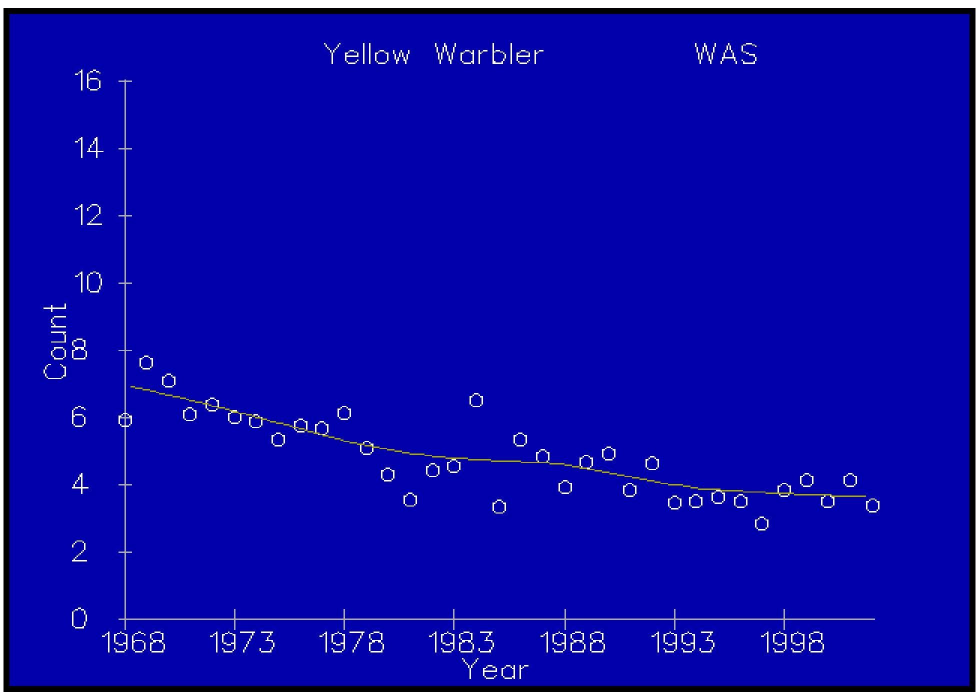

Figure 3. Yellow warbler population trend from BBS data (1966 – 1991) (Peterjohn 1991).

Factors Affecting Yellow Warbler Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat loss due to hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduction of overall area of riparian habitat, conversion of riparian habitats, inundation from impoundments, cutting and spraying for ease of access to water courses, gravel mining, etc.

Habitat degradation from: loss of vertical stratification in riparian vegetation, lack of recruitment of young cottonwoods, ash, willows, and other subcanopy species; stream bank stabilization (e.g., riprap) which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation; invasion of exotic species such as reed canary grass and blackberry; overgrazing which can reduce understory cover; reductions in riparian corridor widths which may decrease suitability of the habitat and may increase encroachment of nest predators and nest parasites to the interior of the stand.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird) and domestic predators (cats), and be subject to high levels of human disturbance.

Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas.

Increased use of pesticide and herbicides associated with agricultural practices may reduce insect food base.

Out-of-Subbasin Effects and Assumptions
No data could be found on the migration and wintering grounds of the yellow warbler. It is a long-distance migrant 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). Riparian management requires the protection of riparian shrubs and understory and the elimination of noxious weeds. Migration routes, corridors and wintering grounds need to be identified and protected just as its breeding areas. In addition to loss of habitat, the yellow warbler, like many wetland or riparian associated birds, faces increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus.

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American Beaver
(*Castor canadensis*)

Introduction

The American beaver (*Castor canadensis*) is a large, highly specialized aquatic rodent found in the immediate vicinity of aquatic habitats (Hoffman and Pattie 1968). The species occurs in streams, ponds, and the margins of large lakes throughout North America, except for peninsular Florida, the Arctic tundra, and the southwestern deserts (Jenkins and Busher 1979). Beavers construct elaborate lodges and burrows and store food for winter use. The species is active throughout the year and is usually nocturnal in its activities. Adult beavers are nonmigratory.

Life History and Habitat Requirements

Life History

Diet

Beavers are exclusively vegetarian in diet. A favorite food item is the cambial, or growing, layer of tissue just under the bark of shrubs and trees. Many of the trees that are cut are stripped of bark, or carried to the pond for storage under water as a winter food cache. Buds and roots are also consumed, and when they are needed, a variety of plant species are accepted. The animals may travel some distance from water to secure food. When a rich food source is exploited, canals may be dug from the pond to the pasture to facilitate the transportation of the items to the lodge.

Much of the food ingested by a beaver consists of cellulose, which is normally indigestible by mammals. However, these animals have colonies of microorganisms living in the cecum, a pouch between the large and small intestine, and these symbionts digest up to 30 percent of the cellulose that the beaver takes in. An additional recycling of plant food occurs when certain fecal pellets are eaten and run through the digestive process a second time (Findley 1987).
Woody and herbaceous vegetation comprise the diet of the beaver. Herbaceous vegetation is a highly preferred food source throughout the year, if it is available. Woody vegetation may be consumed during any season, although its highest utilization occurs from late fall through early spring. It is assumed that woody vegetation (trees and/or shrubs) is more limiting than herbaceous vegetation in providing an adequate food source.

Denney (1952) summarized the food preferences of beavers throughout North America and reported that, in order of preference, beavers selected aspen (*Populus tremuloides*), willow (*Salix spp.*), cottonwood (*P. balsamifera*), and alder (*Alnus spp*.). Although several tree species have often been reported to be highly preferred foods, beavers can inhabit, and often thrive in, areas where these tree species are uncommon or absent (Jenkins 1975). Aspen and willow are considered preferred beaver foods; however, these are generally riparian tree species that may be more available for beaver foraging but are not necessarily preferred over all other deciduous tree species (Jenkins 1981). Beavers have been reported to subsist in some areas by feeding on coniferous trees, generally considered a poor quality source of food (Brenner 1962; Williams 1965). Major winter foods in North Dakota consisted principally of red-osier dogwood (*Cornus stolonifera*), green ash (*Fraxinus pennsylvanica*), and willow (Hammond 1943). Rhizomes and roots of aquatic vegetation also may be an important source of winter food (Longley and Moyle 1963; Jenkins pers. comm.). The types of food species present may be less important in determining habitat quality for beavers than physiographic and hydrologic factors affecting the site (Jenkins 1981).

Aquatic vegetation, such as duck potato (*Sagittaria spp.),* duckweed (*Lemna spp.),* pondweed (*Potamogeton spp.),* and water weed (Elodea spp.), are preferred foods when available (Collins 1976a). Water lilies (Nymphaea spp.), with thick, fleshy rhizomes, may be used as a food source throughout the year (Jenkins 1981). If present in adequate amounts, water lily rhizomes may provide an adequate winter food source, resulting in little or no tree cutting or food caching of woody materials. Jenkins (1981) compared the rate of tree cutting by beavers adjacent to two Massachusetts ponds that contained stands of water lilies. A pond dominated by yellow water lily (*y. variegatum*) and white water lily (*N. odorata*), which have thick rhizomes, had low and constant tree cutting activity throughout the fall. Conversely, the second pond, dominated by watershield (*Brasenia schreberi*), which lacks thick rhizomes, had increased fall tree cutting activity by beavers.

Reproduction

The basic composition of a beaver colony is the extended family, comprised of a monogamous pair of adults, subadults (young of the previous year), and young of the year (Svendsen 1980). Female beavers are sexually mature at 2.5 years old. Females normally produce litters of three to four young with most kits being born during May and June. Gestation is approximately 107 days (Linzey 1998). Kits are born with all of their fur, their eyes open, and their incisor teeth erupted.

Dispersal of subadults occurs during the late winter or early spring of their second year and coincides with the increased runoff from snowmelt or spring rains. Subadult beavers have been reported to disperse as far as 236 stream km (147 mi) (Hibbard 1958), although average emigration distances range from 8 to 16 stream km (5 to 10 mi) (Hodgdon and Hunt 1953; Townsend 1953; Hibbard 1958; Leege 1968). The daily movement patterns of the beaver centers around the lodge or burrow and pond (Rutherford 1964). The density of colonies in favorable habitat ranges from 0.4 to 0.8/km2 (1 to 2/mi2) (Lawrence 1954; Aleksiuk 1968; Voigt *et al.* 1976; Bergerud and Miller 1977 cited by Jenkins and Busher 1979).

Home Range

The mean distance between beaver colonies in an Alaskan riverine habitat was 1.59 km (1 mi) (Boyce 1981). The closest neighbor was 0.48 km (0.3 mi) away. The size of the colony's feeding range is a function of the interaction between the availability of food and water and the colony size (Brenner 1967). The average feeding range size in Pennsylvania, excluding water, was reported to be 0.56 ha (1.4 acre). The home range of beaver in the Northwest Territory was estimated as a 0.8 km (0.5 mi) radius of the lodge (Aleksiuk 1968). The maximum foraging distance from a food cache in an Alaskan riverine habitat was approximately 800 m (874 yds) upstream, 300 m (323 yds) downstream, and 600 m (656 yds) on oxbows and sloughs (Boyce 1981).

Mortality

Beavers live up to 11 years in the wild, 15 to 21 years in captivity (Merritt 1987, Rue 1967). Beavers have few natural predators. However, in certain areas, beavers may face predation pressure from wolves (*Canis lupus*), coyotes (*Canis latrans*), lynx (*Felis lynx*), fishers (*Martes pennanti*), wolverines (*Gulo gulo*), and occasionally bears (*Ursus spp*.). Alligators, minks (*Mustela vison*), otters (*Lutra canadensis*), hawks, and owls periodically prey on kits (Lowery 1974, Merritt 1987, Rue 1967).

Beavers often carry external parasites, one of which, *Platypsylla castoris*, is a beetle found only on beavers.

Harvest

Historic

Because of the high commercial value of their pelts, beavers figured importantly in the early exploration and settlement of western North America. Thousands of their pelts were harvested annually, and it was not many years before beavers were either exterminated entirely or reduced to very low populations over a considerable part of their former range. By 1910 their populations were so low everywhere in the United States that strict regulation of the harvest or complete protection became imperative. In the 1930s live trapping and restocking of depleted areas became a widespread practice which, when coupled with adequate protection, has made it possible for the animals to make a spectacular comeback in many sections.

Current

Trapping was terminated by initiative in Washington. No commercial or recreational trapping of beaver occurs in southeast Washington. Between 1991 and 1999, the beaver harvest in the four counties of southeast Washington ranged from 56 to 162/year, and averaged 107/year. Since the initiative to ban trapping, the beaver harvest has declined 95%, and has averaged about 5/year for southeast Washington. As a result of the declining harvest, populations appear to be increasing along with complaints from landowners. Beavers have become a problem in some tributaries, damming farm irrigation and causing problems for fish passage.

Harvest trends will not indicate population trend, because the price of beaver pelts often determines the level of harvest. The higher the pelt price, the higher the harvest because trappers put more effort into trapping beaver. If pelt prices are low, little effort is expended to trap beaver, regardless of population size.

Habitat Requirements

All wetland cover types (e.g., herbaceous wetland and deciduous forested wetland) must have a permanent source of surface water with little or no fluctuation in order to provide suitable beaver habitat (Slough and Sadleir 1977). Water provides cover for the feeding and reproductive activities of the beaver. Lakes and reservoirs that have extreme annual or seasonal fluctuations in the water level will be unsuitable habitat for beaver. Similarly, intermittent streams, or streams that have major fluctuations in discharge (e.g., high spring runoff) or a stream channel gradient of 15 percent or more, will have little year-round value as beaver habitat. Assuming that there is an adequate food source available, small lakes [< 8 ha (20 acres) in surface area] are assumed to provide suitable habitat. Large lakes and reservoirs [> 8 ha (20 acres) in surface area] must have irregular shorelines (e.g., bays, coves, and inlets) in order to provide optimum habitat for beaver.

Beavers can usually control water depth and stability on small streams, ponds, and lakes; however, larger rivers and lakes where water depth and/or fluctuation cannot be controlled are often partially or wholly unsuitable for the species (Murray 1961; Slough and Sadleir 1977). Rivers or streams that are dry during some parts of the year are assumed to be unsuitable beaver habitat. Beavers are absent from sizable portions of rivers in Wyoming, due to swift water and an absence of suitable dwelling sites during periods of high and low water levels (Collins 1976b).

In riverine habitats, stream gradient is the major determinant of stream morphology and the most significant factor in determining the suitability of habitat for beavers (Slough and Sadleir 1977). Stream channel gradients of 6 percent or less have optimum value as beaver habitat. Retzer *et al.* (1956) reported that 68 percent of the beaver colonies recorded in Colorado were in valleys with a stream gradient of less than 6 percent, 28 percent were associated with stream gradients from 7 to 12 percent, and only 4 percent were located along streams with gradients of 13 to 14 percent. No beaver colonies were recorded in streams with a gradient of 15 percent or more. Valleys that were only as wide as the stream channel were unsuitable beaver habitat, while valleys wider than the stream channel were frequently occupied by beavers. Valley widths of 46 m (150 ft) or more were considered the most suitable. Marshes, ponds, and lakes were nearly always occupied by beavers when an adequate supply of food was available.

Foraging

Beavers are generalized herbivores; however, they show strong preferences for particular plant species and size classes (Jenkins 1975; Collins 1975a; Jenkins 1979). The leaves, twigs, and bark of woody plants are eaten, as well as many species of aquatic and terrestrial herbaceous vegetation. Food preferences may vary seasonally, or from year to year, as a result of variation in the nutritional value of food sources (Jenkins 1979).

An adequate and accessible supply of food must be present for the establishment of a beaver colony (Slough and Sadleir 1977). The actual biomass of herbaceous vegetation will probably not limit the potential of an area to support a beaver colony (Boyce 1981). However, total biomass of winter food cache plants (woody plants) may be limiting. Low marshy areas and streams flowing in and out of lakes allow the channelization and damming of water, allowing access to, and transportation of, food materials. Steep topography prevents the establishment of a food transportation system (Williams 1965; Slough and Sadleir 1977). Trees and shrubs closest to the pond or stream periphery are generally utilized first (Brenner 1962; Rue 1964). Jenkins (1980) reported that most of the trees utilized by beaver in his Massachusetts study area were within 30 m (98.4 ft) of the water's edge. However, some foraging did extend up to 100 m (328 ft). Foraging distances of up to 200 m (656 ft) have been reported (Bradt 1938). In a California study, 90 percent of all cutting of woody material was within 30 m (98.4 ft) of the water's edge (Hall 1970).

Woody stems cut by beavers are usually less than 7.6 to 10.1 cm (3 to 4 inches) DBH (Bradt 1947; Hodgdon and Hunt 1953; Longley and Moyle 1963; Nixon and Ely 1969). Jenkins (1980) reported a decrease in mean stem size cut and greater selectivity for size and species with increasing distance from the water's edge. Trees of all size classes were felled close to the water's edge, while only smaller diameter trees were felled farther from the shore.

Beavers rely largely on herbaceous vegetation, or on the leaves and twigs of woody vegetation, during the summer (Bradt 1938, 1947; Brenner 1962; Longley and Moyle 1963; Brenner 1967; Aleksiuk 1970; Jenkins 1981). Forbs and grasses comprised 30 percent of the summer diet in Wyoming (Collins 1976a). Beavers appear to prefer herbaceous vegetation over woody vegetation during all seasons of the year, if it is available (Jenkins 1981).

Cover

Lodges or burrows, or both, may be used by beavers for cover (Rue 1964). Lodges may be surrounded by water or constructed against a bank or over the entrance to a bank burrow. Water protects the lodges from predators and provides concealment for the beaver when traveling to and from food gathering areas and caches.

The lodge is the major source of escape, resting, thermal, and reproductive cover (Jenkins and Busher 1979). Mud and debarked tree stems and limbs are the major materials used in lodge construction although lesser amounts of other woody, as well as herbaceous vegetation, may be used (Rue 1964). If an unexploited food source is available, beavers will reoccupy abandoned lodges rather than build new ones (Slough and Sadleir 1977). On lakes and ponds, lodges are frequently situated in areas that provide shelter from wind, wave, and ice action. A convoluted shoreline, which prevents the buildup of large waves or provides refuge from waves, is a habitat requirement for beaver colony sites on large lakes.

Population and Distribution

Population

Historic

Historically, beaver populations were more expansive until populations were reduced by unregulated trapping, as they were throughout much of the western United States (P. Fowler, WDFW, personal communications, 2003).

Current

Beaver populations exist in all major watersheds in the Blue Mountains. In the Walla Walla subbasin, beaver can be found in the Walla Walla and Touchet River drainages; Mill Creek, Coppei Creek, North Touchet, South Touchet. Beaver can be found in the Tucannon subbasin in the Tucannon River and its tributaries. Beaver can be found in the Asotin watershed, Asotin Creek and its tributaries. Beaver also occur in the Snake River.

Distribution

Historic

No data are available.

Current

The beaver is found throughout most of North America except in the Arctic tundra, peninsular Florida, and the Southwestern deserts (Figure 1) (Allen 1983; VanGelden 1982; Zeveloff 1988).

Figure 1. Geographic distribution of American beaver (Linzey and Brecht 2002).

Status and Abundance Trends

Status

Status is generally unknown, but beaver populations appear to be stable or increasing slightly in southeast Washington (P. Fowler, WDFW, personal communication, 2003).

Trends

Trend information is not available. No population data is available for southeast Washington.

Factors Affecting American Beaver Population Status

Key Factors Inhibiting Populations and Ecological Processes

Agriculture

Riparian habitat along many water ways has been removed in order to plant agricultural crops, thus removing important habitat and food sources for beaver in southeast Washington.

Agricultural Conflict

Beaver may be removed when complaints are received from farmers about blocked irrigation canals or pumps.

Conflict with Fisheries

Beaver sometimes create dams that restrict fish passage, and are removed in order to restore fish passage. Beaver cutting tree planted to improve riparian habitat have also been removed.

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Great Blue Heron
(*Ardea herodias*)

Introduction

The great blue heron (*Ardea herodias*) is the largest, most widely distributed, and best known of the American herons (Henny 1972). Great blue herons occur in a variety of habitats from freshwater lakes and rivers to brackish marshes, lagoons, mangrove areas, and coastal wetlands (Spendelow and Patton in prep.).

Life History and Habitat Requirements

Life History

Diet

Fish are preferred food items of the great blue heron in both inland and coastal waters (Kirkpatrick 1940; Palmer 1962; Kelsall and Simpson 1980), although a large variety of dietary items has been recorded. Frogs and toads, tadpoles and newts, snakes, lizards, crocodilians, rodents and other mammals, birds, aquatic and land insects, crabs, crayfish, snails, freshwater and marine fish, and carrion have all been reported as dietary items for the great blue heron (Bent 1926; Roberts 1936; Martin *et al.* 1951; Krebs 1974; Kushlan1978). Fish up to about 20 cm in length dominated the diet of herons foraging in southwestern Lake Erie (Hoffman 1978). Ninety-five percent of the fish eaten in a Wisconsin study were 25 cm in length (Kirkpatrick 1940).

Great blue herons feed alone or occasionally in flocks. Solitary feeders may actively defend a much larger feeding territory than do feeders in a flock (Meyerriecks 1962; Kushlan 1978). Flock feeding may increase the likelihood of successful foraging (Krebs 1974; Kushlan 1978) and usually occurs in areas of high prey density where food resources cannot effectively be defended.

In southeast Washington, blue herons are often seen hunting along rivers and streams. In the winter months they are often seen hunting rodents in alfalfa fields (P. Fowler, WDFW, pers. comm. 2003).

Reproduction

The great blue heron typically breeds during the months of March - May in its northern range and November through April in the southern hemisphere. The nest usually consists of an egg clutch between 3-7 eggs, with clutch size increasing from south to north. Chicks fledge at about two months.

Nesting

Great blue herons normally nest near the tree tops. Usually, nests are about 1 m in diameter and have a central cavity 10 cm deep with a radius of 15 cm. This internal cavity is sometimes lined with twigs, moss, lichens, or conifer needles. Great blue herons are inclined to renest in the same area year after year. Old nests may be enlarged and reused (Eckert 1981).

The male gathers nest-building materials around the nest site, from live or dead trees, from neighboring nests, or along the ground, and the female works them into the nest. Ordinarily, a pair takes less than a week to build a nest solid enough for eggs to be laid and incubated. Construction continues during almost the entire nesting period. Twigs are added mostly when the eggs are being laid or when they hatch. Incubation, which is shared by both partners, starts with the laying of the first egg and lasts about 28 days. Males incubate during the days and females at night.

Herons are particularly sensitive to disturbance while nesting. Scientists suggest as a general rule that there should be no development within 300 m of the edge of a heron colony and no disturbance in or near colonies from March to August.

Mortality

The great blue heron lives as long as 17 years. The adult birds have few natural enemies. Birds of prey occasionally attack them, but these predators are not an important limiting factor on the heron population. Draining of marshes and destruction of wetland habitat is the most serious threat. The number of herons breeding in a local area is directly related to the amount of feeding habitat.

Mortality of the young is high: both the eggs and young are preyed upon by crows, ravens, gulls, birds of prey, and raccoons. Heavy rains and cold weather at the time of hatching also take a heavy toll. Pesticides are suspected of causing reproductive failures and deaths, although data obtained up to this time suggest that toxic chemicals have not caused any decline in overall population levels.

Habitat Requirements

Minimum Habitat Area

Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will live and reproduce in an area. Minimum habitat area for the great blue heron includes wooded areas suitable for colonial nesting and wetlands within a specified distance of the heronry where foraging can occur. A heronry frequently consists of a relatively small area of suitable habitat. For example, heronries in the Chippewa National Forest, Minnesota, ranged from 0.4 t o 4.8 ha in size and averaged 1.2 ha (Mathisen and Richards 1978). Twelve heronries in western Oregon ranged from 0.12 t o 1.2 ha in size and averaged 0.4 ha (Werschkul *et al.* 1977).

Foraging

Short and Cooper (1985) provide criteria for suitable great blue heron foraging habitat. Suitable great blue heron foraging habitats are within 1.0 km of heronries or potential heronries. The suitability of herbaceous wetland, scrub-shrub wetland, forested wetland, riverine, lacustrine or estuarine habitats as foraging areas for the great blue heron is ideal if these potential foraging habitats have shallow, clear water with a firm substrate and a huntable population of small fish. A potential foraging area needs to be free from human disturbances several hours a day while the herons are feeding. Suitable great blue heron foraging areas are those in which there is no human disturbance near the foraging zone during the four hours following sunrise or preceding sunset or the foraging zone is generally about 100m from human activities and habitation or about 50m from roads with occasional, slow-moving traffic.

A smaller energy expenditure by adult herons is required to support fledglings if an abundant source of food is close to the nest site than if the source of food is distant. Nest sites frequently are located near suitable foraging habitats. Social feeding is strongly correlated with colonial nesting (Krebs 1978), and a potential feeding site is valuable only if it is within “commuting” distance of an active heronry. For example, 24 of 31 heronries along the Willamette River in Oregon were located within 100m of known feeding areas (English 1978). Most heronries along the North Carolina coast were located near inlets, which have large concentrations of fish (Parnell and Soots 1978). The average distance from heronries to inlets was 7.0 to 8.0 km. The average distance of heronries to possible feeding areas (lakes 140 ha in area) varied from 0 to 4.2 km and averaged 1.8 km on the Chippewa National Forest in Minnesota (Mathisen and Richards 1978). Collazo (1981) reported the distance from the nearest feeding grounds to a heronry site as 0.4 and 0.7 km. The maximum observed flight distance from an active heronry to a foraging area was 29 km in Ohio (Parris and Grau 1979).

Great blue herons feed anywhere they can locate prey (Burleigh 1958). This includes the terrestrial surface but primarily involves catching fish in shallow water, usually 150m deep (Bent 1926; Meyerriecks 1960; Bayer 1978).

Thompson (1979b) reported that great blue herons along the Mississippi River commonly foraged in water containing emergent or submergent vegetation, in scattered marshy ponds, sloughs, and forested wetlands away from the main channel. He noted that river banks, jetties, levees, rip-rapped banks, mudflats, sandbars, and open ponds were used to a lesser extent. Herons near southwestern Lake Erie fed intensively in densely vegetated areas (Hoffman 1978).

Other studies, however, have emphasized foraging activities in open water (Longley 1960; Edison Electric Institute 1980). Exposed mud flats and sandbars are particularly desirable foraging sites at low tides in coastal areas in Oregon (Bayer 1978), North Carolina (Custer and Osborn 1978), and elsewhere (Kushlan 1978). Cooling ponds (Edison Electric Institute 1980) and dredge spoil settling ponds (Cooper *et al.* in prep.) also are used extensively by foraging great blue herons.

Water

The great blue heron routinely feeds on soft animal tissues from an aquatic environment, which provides ample opportunity for the bird to satisfy its physiological requirements for water.

Cover

Cover for concealment does not seem to be a limiting factor for the great blue heron. Heron nests often are conspicuous, although heronries frequently are isolated. Herons often feed in marshes and areas of open water, where there is no concealing cover.

Reproduction

Short and Cooper (1985) describe suitable great blue heron nesting habitat as a grove of trees at least 0.4 ha in area located over water or within 250m of water. These potential nest sites may be on an island with a river or lake, within a woodland dominated swamp, or in vegetation near a river or lake. Trees used as nest sites are at least 5m high and have many branches at least 2.5 cm in diameter that are capable of supporting nests. Trees may be alive or dead but must have an "open canopy" that allows an easy access to the nest. The suitability of potential heronries diminishes as their distance from current or former heronry sites increases because herons develop new heronries in suitable vegetation close to old heronries.

A wide variety of nesting habitats is used by the great blue heron throughout its range in North America. Trees are preferred heronry sites, with nests commonly placed from 5 to 15 m above ground (Burleigh 1958; Cottrille and Cottrille 1958; Vermeer 1969; McAloney 1973). Smaller trees, shrubs, reeds (*Phragmites communis*), the ground surface, rock ledges along coastal cliffs, and artificial structures may be utilized in the absence of large trees, particularly on islands (Lahrman 1957; Behle 1958; Vermeer 1969; Soots and Landin 1978; Wiese 1978). Most great blue heron colonies along the Atlantic coast are located in riparian swamps (Ogden 1978). Most colonies along the northern Gulf coast are in cypress - tupelo (*Taxodium Nyssa*) swamps (Portnoy 1977). Spendelow and Patton (in prep.) state that many birds in coastal Maine nest on spruce (*Picea spp*.) trees on islands. Spruce trees also are used on the Pacific coast (Bayer 1978), and black cottonwood (*Populus trichocarpa*) trees frequently are used as nest sites along the Willamette River in Oregon (English 1978). Miller (1943) stated that the type of tree was not as important as its height and distance from human activity. Dead trees are commonly used as nest sites (McAloney 1973). Nests usually consist of a platform of sticks, sometimes lined with smaller twigs (Bent 1926; McAloney 1973), reed stems (Roberts 1936), and grasses (Cottrille and Cottrille 1958).

Heron nest colony sites vary, but are usually near water. These areas often are flooded (Sprunt 1954; Burleigh 1958; English 1978). Islands are common nest colony sites in most of the great blue heron's range (Vermeer 1969; English 1978; Markham and Brechtel 1979). Many colony sites are isolated from human habitation and disturbance (Mosely 1936; Burleigh 1958). Mathisen and Richards (1978) recorded all existing heronries in Minnesota as at least 3.3 km from human dwellings, with an average distance of 1.3 km to the nearest surfaced road. Nesting great blue herons may become habituated to noise (Grubb 1979), traffic (Anderson 1978), and other human activity (Kelsall and Simpson 1980). Colony sites usually remain active until the site is disrupted by land use changes.

A few colony sites have been abandoned because the birds depleted the available nest building material and possibly because their excrement altered the chemical composition of the soil and the water. Heron exretia can have an adverse effect on nest trees (Kerns and Howe 19667; Wiese 1978).

Population and Distribution

Population

Historic

In the past, herons and egrets were shot for their feathers, which were used as cooking utensils and to adorn hats and garments, and they also provided large, accessible targets. The slaughter of these birds went relatively unchecked until 1900 when the federal government passed the Lacey Act, which prohibits the foreign and interstate commercial trade of feathers. Greater protection was afforded in 1918 with the Migratory Bird Treaty Act, which empowered the federal government to set seasons and bag limits on the hunting of waterfowl and waterbirds. With this protection, herons and other birds have made dramatic comebacks.

In southeast Washington, few historical colonies have been reported. The Foundation Island colony is the oldest, but has been taken over by cormorants. It appears blue herons numbers in the colony have declined significantly.

One colony was observed from a helicopter in 1995 on the Touchet River just upriver from Harsha, but that colony appears to have been destroyed by a wind storm (trees blown down), and no current nesting has been observed in the area (Fowler per. com.)

Current

The great blue heron breeds throughout the U.S. and winters as far north as New England and southern Alaska (Bull and Farrand 1977). The nationwide population is estimated at 83,000 individuals (NACWCP 2001).

In southeast Washington, three new colonies have been discovered over the last few years. One colony on the Walla Walla River contains approximately 24 nests. This colony has been active for approximately 12 years. Two new colonies were discovered in 2003, one on a railroad bridge over the Snake River at Lyons Ferry, and one near Chief Timothy Park on the Snake River. The Lyons Ferry colony contained approximately 11 nests, and the Chief Timothy colony 5 nests (P. Fowler, WDFW, personal communication, 2003).

Distribution

Two known heron rookeries occur within the Walla Walla subbasin, one on the Walla Walla and one on the Touchet River (NPPC 2001). The Walla Walla River rookery contains approximately 13 active nests. The Touchet River rookery contains approximately 8-10 active nests. Blue herons are observed throughout the lowlands of southeast Washington near rivers or streams (P. Fowler, WDFW, personal communication, 2003).

Historic

No data are available.

Current

Figures 1-3 illustrate summer, breeding, and winter distributions of great blue herons.

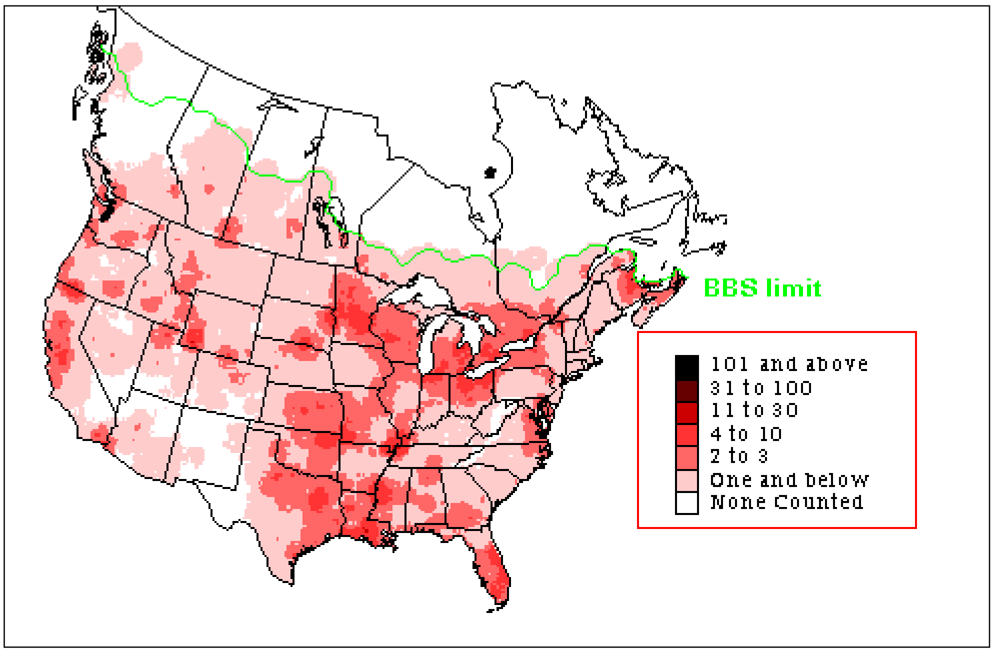

Figure 1. Great blue heron summer distribution from Breeding Bird Survey (BBS) data (Sauer *et al.* 2003).

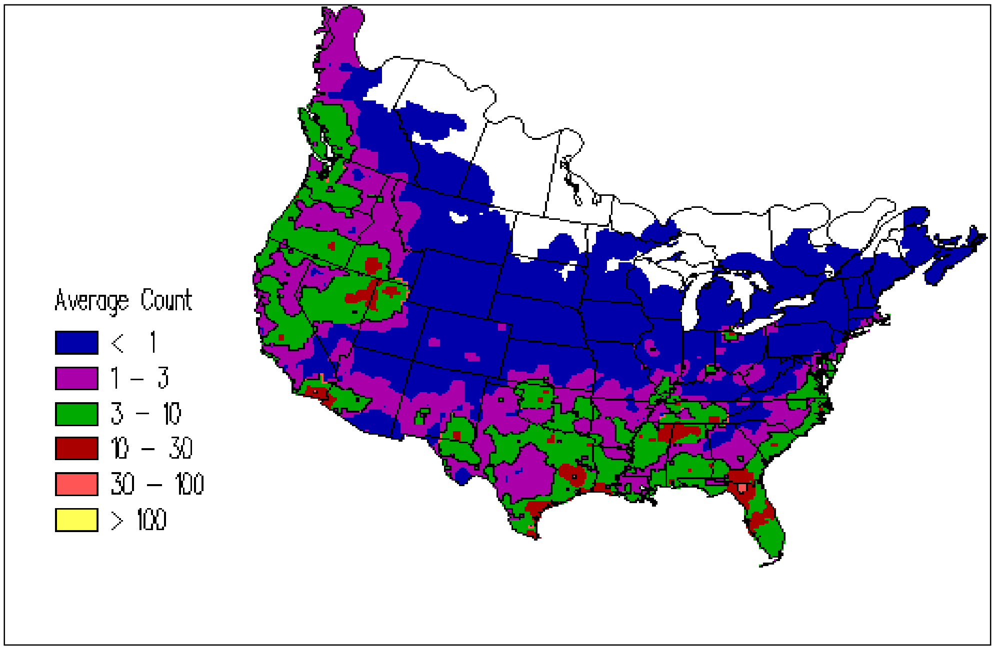

Figure 2. Great blue heron breeding distribution from Breeding Bird Survey (BBS) data (Sauer *et al.* 2003).

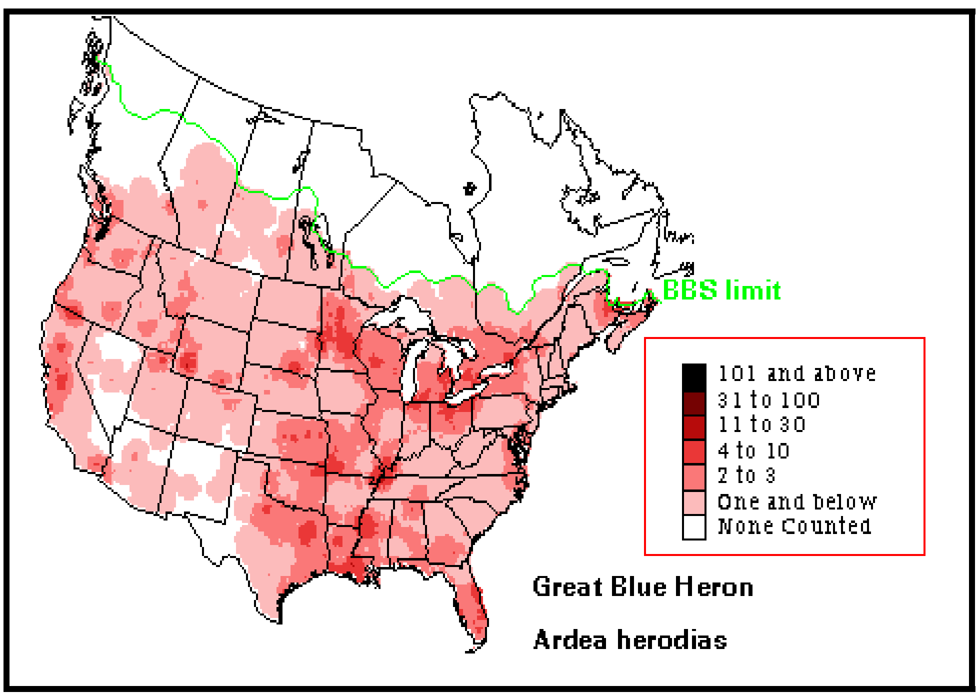

Figure 3. Great blue heron winter distribution from CBC data (Sauer *et al.* 2003).

Status and Abundance Trends

Status

Surveys of blue heron populations are not conducted. However, populations appear to be stable and possibly expanding in some areas. Two new nesting colonies have been found in on the Lower Snake River (P. Fowler, WDFW, personal communication, 2003).

Trends

Populations in southeast Washington appear to be stable, and may actually be increasing.

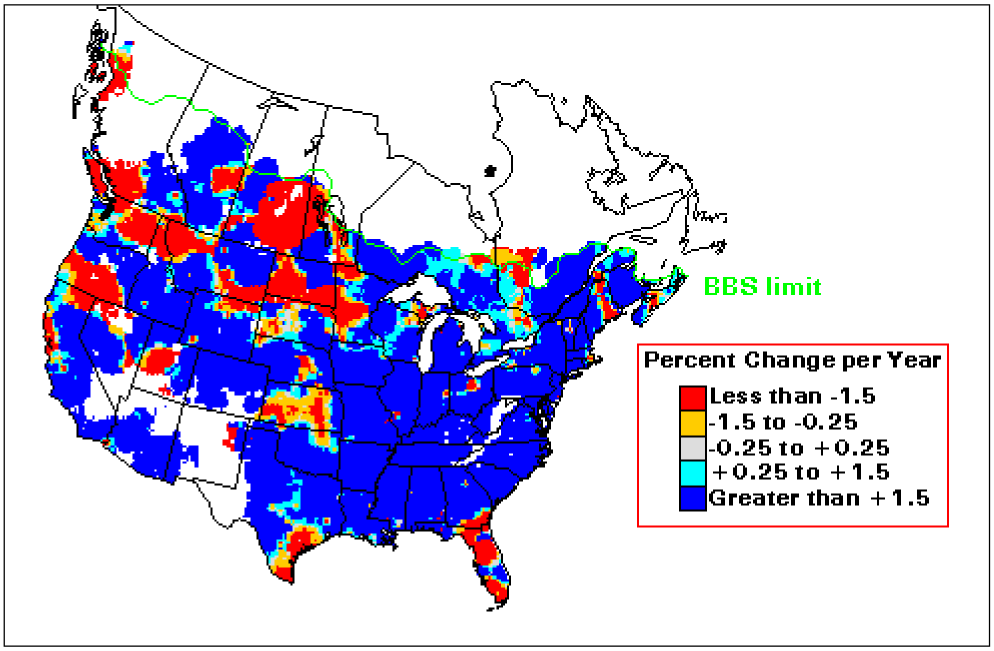

Figure 4. Great blue heron Breeding Bird Survey (BBS) trend results: 1966-1996 (Sauer *et al.* 2003).

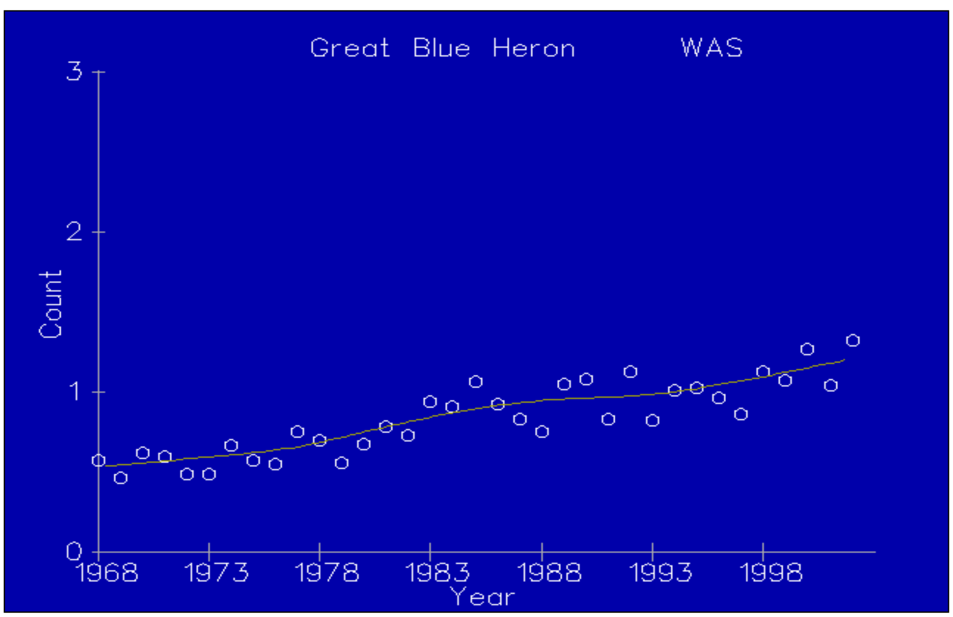

Figure 5. Great blue heron Breeding Bird Survey (BBS) Washington trend results: 1966-2002 (Sauer *et al.* 2003).

Factors Affecting Great Blue Heron Population Status

Key Factors Inhibiting Populations and Ecological Processes

Habitat destruction and the resulting loss of nesting and foraging sites, and human disturbance probably have been the most important factors contributing to declines in some great blue heron populations in recent years (Thompson 1979a; Kelsall and Simpson 1980; McCrimmon 1981).

Habitat Loss

Natural generation of new nesting islands, created when old islands and headlands erode, has decreased due to artificial hardening of shorelines with bulkheads. Loss of nesting habitat in certain coastal sites may be partially mitigated by the creation of dredge spoil islands (Soots and Landin 1978). Several species of wading birds, including the great blue heron, use coastal spoil islands (Buckley and McCaffrey 1978; Parnell and Soots 1978; Soots and Landin 1978). The amount o f usage may depend on the stage of plant succession (Soots and Parnell 1975; Parnell and Soots 1978), although great blue herons have been observed nesting in shrubs (Wiese 1978), herbaceous vegetation (Soots and Landin 1978), and on the ground on spoil islands.

Water Quality

Poor water quality reduces the amount of large fish and invertebrate species available in wetland areas. Toxic chemicals from runoff and industrial discharges pose yet another threat. Although great blue herons currently appear to tolerate low levels of pollutants, these chemicals can move through the food chain, accumulate in the tissues of prey and may eventually cause reproductive failure in the herons.

Several authors have observed eggshell thinning in great blue heron eggs, presumably as a result of the ingestion of prey containing high levels of organochlorines (Graber *et al.* 1978; Ohlendorf *et al.* 1980). Konermann *et al.* (1978) blamed high levels of dieldrin and DDE use for reproductive failure, followed by colony abandonment in Iowa. Vermeer and Reynolds (1970) recorded high levels of DDE in great blue herons in the prairie provinces of Canada, but felt that reproductive success was not diminished as a result. Thompson (1979a) believed that it was too early to tell if organochlorine residues were contributing to heron population declines in the Great Lakes region.

Human Disturbance

Heronries often are abandoned as a result of human disturbance (Markham and Brechtel 1979). Werschkul *et al.* (1976) reported more active nests in undisturbed areas than in areas that were being logged. Tree cutting and draining resulted in the abandonment of a mixed-species heronry in Illinois (Bjorkland 1975). Housing and industrial development (Simpson and Kelsall 1979) and water recreation and highway construction (Ryder *et al.* 1980) also have resulted in the abandonment of heronries. Grubb (1979) felt that airport noise levels could potentially disturb a heronry during the breeding season.

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Appendix G: Changes in Key Ecological Functions

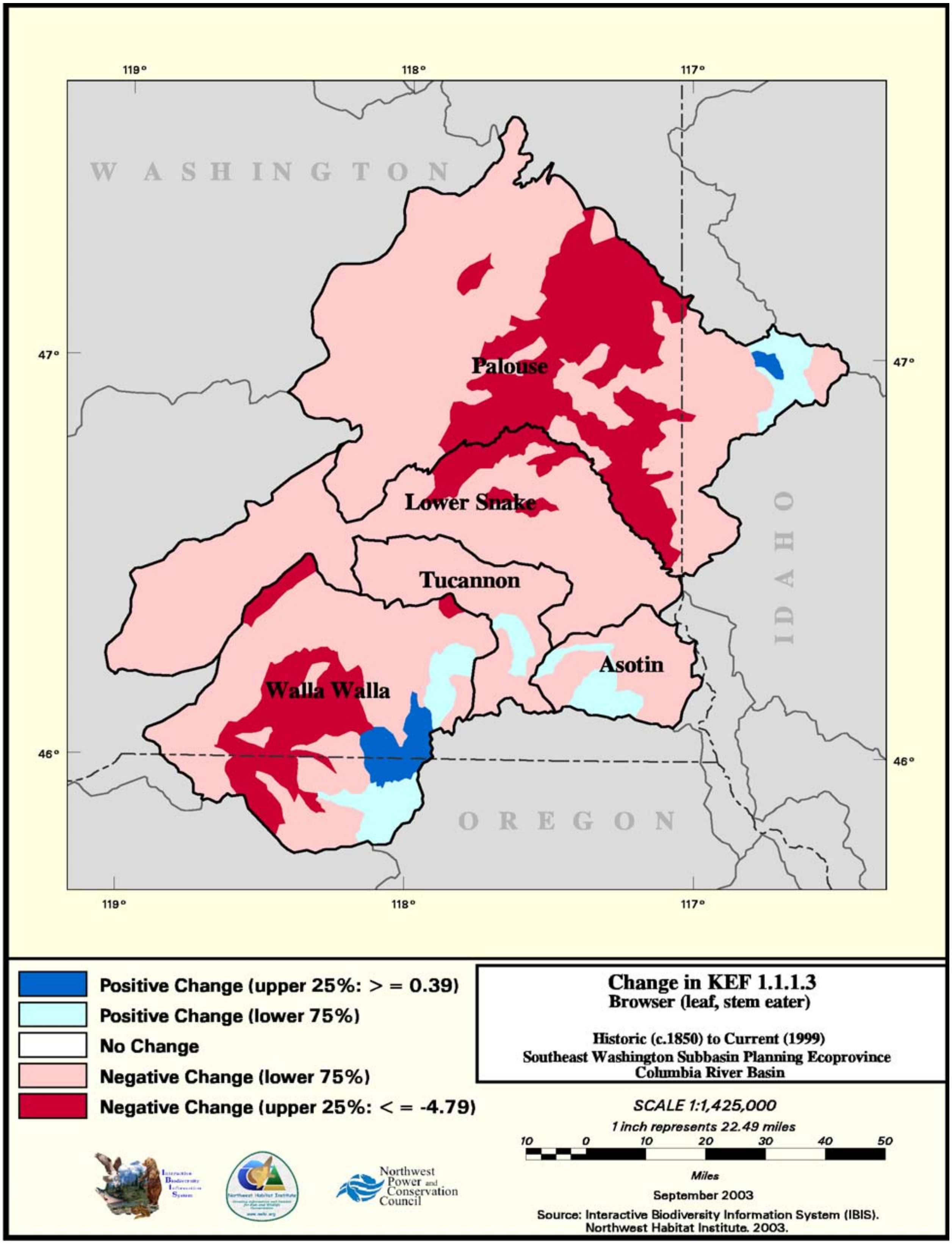

Figure G-1. Change in KEF 1.1.1.3 in the Southeast Washington Subbasin Planning Ecoregion (IBIS 2003).

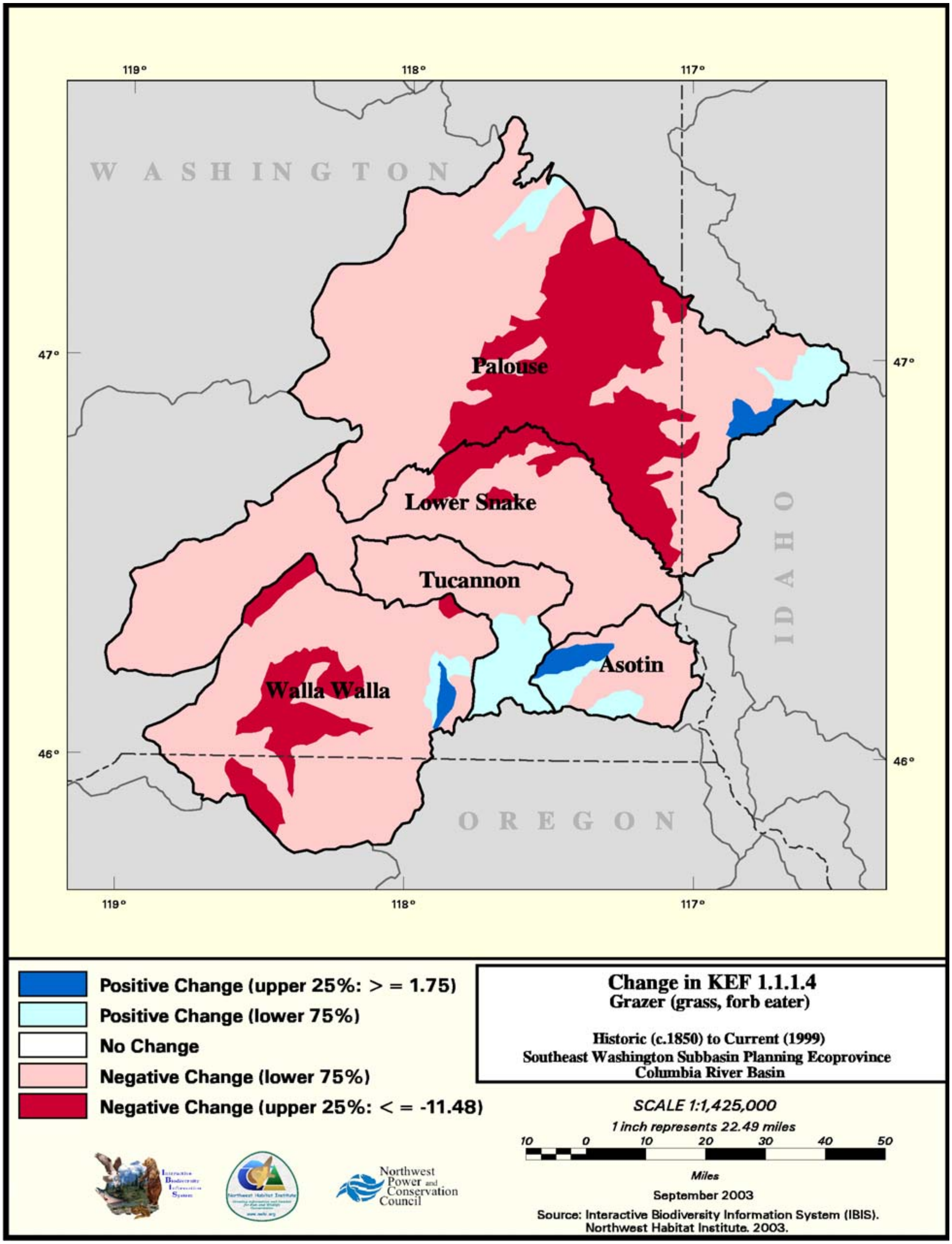

Figure G-2. Change in KEF 1.1.1.4 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

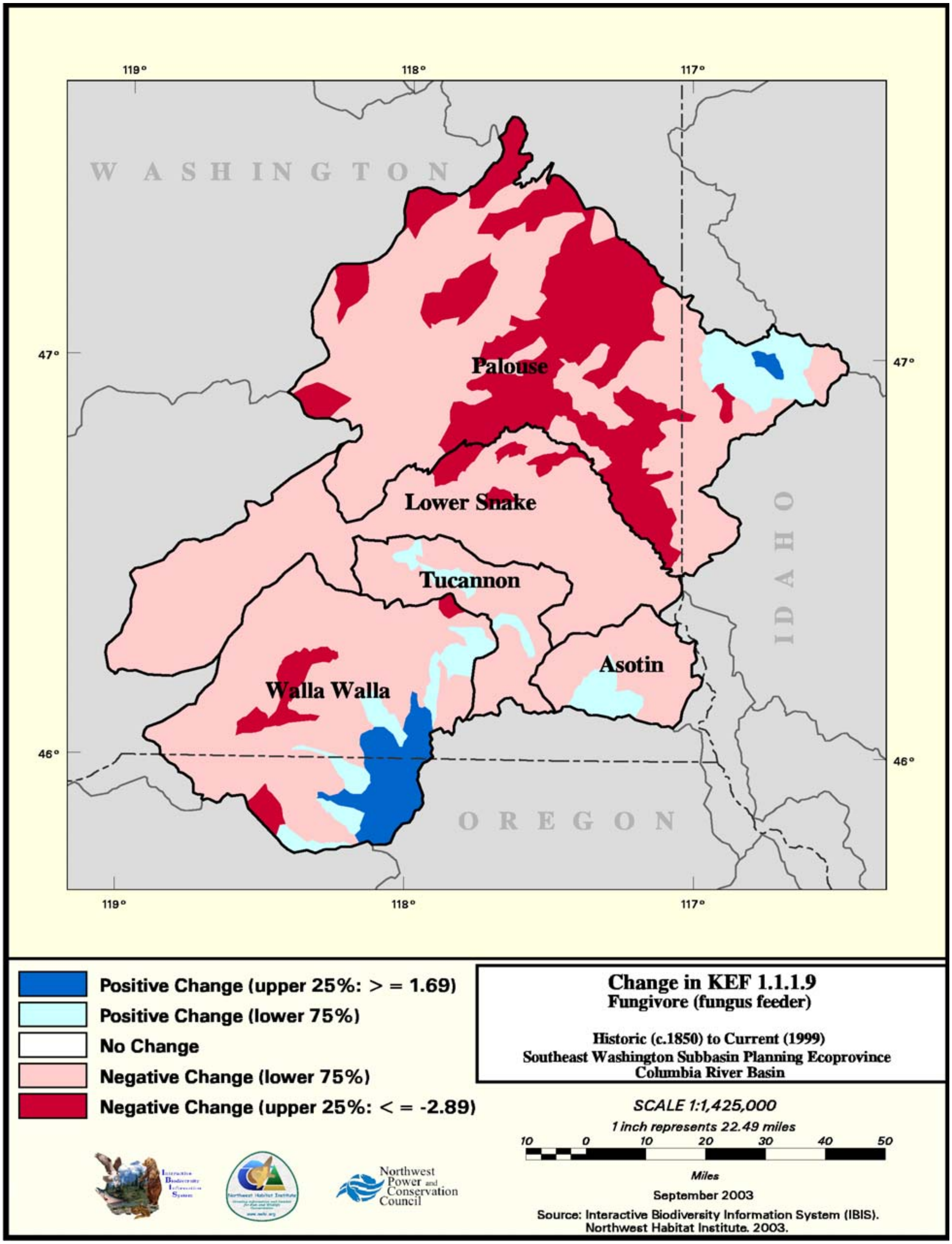

Figure G-3. Change in KEF 1.1.1.9 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

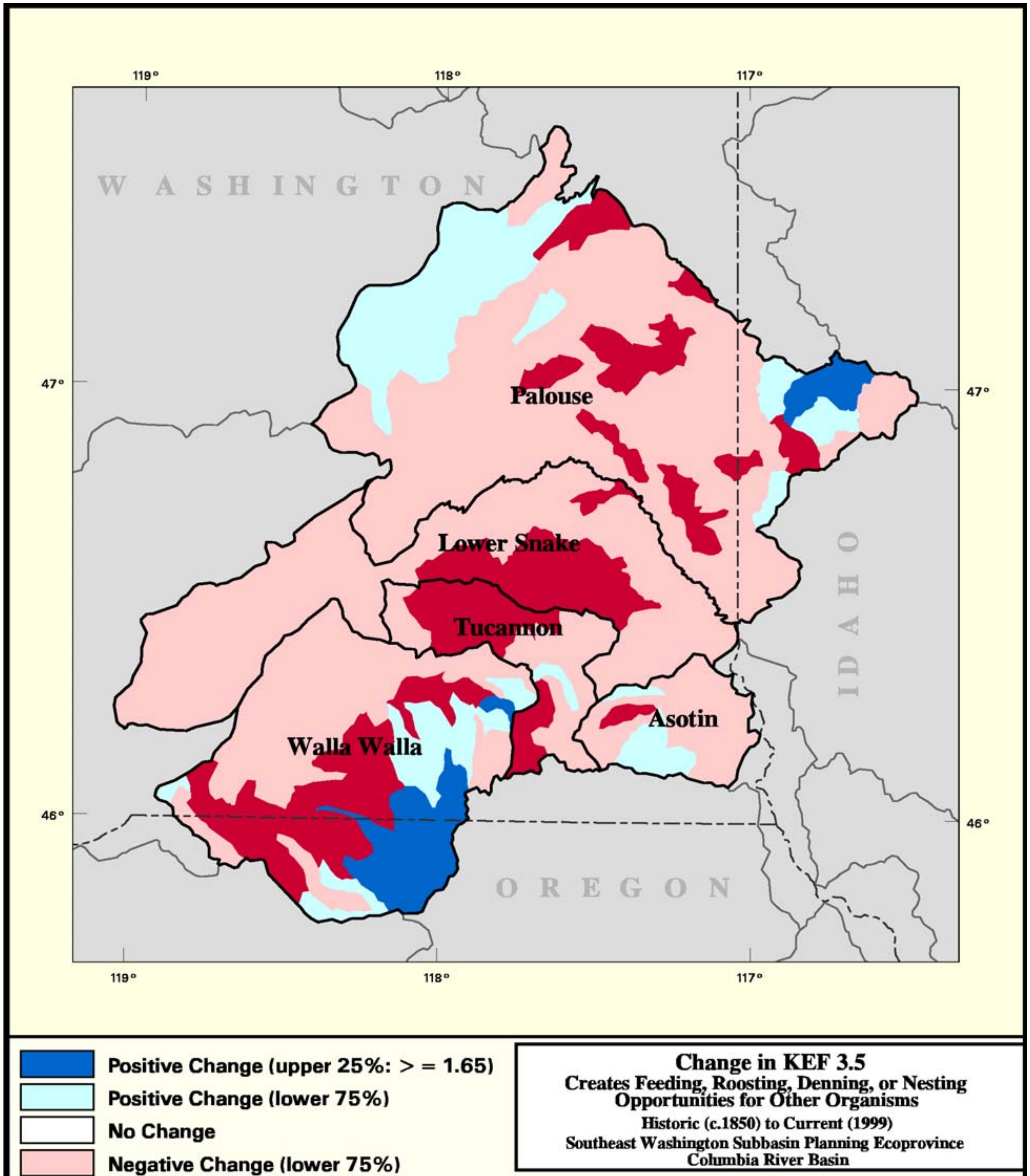

Figure G-4. Change in KEF 3.5 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

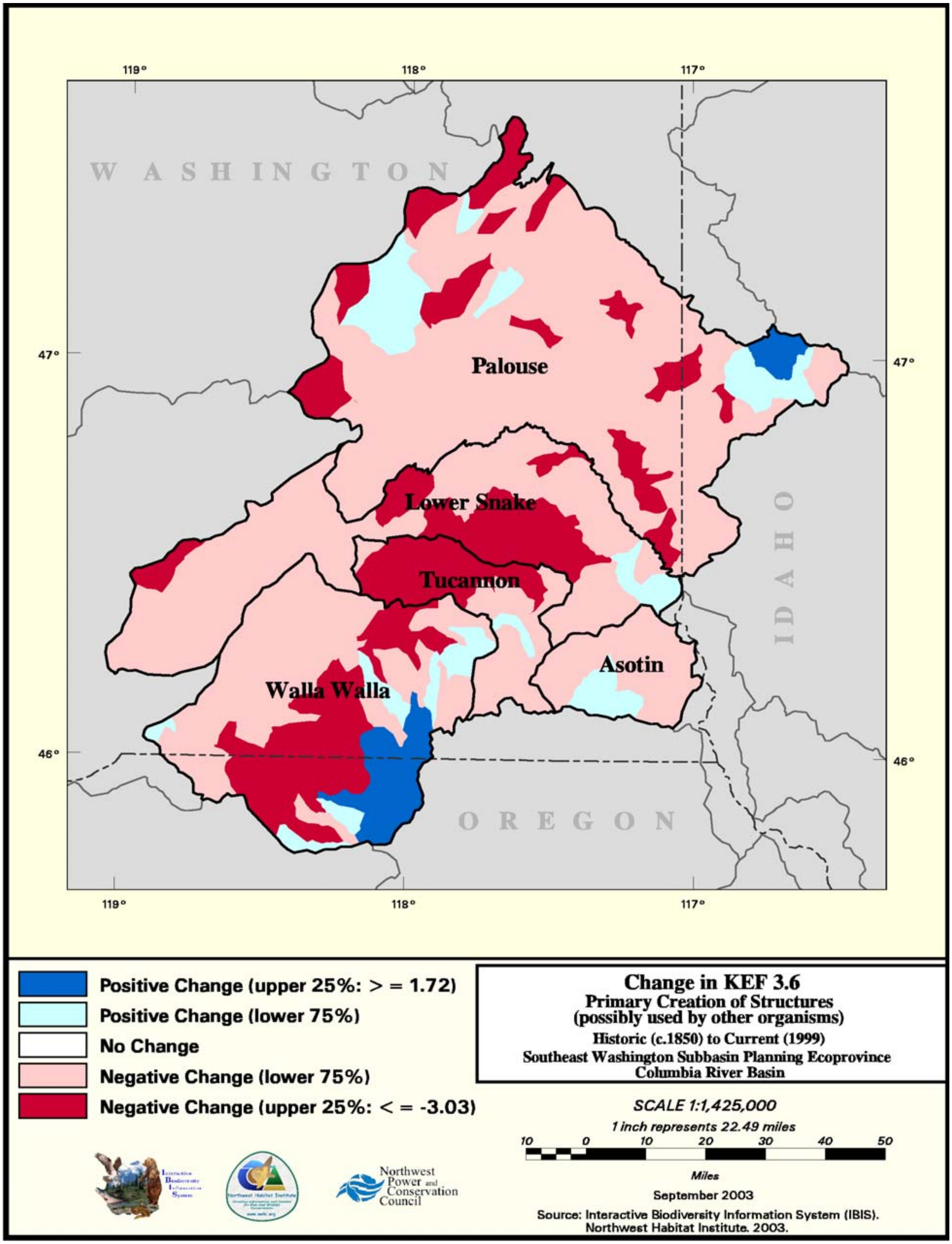

Figure G-5. Change in KEF 3.6 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

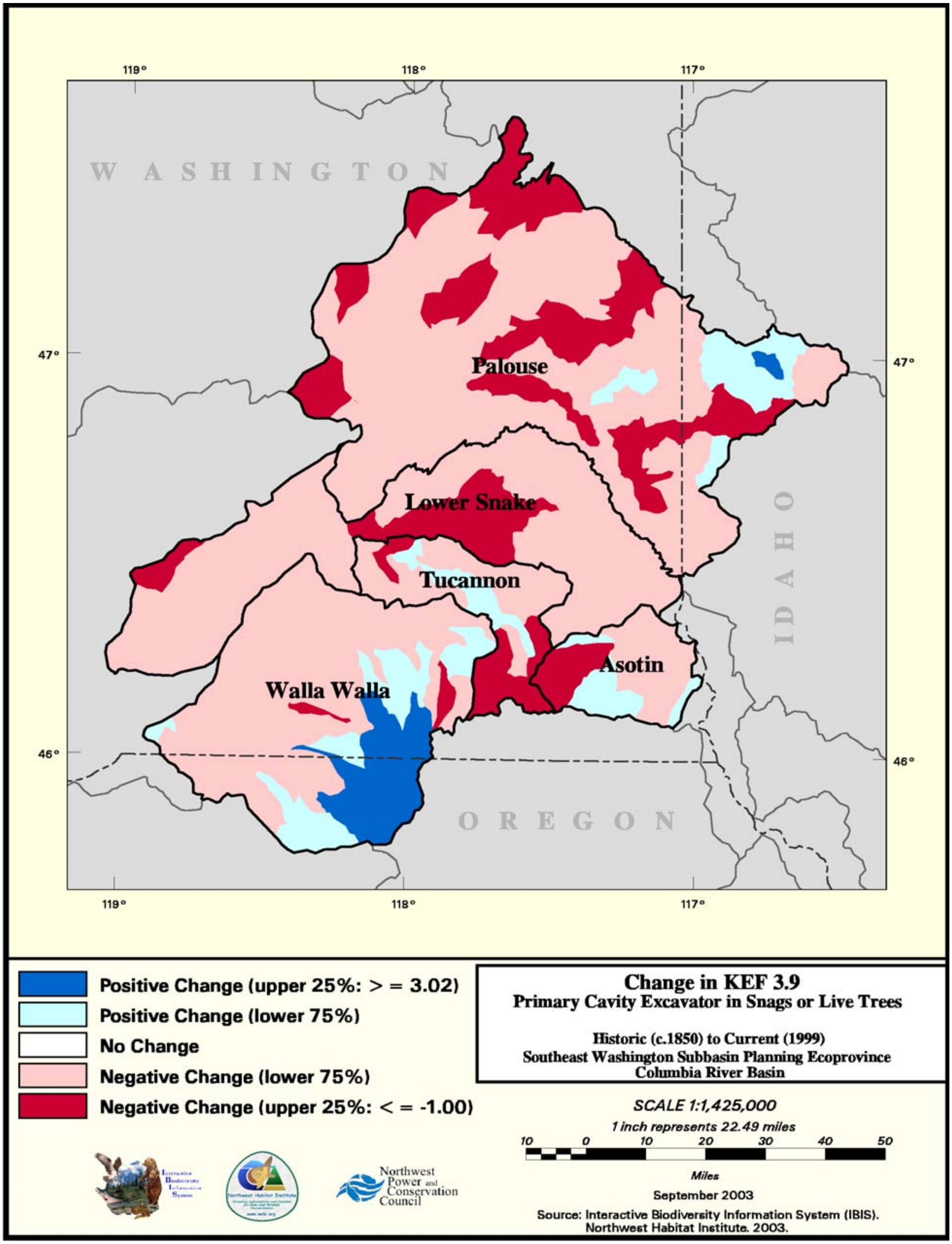

Figure G-6. Change in KEF 3.9 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

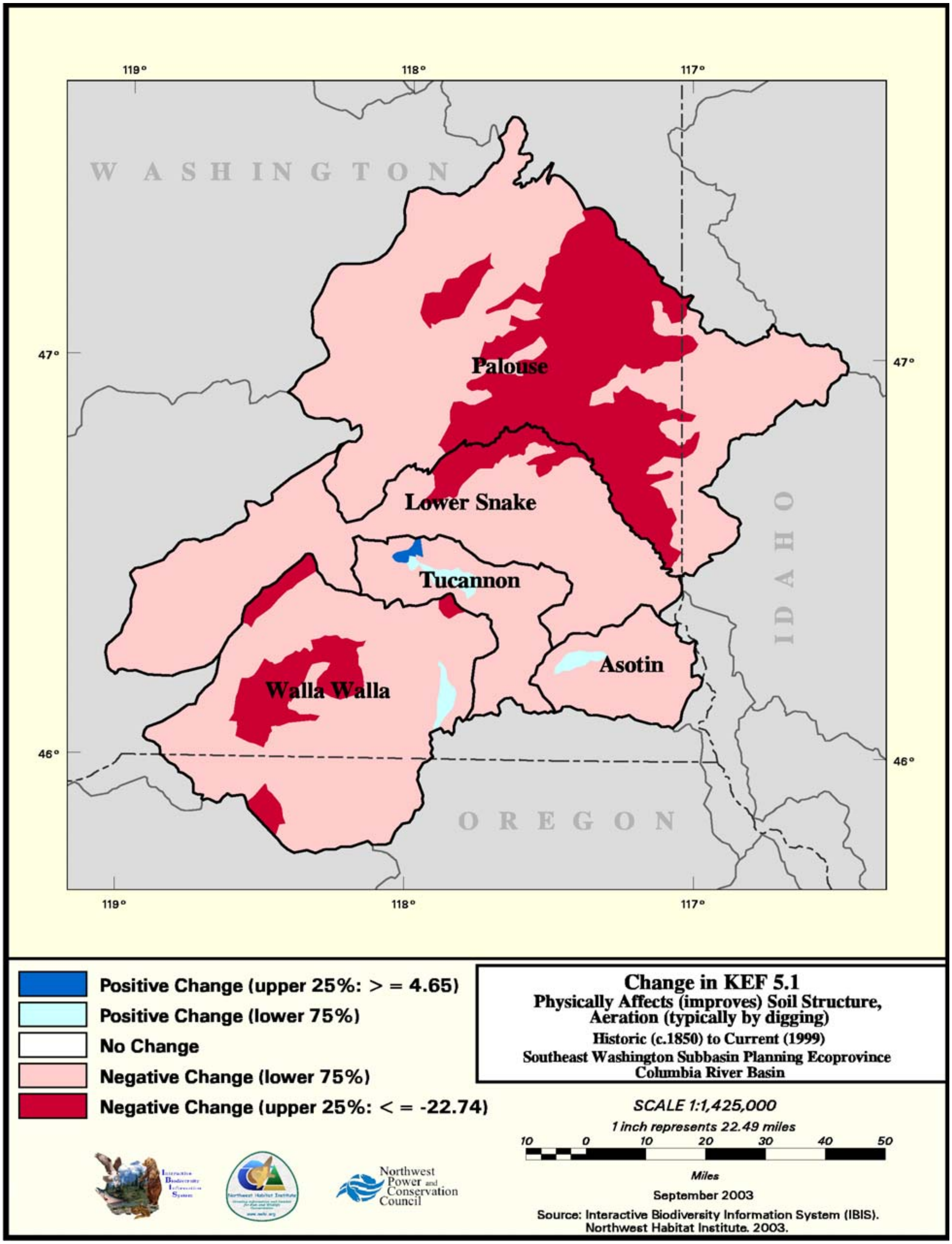

Figure G-7. Change in KEF 1.1.1.3 in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Appendix H: Changes in Functional Redundancy

Table H-1. Summary of changes in key ecological function in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

SHP-KEF	Current Total KEF Value	Historic Total KEF Value	Percent Change		SHP-KEF	Current Total KEF Value	Historic Total KEF Value	Percent Change
1	99.92	167.81	-40.45		3.15	1.73	2.42	-28.54
1.1	99.92	167.81	-40.45		3.16	4.12	5.71	-27.83
1.1.1	57.67	88.93	-35.15		3.2	10.54	18.64	-43.42
1.1.1.1	12.39	22.43	-44.78		3.3	0.80	1.41	-43.49
1.1.1.10	4.43	6.51	-32.01		3.4	39.81	56.89	-30.03
1.1.1.11	8.73	17.14	-49.08		3.4.1	1.94	2.37	-18.48
1.1.1.12	2.73	6.91	-60.53		3.4.2	0.44	0.26	70.31
1.1.1.13	0.90	1.49	-39.82		3.4.4	10.22	15.56	-34.33
1.1.1.2	37.20	52.67	-29.37		3.4.5	28.43	40.99	-30.65
1.1.1.3	3.26	6.12	-46.73		3.4.6	9.22	12.12	-23.94
1.1.1.4	10.78	17.42	-38.07		3.5	1.69	1.50	12.57
1.1.1.5	24.56	35.13	-30.10		3.5.1	1.69	1.50	12.57
1.1.1.6	1.88	1.04	81.36		3.5.1.1	0.33	0.26	25.91
1.1.1.7	1.81	2.87	-36.92		3.5.2	0.71	0.13	464.55
1.1.1.8	0.56	0.58	-4.50		3.6	9.08	10.59	-14.23
1.1.1.9	5.10	6.55	-22.14		3.6.1	7.90	9.78	-19.19
1.1.2	88.06	147.05	-40.11		3.6.2	1.00	0.40	150.19
1.1.2.1	78.55	128.54	-38.89		3.6.3	0.30	0.53	-43.90
1.1.2.1.1	73.46	121.39	-39.49		3.7	4.69	6.46	-27.44
1.1.2.1.2	19.80	29.23	-32.27		3.7.1	1.86	2.40	-22.68
1.1.2.1.3	1.05	2.26	-53.58		3.7.2	1.68	2.86	-41.20
1.1.2.2	32.44	55.31	-41.35		3.7.3	1.17	1.24	-5.99
1.1.2.2.1	6.06	10.37	-41.56		3.8	8.15	11.94	-31.71
1.1.2.3	8.24	9.90	-16.82		3.8.1	1.01	1.04	-3.45
1.1.3	2.56	5.97	-57.21		3.8.2	7.15	10.90	-34.41
1.1.4	8.87	16.27	-45.46		3.9	1.81	2.14	-15.38
1.1.5	1.31	2.95	-55.76		4	15.30	28.97	-47.20
1.1.6	1.07	2.76	-61.25		4.1	11.52	20.26	-43.14
1.1.7	0.01	0.01	120.00		4.2	0.02	0.05	-51.20
1.1.7.1	0.01	0.01	120.00		4.3	8.78	16.76	-47.60
1.2	73.68	118.46	-37.80		5	12.11	26.14	-53.68
1.2.1	73.68	118.46	-37.80		5.1	12.11	26.14	-53.68
2	9.64	20.48	-52.92		6	4.42	7.64	-42.21
3	81.66	134.88	-39.46		6.1	4.03	6.73	-40.07
3.1	13.01	24.15	-46.11		6.2	1.83	2.79	-34.40
3.10	8.43	8.66	-2.64		7	0.55	1.12	-50.94
3.11	12.42	23.68	-47.57		7.1	0.13	0.13	0.08
3.11.1	3.32	7.26	-54.22		7.2	0.55	1.12	-50.94
3.11.2	9.09	16.42	-44.63		8	3.88	7.36	-47.31
3.12	15.86	31.27	-49.27		8.1	0.74	1.38	-46.68

3.13	6.42	12.02	-46.61		8.2	1.94	4.20	-53.89
3.14	9.03	15.60	-42.10		8.3	2.49	4.85	-48.63
13 KEFs have changed more than – 50%								

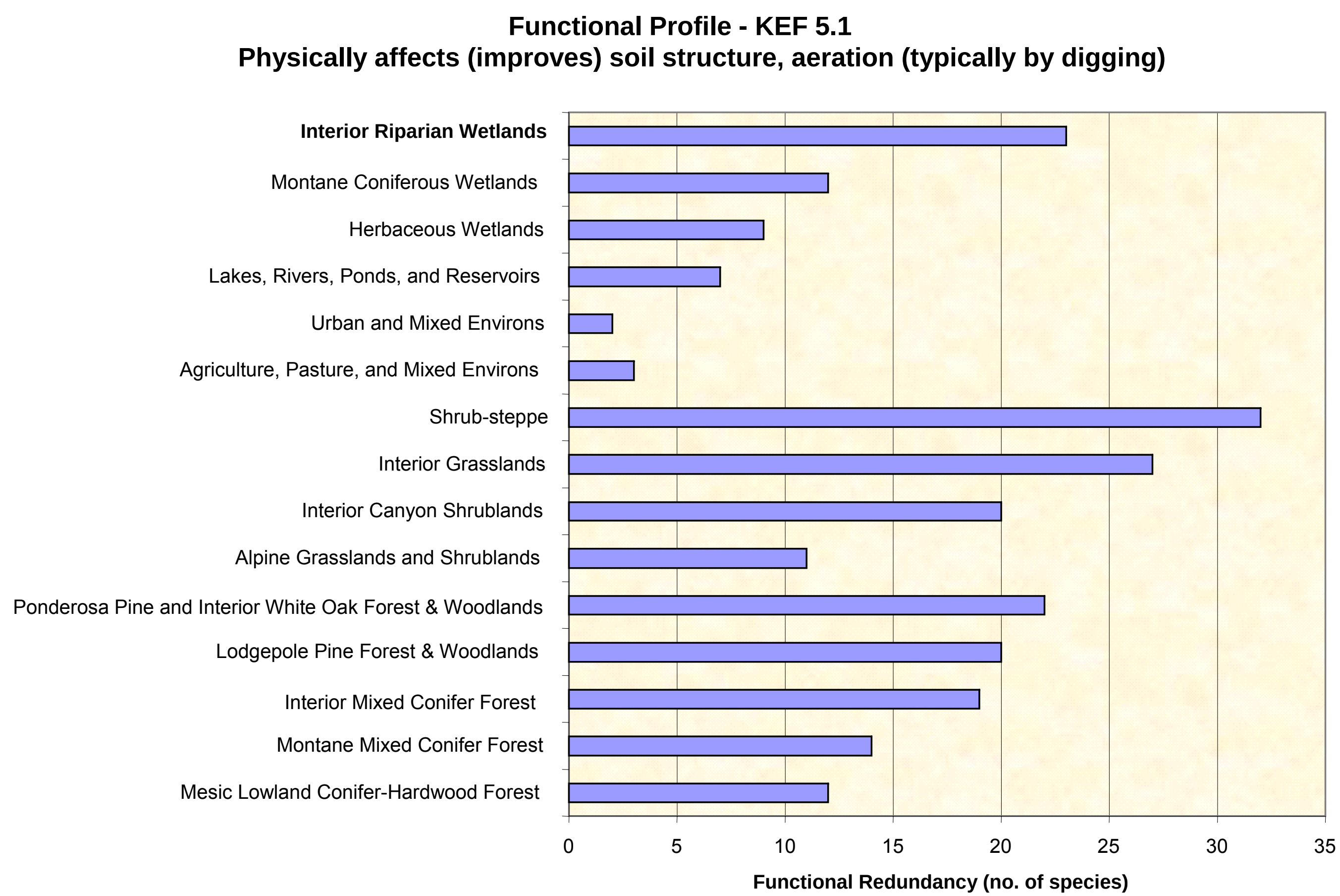

Figure H-1. Functional redundancy of KEF 5.1 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

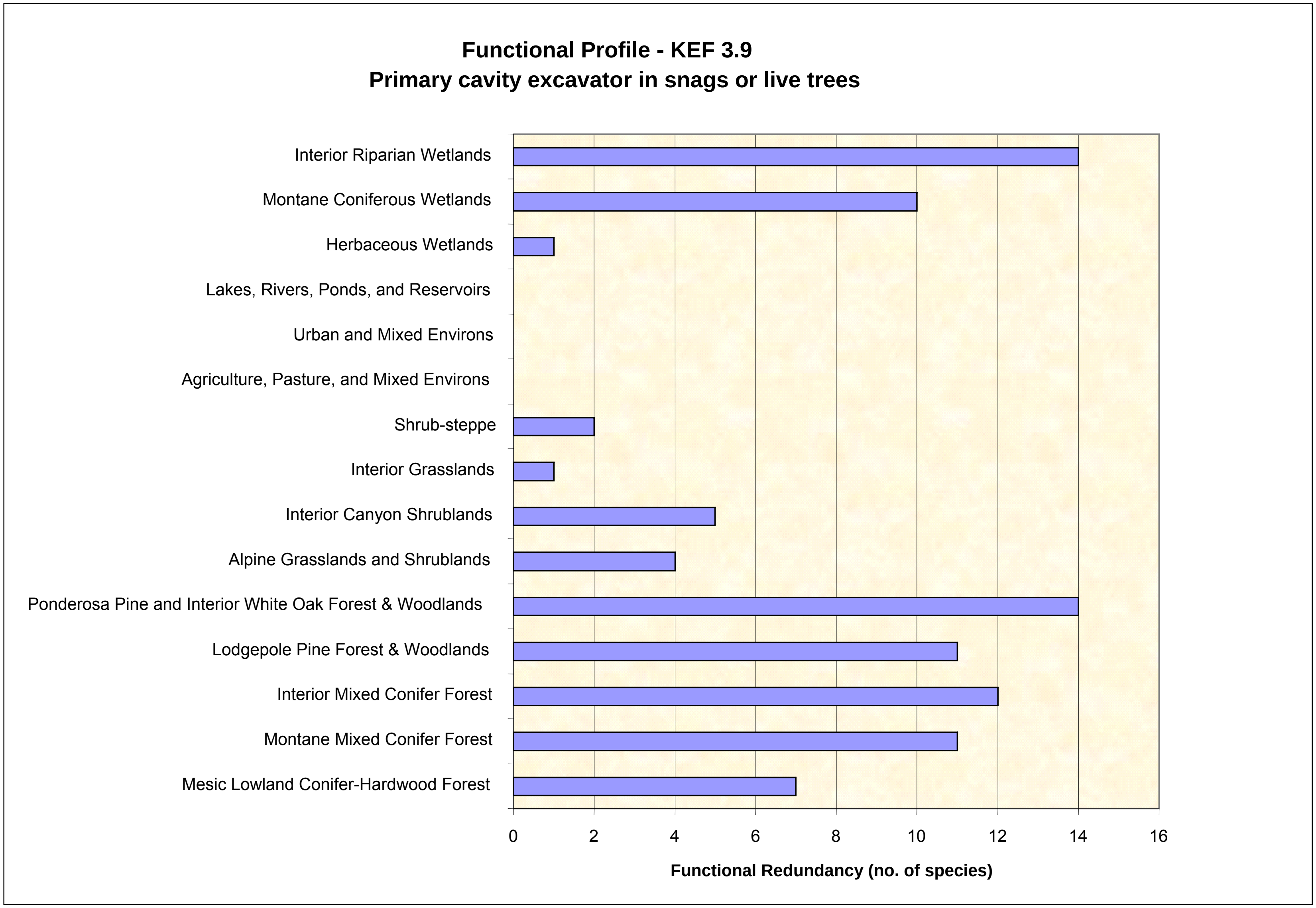

Figure H-2. Functional redundancy of KEF 3.9 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

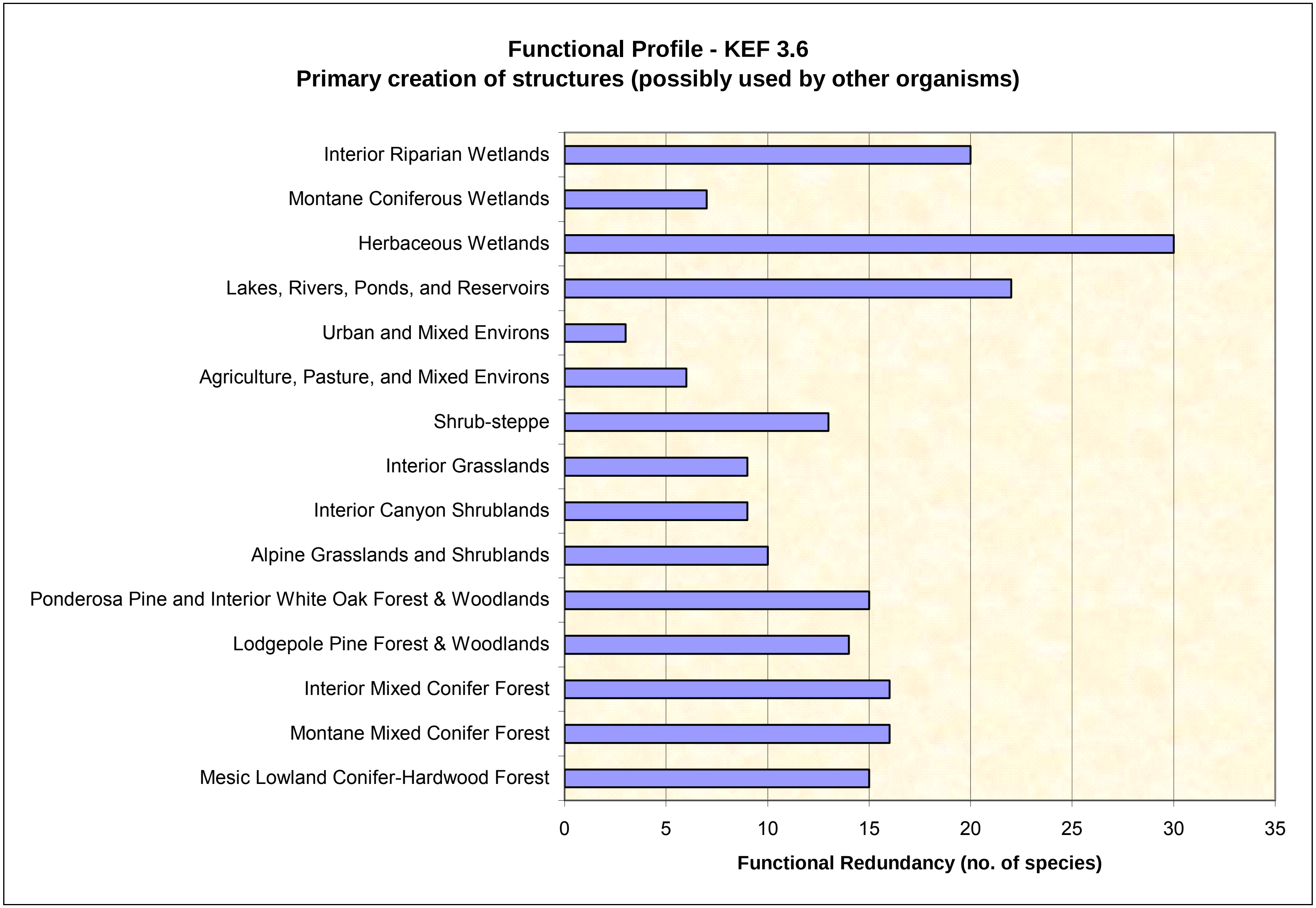

Figure H-3. Functional redundancy of KEF 3.6 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

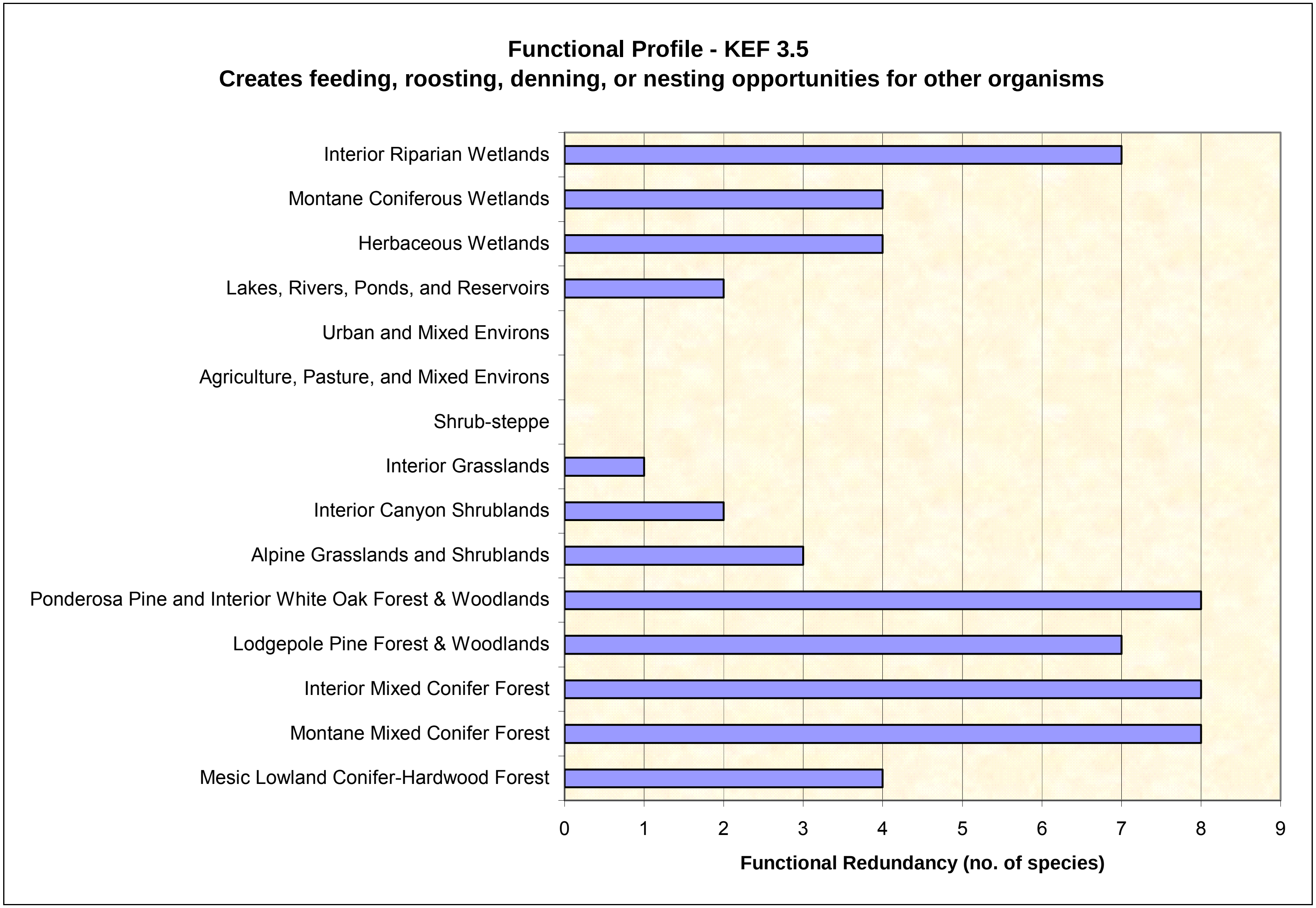

Figure H-4. Functional redundancy of KEF 3.5 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

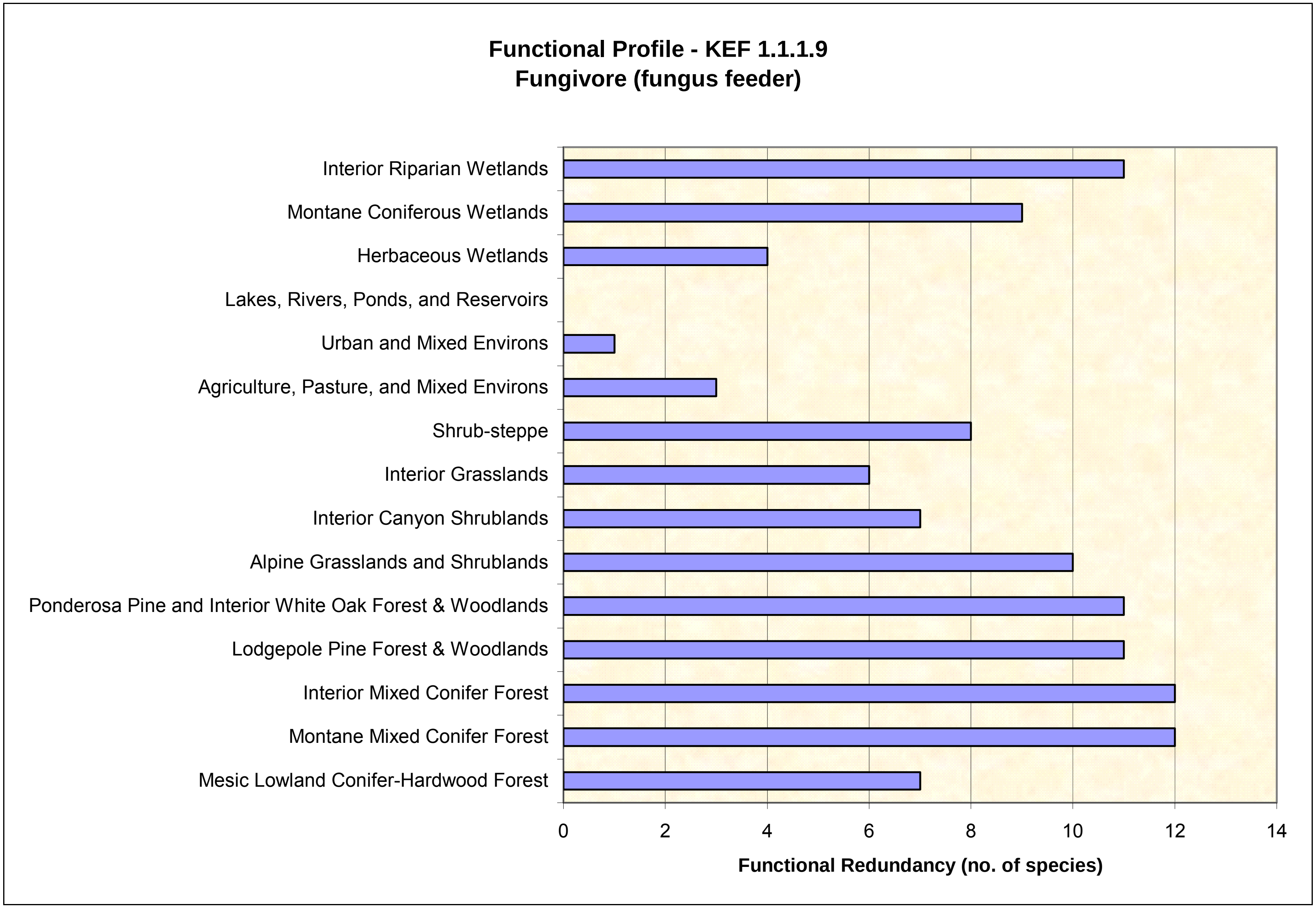

Figure H-5. Functional redundancy of KEF 1.1.1.9 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

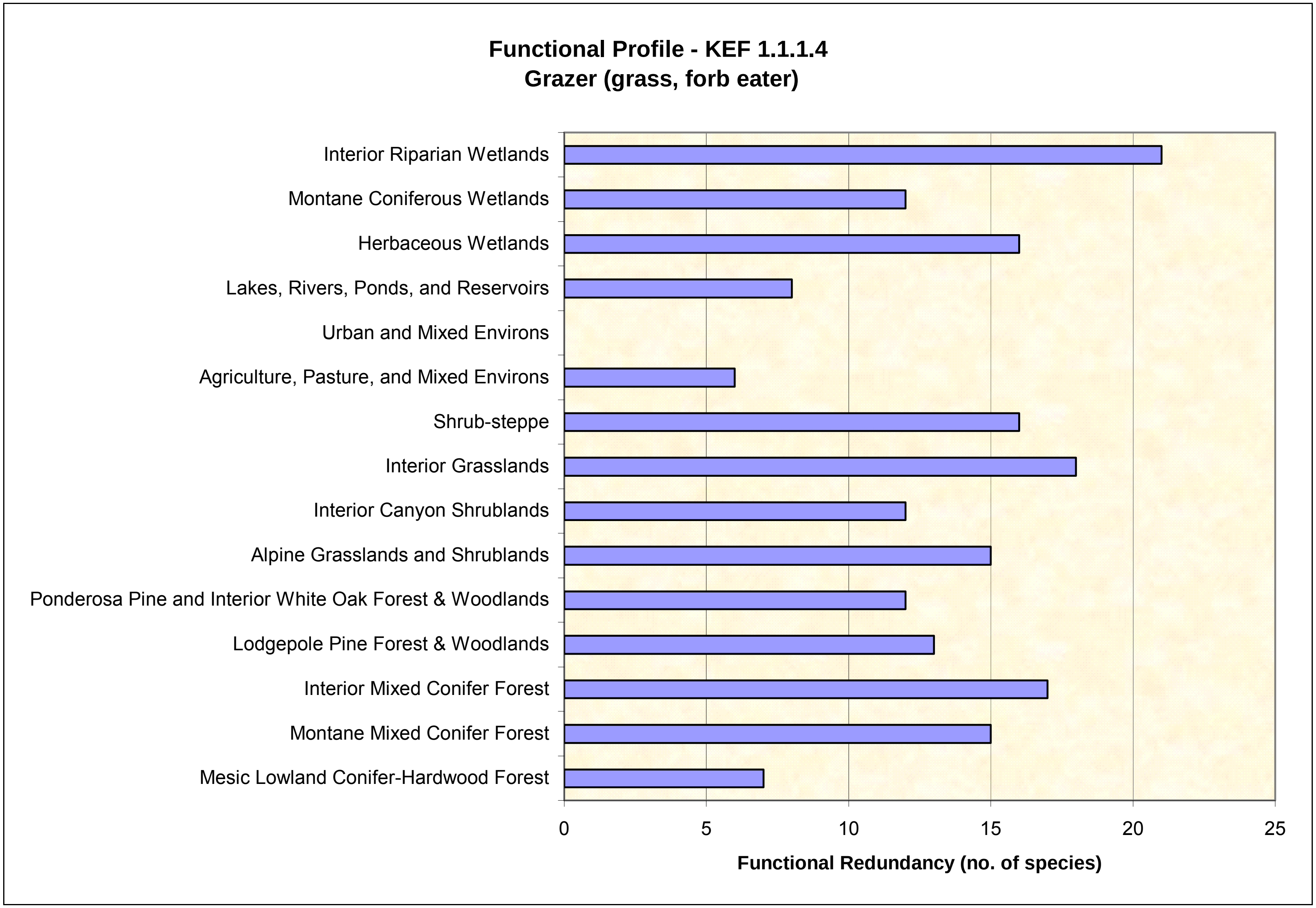

Figure H-6. Functional redundancy of KEF 1.1.1.4 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

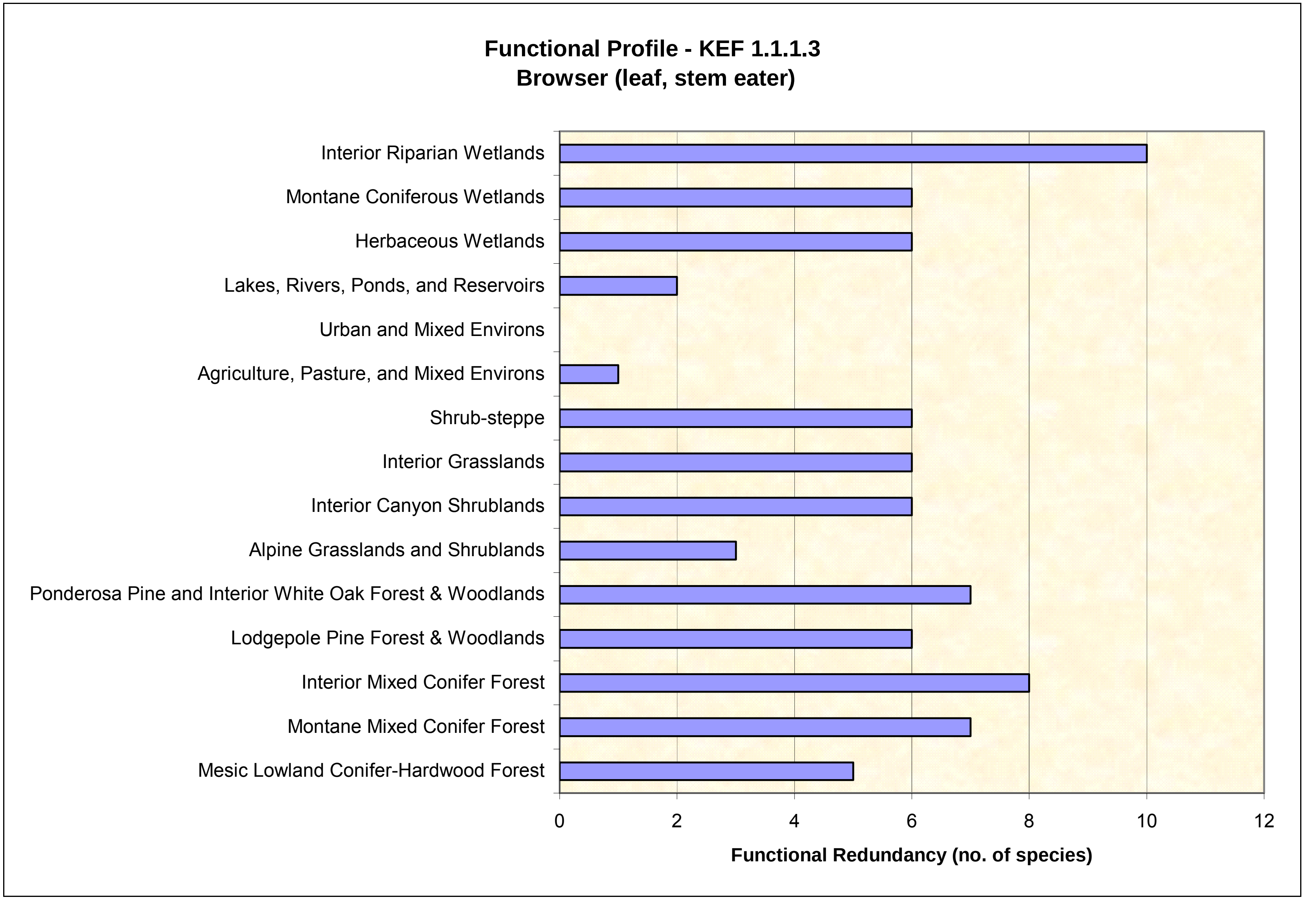

Figure H-7. Functional redundancy of KEF 1.1.1.3 for all wildlife habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Appendix I: Aquatic Key Environmental Correlates

4. Freshwater Riparian and Aquatic Bodies Habitat Elements or KECs.
Includes selected forms and characteristics of any body of freshwater.

4.1 *Water Characteristics.* Includes various freshwater attributes. Ranges of continuous attributes that are key to the queried species, if known, will be in the comments.

4.1.1 *Dissolved Oxygen.* Amount of oxygen passed into solution.

4.1.2 *Water Depth.* Distance from the surface of the water to the bottom substrate.

4.1.3 *Dissolved Solids.* A measure of dissolved minerals in water

4.1.4 *Water pH.* A measure of water acidity or alkalinity.

4.1.5 *Water Temperature.* Water temperature range that is key to the queried species; if known, it is in the comments field.

4.1.6 *Water Velocity.* Speed or momentum of water flow.

4.1.7 *Water Turbidity.* Amount of roiled sediment within the water.

4.1.8 *Free Water.* Water derived from any source.

4.1.9 *Salinity and Alkalinity.* The presence of salts.

4.2 *Rivers and streams.* Various characteristics of streams and rivers.
4.2.1 *Oxbows.* A pond or wetland created when a river bend is cut off from the main channel of the river.

4.2.2 *Order and class.* Systems of stream classification.
4.2.2.1 *Intermittent.* Streams/rivers that contain non-tidal flowing water for only part of the year; water *may* remain in isolated pools.
4.2.2.2 *Upper Perennial.* Streams/rivers with a high gradient, fast water velocity, no tidal influence; some water flowing throughout the year, substrate consists of rock, cobbles, or gravel with occasional patches of sand; little floodplain development.
4.2.2.3 *Lower Perennial.* Streams/rivers with a low gradient, slow water velocity, no tidal influence; some water flowing throughout the year, substrate consists mainly of sand and mud; floodplain is well developed.

4.2.3 *Zone.* System of water body classification based on the horizontal strata of the water column.
4.2.3.1 *Open Water.* Open water areas not closely associated with the shoreline or bottom.
4.2.3.2 *Submerged/Benthic.* Relating to the bottom of a body of water, includes the substrate and the overlaying body of water within 3.2 feet (1 m) of the substrate.
4.2.3.3 *Shoreline.* Continually exposed substrate that is subject to splash, waves, and/ or periodic flooding. Includes gravel bars, islands, and immediate near-shore areas.

4.2.4 *In-stream Substrate.* The bottom materials in a body of water.

4.2.4.1 *Rocks.* Rocks >10 inches (256mm) in diameter.

4.2.4.2 *Cobble/Gravel.* Rocks or pebbles, .1-10 inches (2.5-256mm) in diameter, substrata may consist of cobbles, gravel, shell, and sand with no substratum type >70% cover.

4.2.4.3 *Sand/Mud.* Fine substrata <.01 inch (l mm) in diameter, little gravel present, may be mixed with organics.

4.2.5 *Vegetation.* Herbaceous plants.

4.2.5.1 *Submergent vegetation.* Rooted aquatic plants that do not emerge above the water surface.

4.2.5.2 *Emergent Vegetation.* Rooted aquatic plants that emerge above the water surface.

4.2.5.3 *Floating Mats.* Unrooted plants that form vegetative masses on the surface of the water.

4.2.6 *Coarse Woody Debris.* Any piece of woody material (debris piles, stumps, root wads, fallen trees) that intrudes into or lies within a river or stream.

4.2.7 *Pools.* Portions of the stream with reduced current velocity, often with water deeper than surrounding areas.

4.2.8 *Riffles.* Shallow rapids where the water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but where standing waves are absent.

4.2.9 *Runs/Glides.* Areas of swiftly flowing water, without surface agitation or waves, which approximates uniform flow and in which the slope of the water surface is roughly parallel to the overall gradient of the stream reach.

4.2.10 *Over Hanging Vegetation.* Herbaceous plants that cascade over stream and river banks and are <3.2 feet (1m) above the water surface.

4.2.11 *Waterfalls.* Steep descent of water within a stream or river.

4.2.12 *Banks.* Rising ground that borders a body of water.

4.2.13 *Seeps or Springs.* A concentrated flow of ground water issuing from openings in the ground.

4.3 *Ephemeral Pools.* Pools that contain water for only brief periods of time usually associated with periods of high precipitation.

4.4 *Sandbars.* Exposedareas of sand or mud substrate.

4.5 *Gravel Bars.* Exposed areas of gravel substrate.

4.6 *Lakes/Ponds/Reservoirs.* Various characteristics of lakes, ponds, and reservoirs.

4.6.1 *Zone.* System of water body classification based on the horizontal strata of the water column.

4.6.1.1 *Open Water.* Open water areas not closely associated with the shoreline or bottom substrates.

4.6.1.2 *Submerged/Benthic.* Relating to the bottom of a body of water, includes the substrate and the overlaying body of water within one meter of the substrate.

4.6.1.3 *Shoreline.* Continually exposed substrate that is subject to splash, waves, and/ or periodic, flooding. Includes gravel bars, islands, and immediate near-shore areas.

4.6.2 *In-Water Substrate.* The bottom materials in a body of water.

4.6.2.1 *Rock.* Rocks >10 inches (256rnrn) in diameter.

4.6.2.2 *Cobble/Gravel.* Rocks or pebbles, .1-10 inches (2.5-256mm) in diameter, substrata may consist of cobbles, gravel, shell, and sand with no substratum type exceeding 70%cover.

4.6.2.3 *Sand/Mud.* Fine substrata <.1 inch (2.5 mm) in diameter, little gravel present, may be mixed with organics.

4.6.3 *Vegetation.* Herbaceous plants. 4.6.3.1 *Submergent vegetation.* Rooted aquatic plants that do not emerge above the water surface.

4.6.3.2 *Emergent Vegetation.* Rooted aquatic plants that emerge above the water surface.

4.6.3.3 *Floating Mats.* Unrooted plants that from vegetative masses on the surface of the water.

4.6.4 *Size.* Refers to whether or not the species is differentially associated with water bodies based on their size.

4.6.4.1 *Ponds.* Bodies of water <5 acre (2 ha).

4.6.4.2 *Lakes.* Bodies of water .2.5acre (2 ha).

4.7 Wetlands/Marshes/Wet Meadows/ Bogs and Swamps. Various components and characteristics related to any of these systems.

4.7.1 *Riverine wetlands.* Wetlands found in association with rivers.

4.7.2 *Context.* When checked, indicates that the setting of the wetland, marsh, wet meadow, bog, or swamp is key to the queried species.

4.7.2.1 *Forest.* Wetlands within a forest.

4.7.2.2 *Non-forest.* Wetlands that are not surrounded by forest.

4.7.3 *Size.* When checked, indicates that the queried species is differentially associated with a wetland, marsh, wet meadow, bog, or swamp based on the size of the water body.

4.7.4 *Marshes.* Frequently or continually inundated wetlands characterized by emergent herbaceous vegetation (grasses, sedges, reeds) adapted to saturated soil conditions.

4.7.5 *Wet Meadows.* Grasslands with waterlogged soil near the surface but without standing water for most of the year.

4.8 *Islands.* A piece of land made up of either rock and/or unconsolidated material that projects above and is completely surrounded by water.

4.9 *Seasonal Flooding.* Flooding that occurs periodically.

Appendix J: Draft Walla Walla Subbasin Wildlife Assessment and Inventory

Draft

Walla Walla Subbasin

Wildlife Assessment and Inventory

Paul R. Ashley

Stacey H. Stovall

2004

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1.0 Physical Features

1.1 Land Area

The 1,126,198-acre (1,760 mi^2) Walla Walla subbasin (Subbasin) is located in Walla Walla, Columbia, Umatilla, Union, and Wallowa Counties in both Washington and Oregon (Figure_1 and Figure_2). The Subbasin comprises 22 percent of the Southeast Washington Subbasin Planning Ecoregion (Ecoregion) and is the second largest subbasin in the Ecoregion (Table_1).

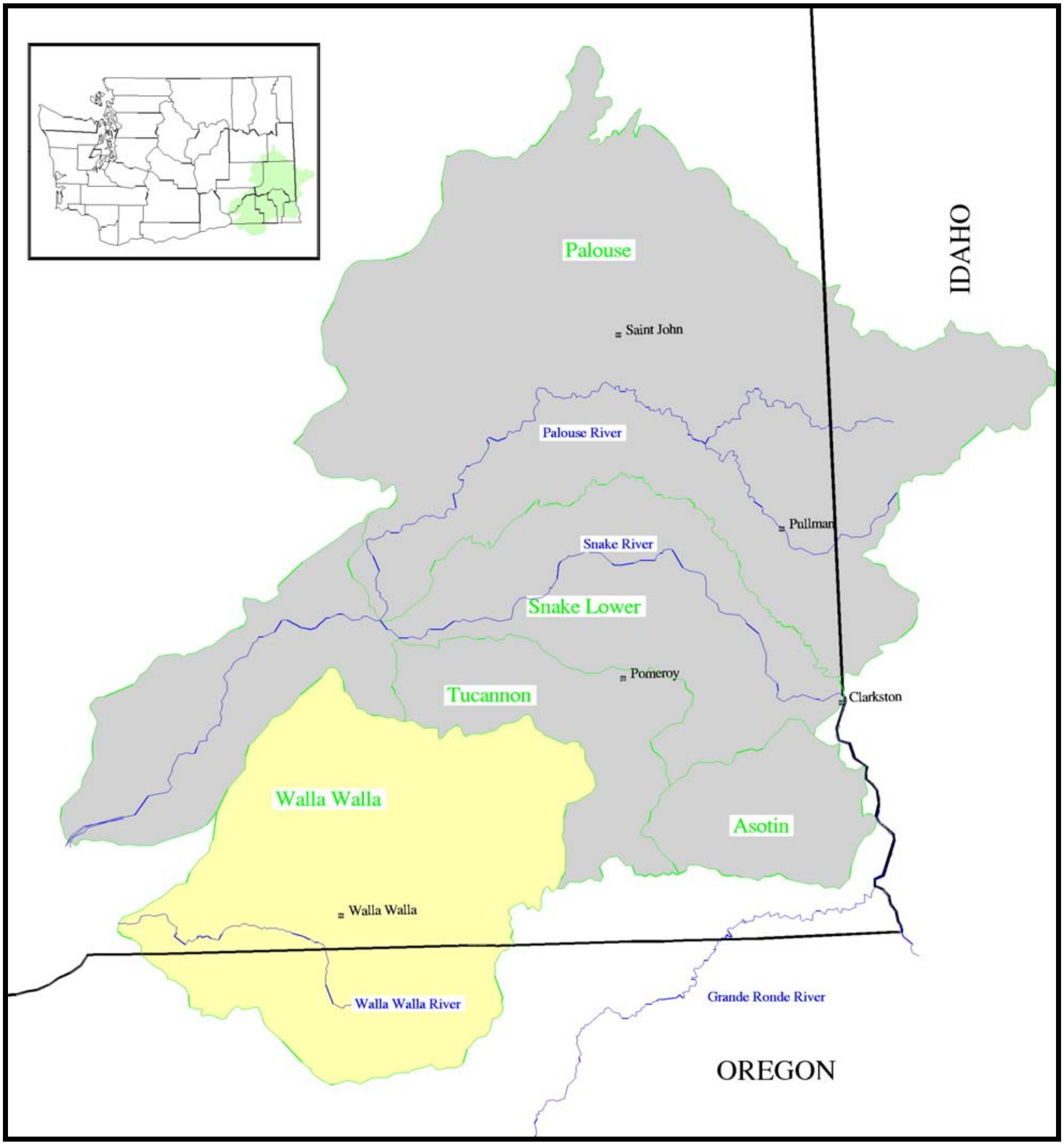

Figure 72. Location of the Walla Walla subbasin.

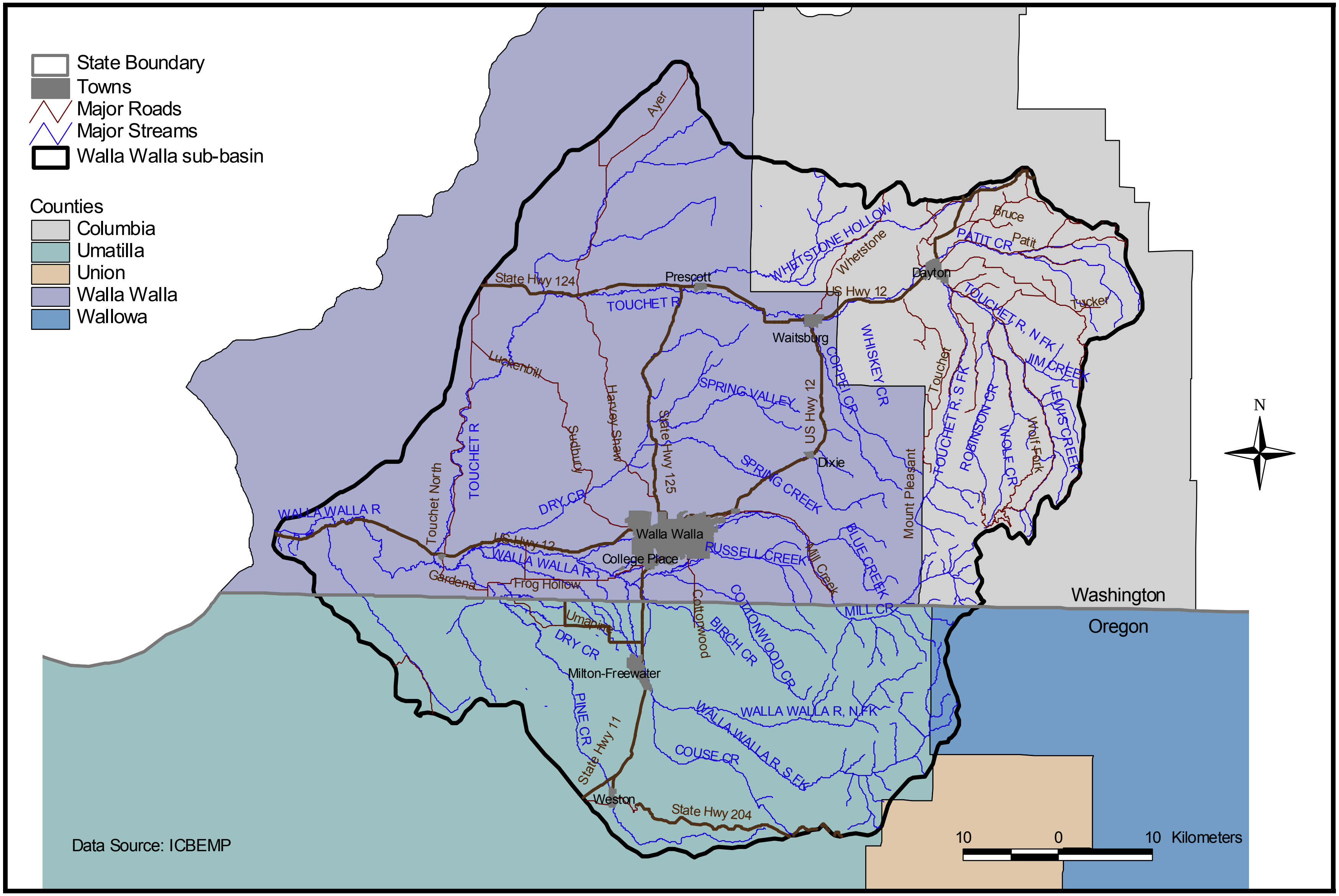

Figure 73. Counties of the Walla Walla subbasin (NPPC 2001).

Table 59. Subbasin size relative to the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Subbasin	Size		Percent of Ecoregion
	Acres	Mi^2	
Palouse	2,125,841	3,322	44
Lower Snake	1,059,935	1,656	22
Tucannon	326,185	510	7
Asotin	246,001	384	5
Walla Walla	1,126,198	1,760	22
Total (Ecoregion)	**4,884,160**	**7,631**	**100**

1.2 Physiography

The Subbasin encompasses two major physiographic features: the Blue Mountains and valley lowlands (Newcomb 1965 in NPPC 2001). The Blue Mountains dominate the eastern portion of the Subbasin with an average elevation of 5,000 feet. The highest point is 6,000 feet at Table Mountain (Figure_3). The topography of the Blue Mountains consists of flat-topped ridges and steep stair-stepped valley walls formed by thousands of feet of Miocene basalt flows that engulfed the folded, faulted, and uplifted granitic core of the mountains. As mountains were uplifted, streams and glaciers carved canyons through the basalt layers. Valley lowlands extend from the center of the basin north to the divide between the Touchet and Snake Rivers and south to the Horse Heaven Hills.

The dominant bedrock across the region consists of a series of basalt flows known as the Columbia River basalt that are stacked like a layer cake across much of eastern Washington, eastern Oregon, and southern Idaho. The basalt is divided into formations, each an aggregation of individual flows sharing similar flow histories and geochemistry. The three major formations that occur in the Subbasin are the Saddle Mountains, Wanapum, and Grande Ronde. The flow thickness ranges from five feet to as much as 150 feet, and collectively is estimated to be hundreds to thousands of feet thick (Newcomb 1965 in NPPC 2001). The topography of the basin is directly related to the folding, faulting, and erosion of these formations, creating a regional structure that dips westward from the Blue Mountains, southward down the Touchet Slope, northward from Horse Heaven Ridge, and eastward from a dividing ridge in the lower Walla Walla Valley (Newcomb 1965 in NPPC 2001).

Fertile soils formed from Pleistocene silt and sand blanket the subbasin. During the Pleistocene ice ages, the region underwent severe change as the continental glaciers advanced and retreated to the north, and valley glaciers carved channels in the higher elevations. The oldest of the Pleistocene deposits washed down from the canyons of the Blue Mountains and are referred to locally as the “old gravels and clays” (Newcomb 1965 in NPPC 2001). These deposits filled the structural troughs formed by the folding of the basalt layers in the Subbasin. Massive floods swept through the Columbia basin periodically through the quaternary era, bringing vast amounts of sediment into the region. Wind, intensified by the expanse of glacial ice, piled the sand and silt known as loess into dunes that spread across much of central and southeastern Washington. These dunes characterize the region known as the Palouse, and can be seen throughout the Subbasin. The Touchet beds are another reflection of Pleistocene glaciation and climate. They represent cyclic slow water deposits laid down when massive floods resulting from the breaching of an ice dam located near Missoula, Montana scoured the area and backed up into the mouth of the Walla Walla River (Alwin 1970 in NPPC 2001).

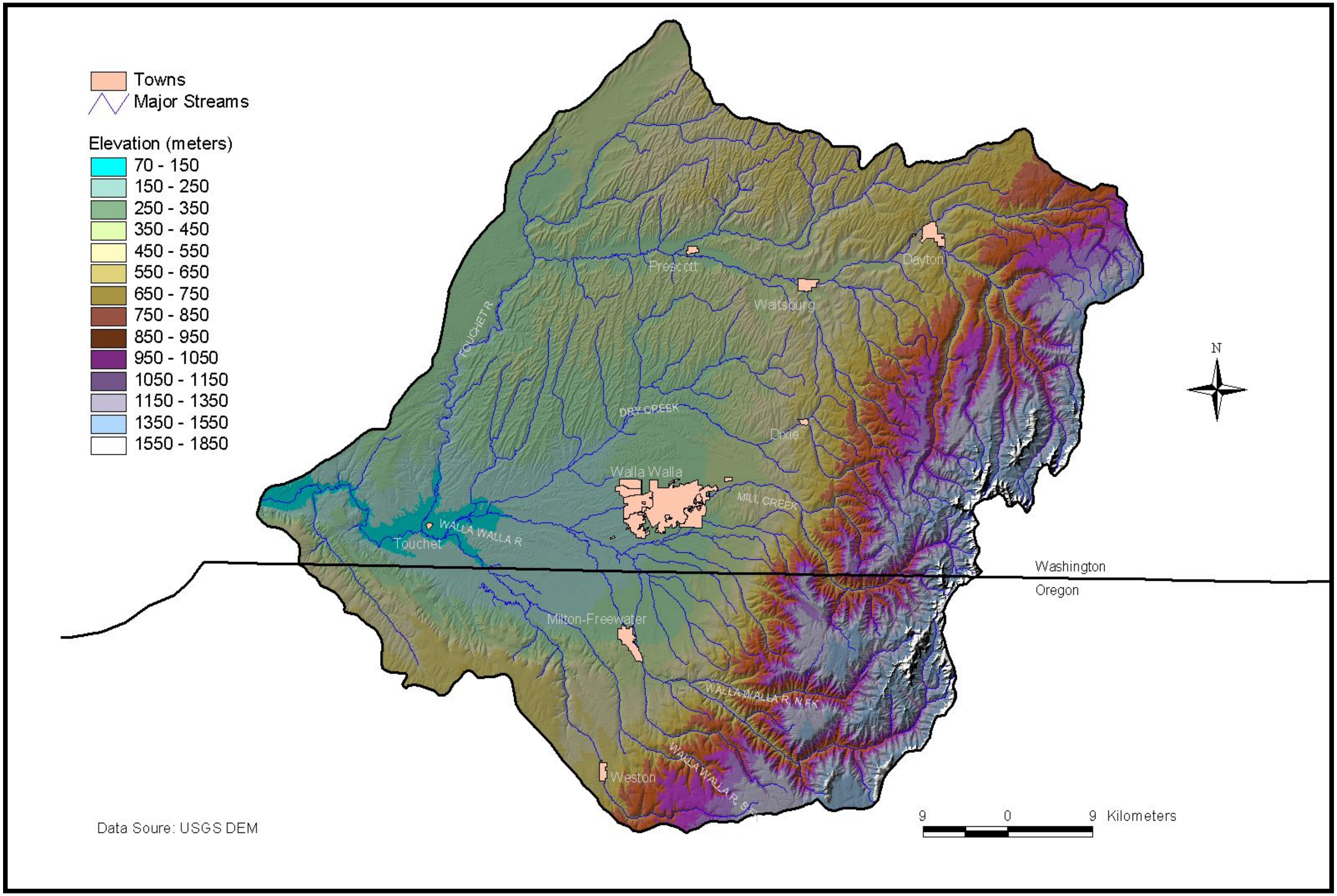

Figure 74. Elevation and topography of the Walla Walla subbasin (NPPC 2001).

2.0 Socio-Political Features

2.1 Land Ownership

Approximately 11 percent of the Subbasin is in federal, state, tribal and local government ownership, while the remaining 89 percent is privately owned or owned by non-governmental organizations (Figure_4). Private lands in the Subbasin comprise 21 percent of the entire Ecoregion (Table_2).

Table 60. Land ownership in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Land Ownership	Subbasin					
	Palouse	Lower Snake	Tucannon	Asotin	Walla Walla	Total
Federal Lands[1]	68,778	24,542	78,417	64,684	102,100	**338,521**
Native American Lands	0	0	0	0	8,500	**8,500**
State Lands[2]	79,890	35,432	19,111	16,742	16,634	**167,809**
Local Government Lands	0	139	0	31	595	**765**
NGO Lands	49	0	0	0	0	**49**
Private Lands	1,977,093	999,816	228,657	164,544	998,369	**4,368,479**
Water	31	6	0	0	0	**37**
Total	**2,125,841**	**1,059,935**	**326,185**	**246,001**	**1,126,198**	**4,884,160**

[1] Includes lands owned by the U.S .Forest Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, and the U.S. Army Corps of Engineers.
[2] Includes lands owned by WDFW, Washington State Parks, University, and the Washington Department of Natural Resources.

The Subbasin has the most acres under public ownership in the Ecoregion, but the third highest relative percentage of land under public ownership. Only the Tucannon and Asotin subbasins have more government ownership (33 percent and 30 percent, respectively).

Federal land management entities include the USFS (Umatilla National Forest) and BLM. All lands managed by the USFS and BLM are located in the Blue Mountains. The Umatilla National Forest forms the eastern border of the subbasin and extends into both Washington and Oregon.

State management entities in the subbasin include WDFW), Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Forestry (ODF), Washington Department of Forestry (WDF), WDNR, Oregon Department of Environmental Quality (ODEQ), WDOE, and the Oregon Water Resources Department (OWRD).

2.2 Land Use

Land use in the Subbasin includes agriculture, timber production, livestock grazing, and urban development. The Walla Walla region is one of the most productive agricultural areas in the world. Wheat, barley, peas, and fruit are the principle crops grown in the subbasin. Irrigated lands primarily occur in the narrow lowland portions of the Subbasin, representing the largest use of surface and groundwater in the Subbasin. Non-irrigated grain crops account for about half of the 133,000 acres in the Oregon portion of the Subbasin. Green peas take up approximately 17,600 dryland acres, spanning from Milton-Freewater to Walla Walla. An estimated 11,800 acres of fruit is grown primarily north of Milton-Freewater (BOR 1999).

The majority of timber harvest on federally managed lands occurs in the high-elevation portions of the Subbasin, while privately owned timber is generally harvested on mid-elevation lands.

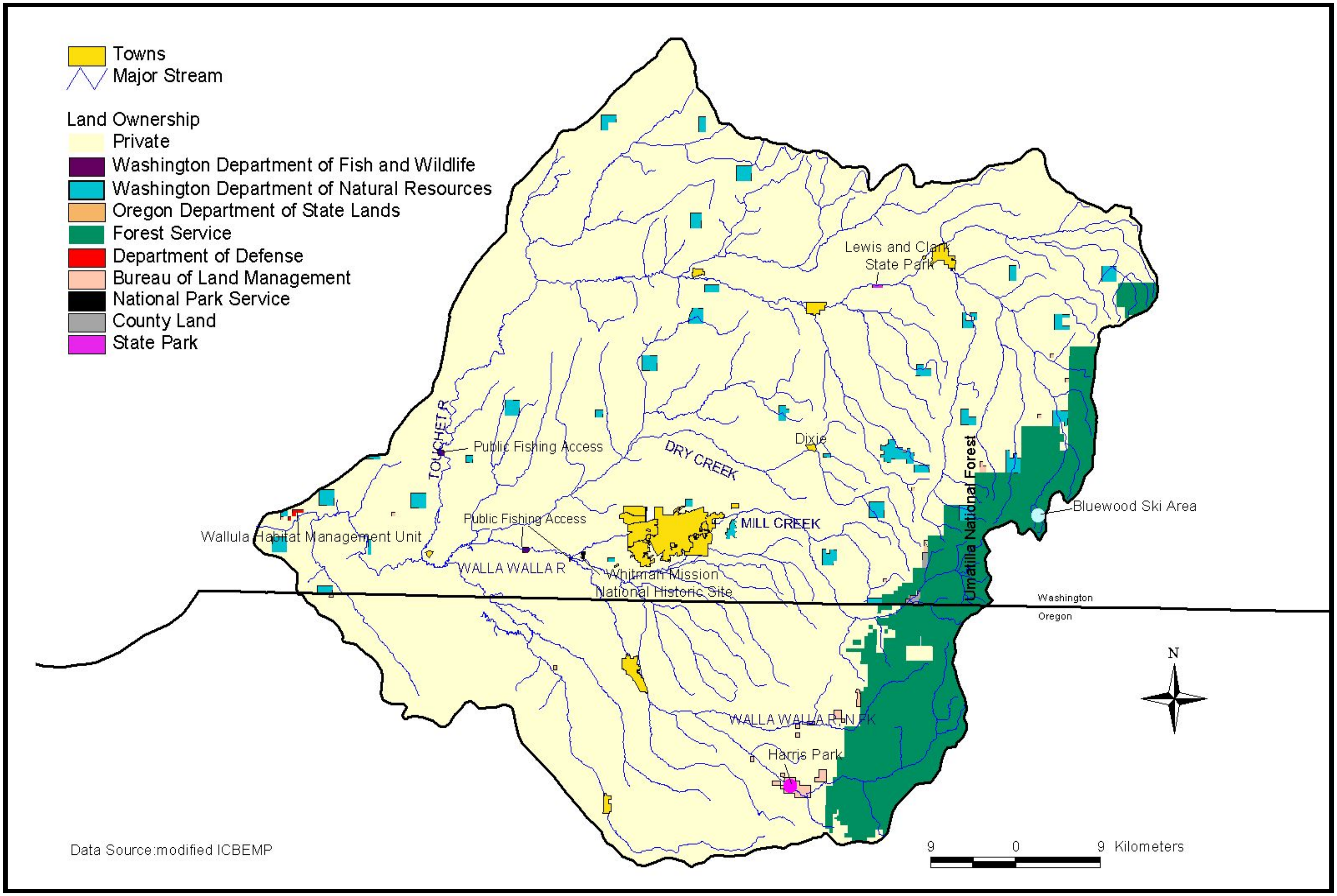

Figure 75. Land ownership in the Walla Walla subbasin (NPPC 2001).

Little livestock grazing occurs on federal lands in the North and South Fork Walla Walla watersheds because of steep slopes. Livestock grazing does occur, however, in the upper portions of the subbasin, while dairies are southwest of Walla Walla in the Umapine area (NPPC 2001).

Numerous towns are located within the Subbasin, many of which are incorporated. Urban development has resulted in a growing number of ranchettes, subdivisions, subdivided cropland, and floodplain encroachments. General land use is illustrated in Figure_5. For more information about the effects on wildlife habitat from changes in land use from circa 1850 to today, see section 3.2 in Ashley and Stovall (unpublished report 2004).

2.3 Protection Status

An estimated 0.7 percent (8,211 acres) of the Subbasin is permanently protected from conversion of natural land cover and has a mandated management plan in operation to maintain a natural state (Priority Status 1: high protection) (Figure_6). The majority of Priority Status 1 lands in the Subbasin are associated with the Wenaha -Tucannon Wilderness Area. Conversely, no lands within the Subbasin receive Priority 2 protection status. The vast majority of state and federal lands, in both Washington and Oregon, fall under Priority Status 3, while most privately owned lands receive no protection (Table_3).

Table 61. GAP protection status in the Walla Walla subbasin (NHI 2003).

Subbasin	GAP Protection Status	Acres	Percent
Walla Walla	High Protection	8,211	1
	Medium Protection	8,500	1
	Low Protection	124,645	11
	No Protection	984,842	87

The Subbasin ranks third within the Ecoregion in terms of the amount of unprotected land (Figure_7). Medium, low, and no protection status lands (Priority Status 2, 3, and 4, respectively) show similar trends throughout the Ecoregion, except for the Walla Walla subbasin, which has no lands in the medium protection status category (Figure_8). Protection status priorities are defined in section 3.3 in Ashley and Stovall (unpublished report, 2004).

Additional habitat protection, primarily on privately owned lands, is provided through the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). The Conservation Reserve Program is intended to reduce soil erosion on upland habitats through re-establishment of perennial vegetation on former agriculture lands. Similarly, CREP conservation practices reduce stream sedimentation and provide protection for riparian wetland habitats through establishment of stream corridor buffer strips comprised of herbaceous and woody vegetation.

Both programs provide short-term (CRP-10 years; CREP-15 years), high protection of habitats. The U.S. Congress authorizes program funding/renewal, while the USDA determines program criteria. Program enrollment eligibility and sign-up is decentralized to state and local NRCS offices (R. Hamilton, FSA, personal communication, 2003).

Conservation Reserve Program acreage figures for each county in the Ecoregion are summarized by cover practice (CP) in Table_4 (CP data are not available for Oregon). Conservation Reserve Enhancement Program acreages are compared in Table_5 for both

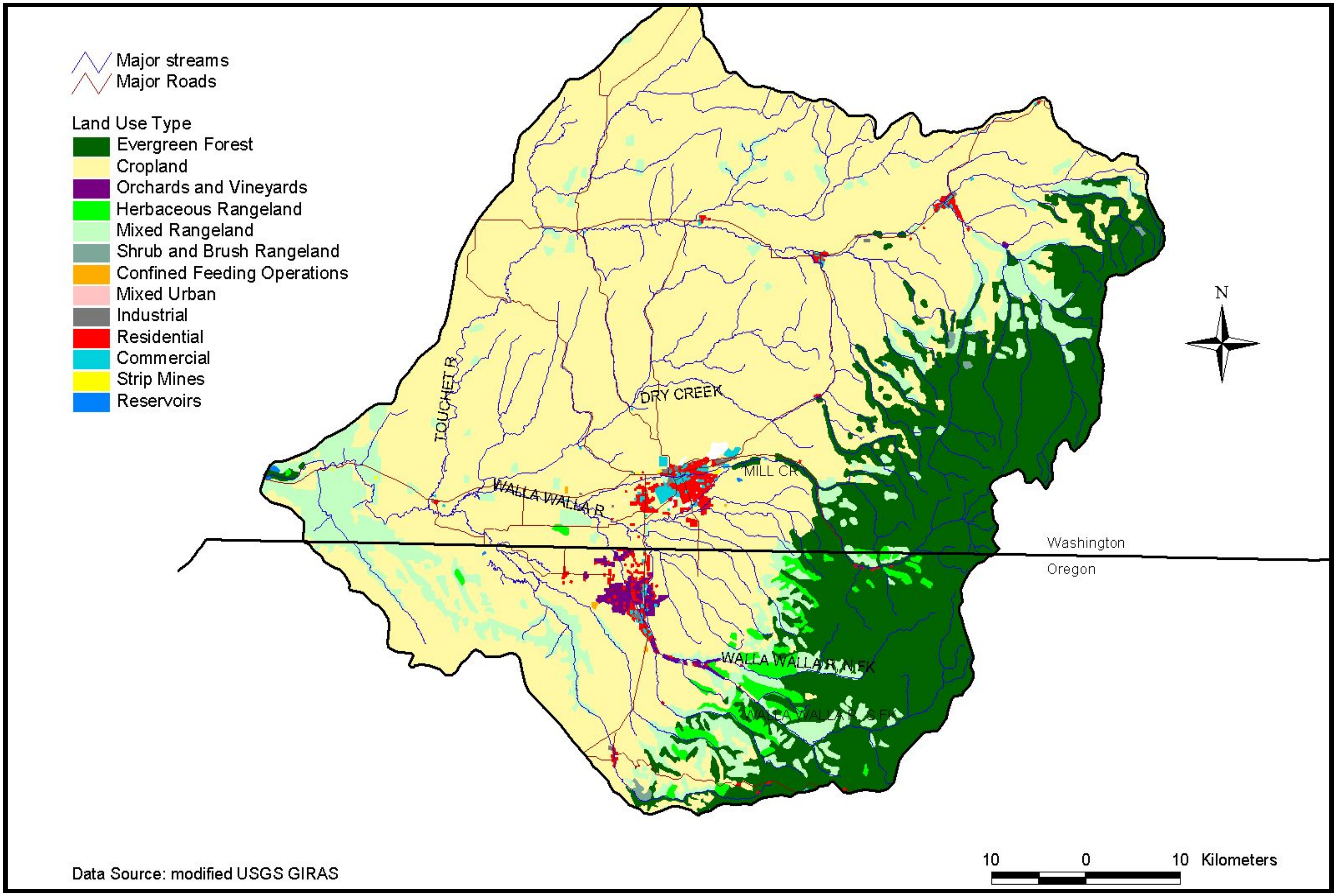

Figure 76. Land use in the Walla Walla subbasin (NPPC 2001).

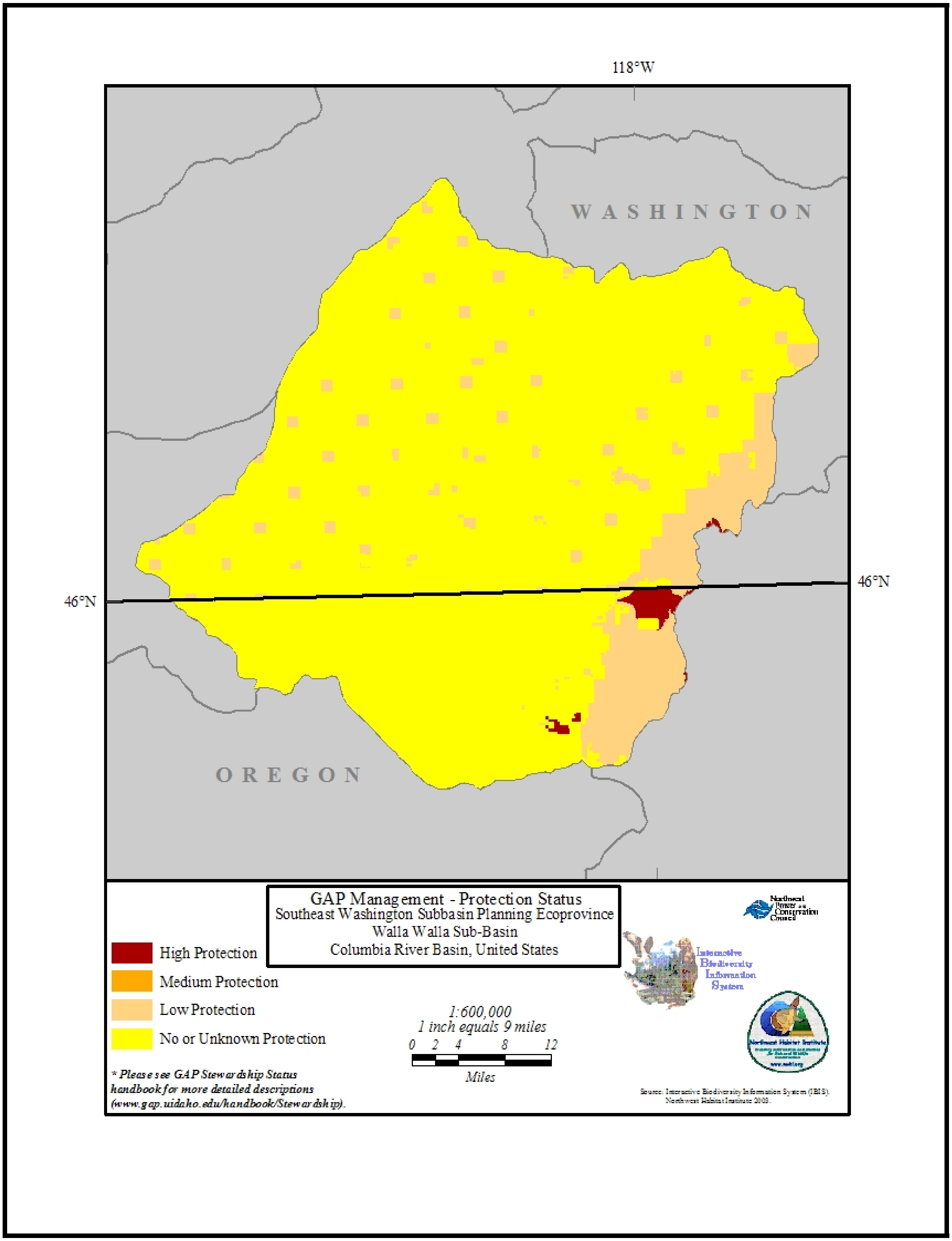

Figure 77. GAP protection status lands in the Walla Walla subbasin (NHI 2003).

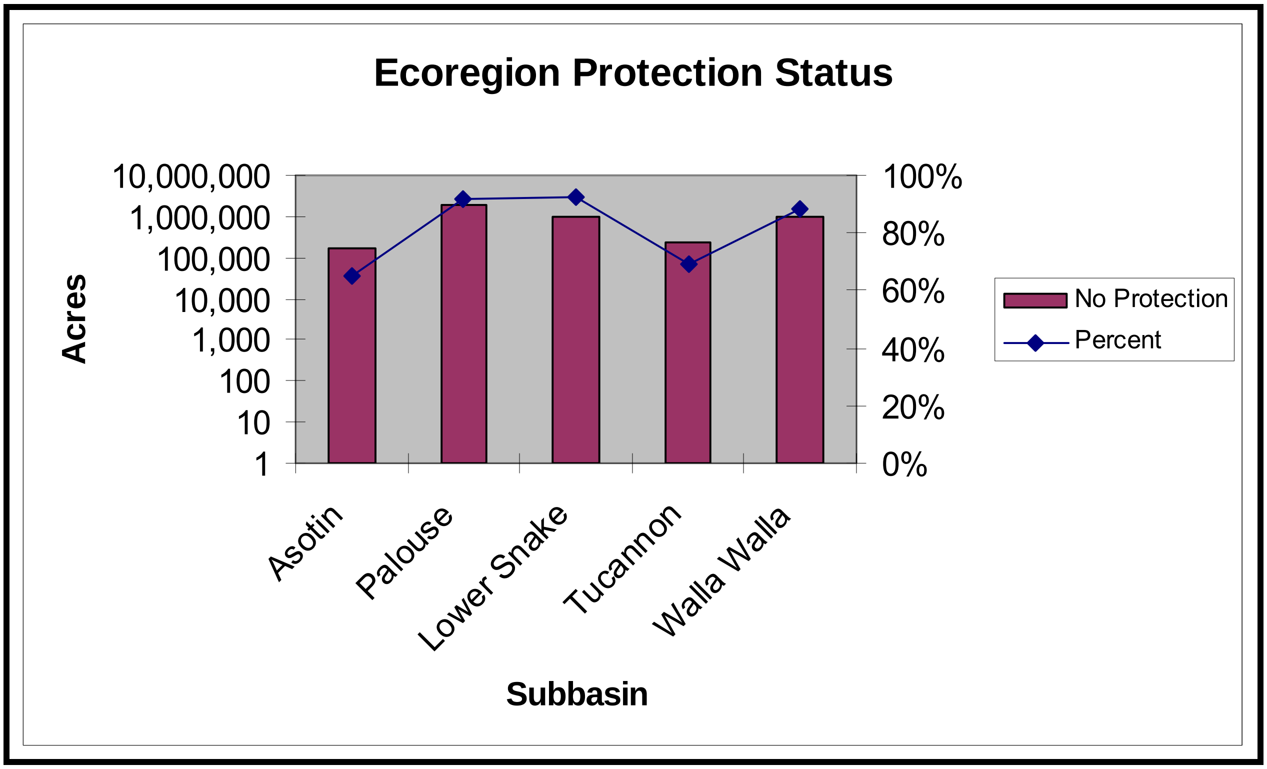

Figure 78. Comparison of GAP unprotected status lands by subbasin (NHI 2003).

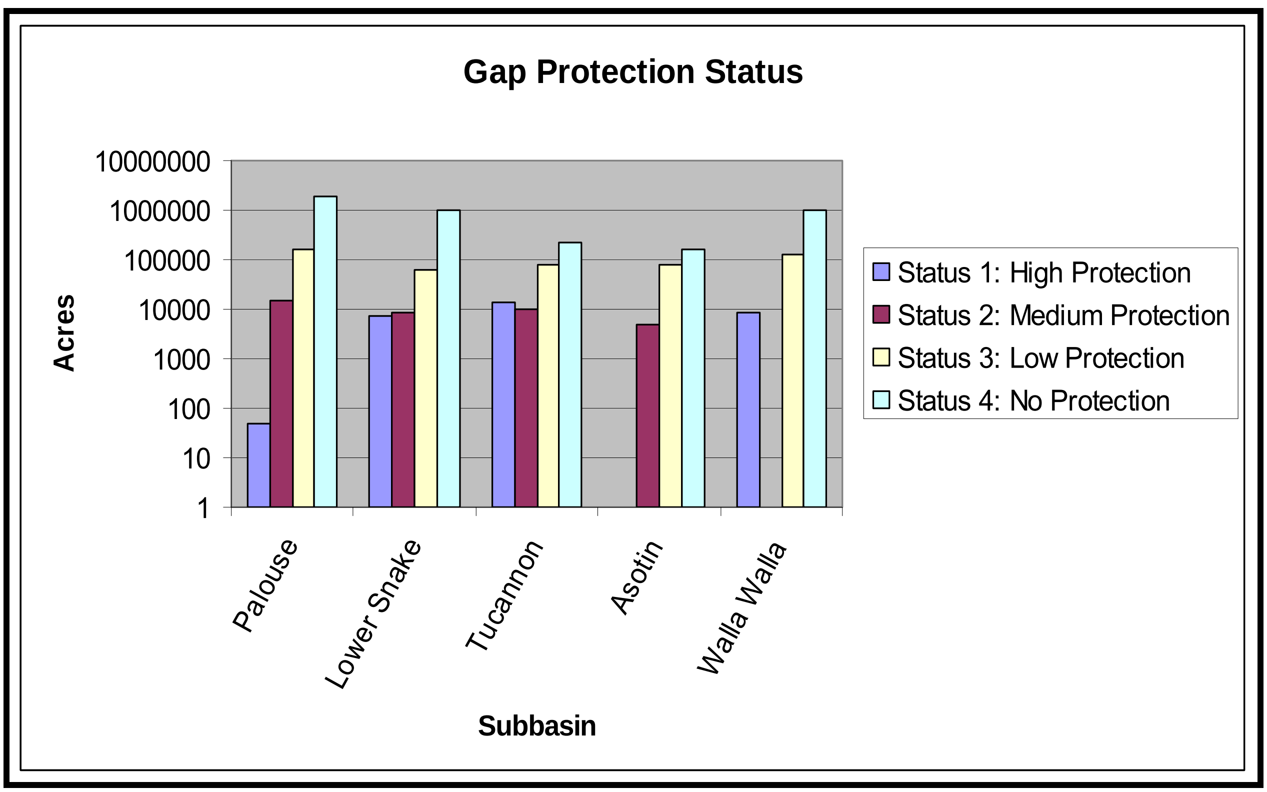

Figure 79. GAP protection status for all habitat types by subbasin (NHI 2003).

Table 62. CRP protected acres by county within the Southeast Washington Subbasin Planning Ecoregion (FSA, unpublished data, 2003).

County	Introduced Grasses (CP1)	Native Grasses (CP2)	Tree Plantings (CP3)	Wildlife Habitat (CP4)	Grass (CP10)	Trees (CP11)	Contour Grass (CP15)	Total Acres
Asotin	7,812	9,591	35	7,450	3,367	19	0	28,274
Columbia	5,991	20,162	581	5,929	10,839	355	28	43,885
Garfield	4,545	13,328	0	19,911	7,428	0	2,414	47,626
Umatilla	4,501	3,989	777	1,219	3,276	385	N/A	14,147
Walla Walla	44,955	95,555	129	0	11,735	166	0	152,540
Whitman	67,804	142,625	1,522	34,509	36,645	925	2,442	286,472

Table 63. The number of acres protected through CREP by county (FSA, unpublished data, 2003).

County	Acres
Asotin	1,339
Columbia	1,972
Garfield	2,535
Umatilla	52
Walla Walla	1,922
Whitman	1,052
Umatilla (Oregon)	61

Washington and Oregon Counties. The Farm Service Administration (FSA) provided the CRP and CREP data, which are available only at the county level.

2.4 Ecoregional Conservation Assessment Priorities and Public Land Ownership

Subbasin ECA priorities and public land ownership are compared in Figure_9 and Figure_10. ECA designated areas include USFS, private, and other state and federal managed lands. All ECA designated lands in the Subbasin (Washington State) are Class 2 priority. Class 2 lands are critical wildlife habitats that usually have some measure of protection such as public ownership.

In addition to identifying links between existing public lands and ECA conservation priorities, it is important to recognize how ECA priorities relate to focal habitat types. ECA priority areas encompass conifer forest (including ponderosa pine), steppe grassland habitats, and agricultural lands (Figure_11). Shrubsteppe habitat is not an ECA conservation priority in this subbasin. ECA is further discussed in section_4.2 in Ashley and Stovall (unpublished report, 2004).

3.0 Ecological Features

3.1 Vegetation

Subbasin vegetation, wildlife habitat descriptions, and changes in habitat extent, distribution, abundance, and condition are summarized in the following sections. Landscape level vegetation information is derived from the Washington GAP Analysis Project (Cassidy 1997) and NHI data (2003).

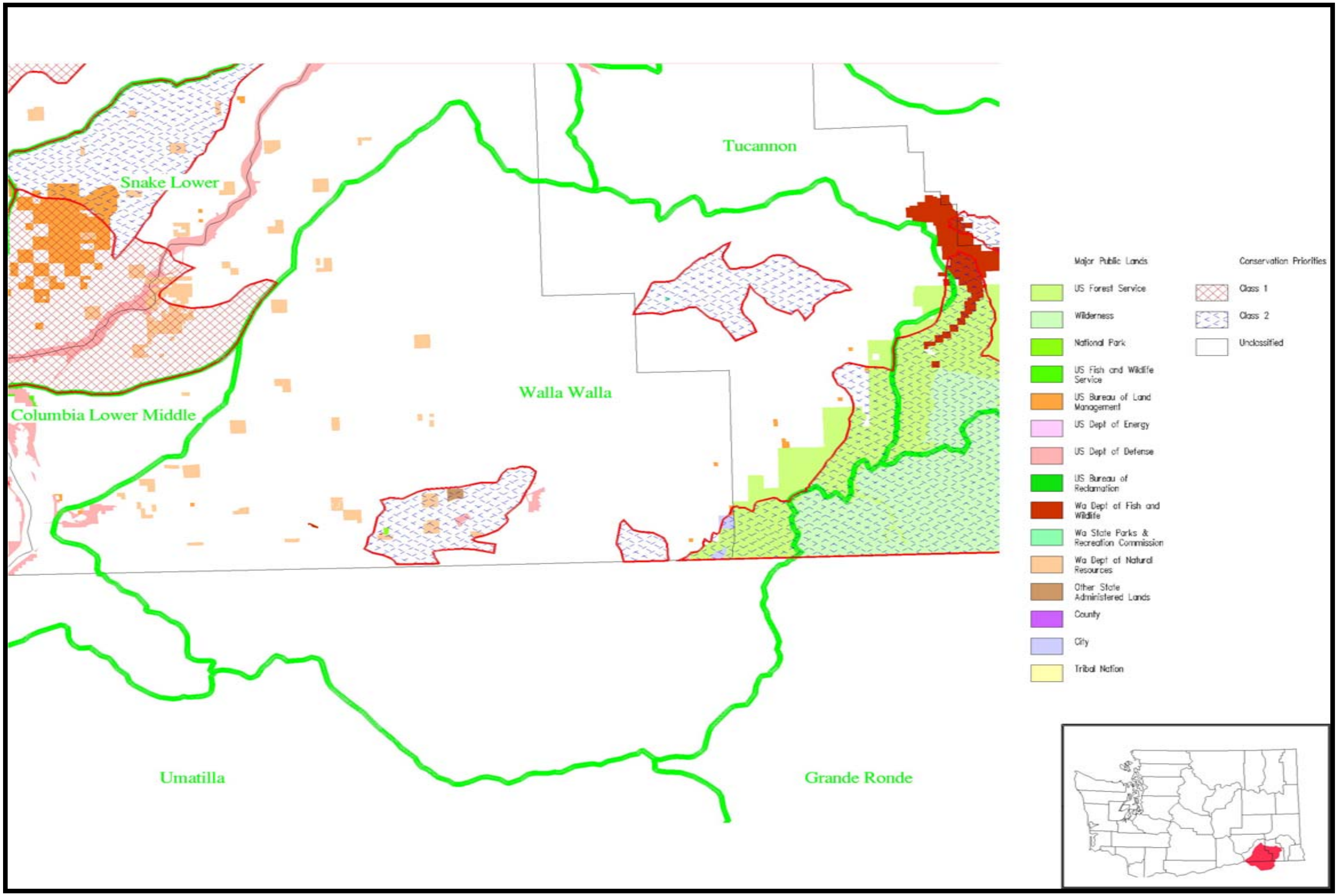

Figure 80. Washington State ECA designations and public land ownership in the Walla Walla subbasin (ECA 2003).

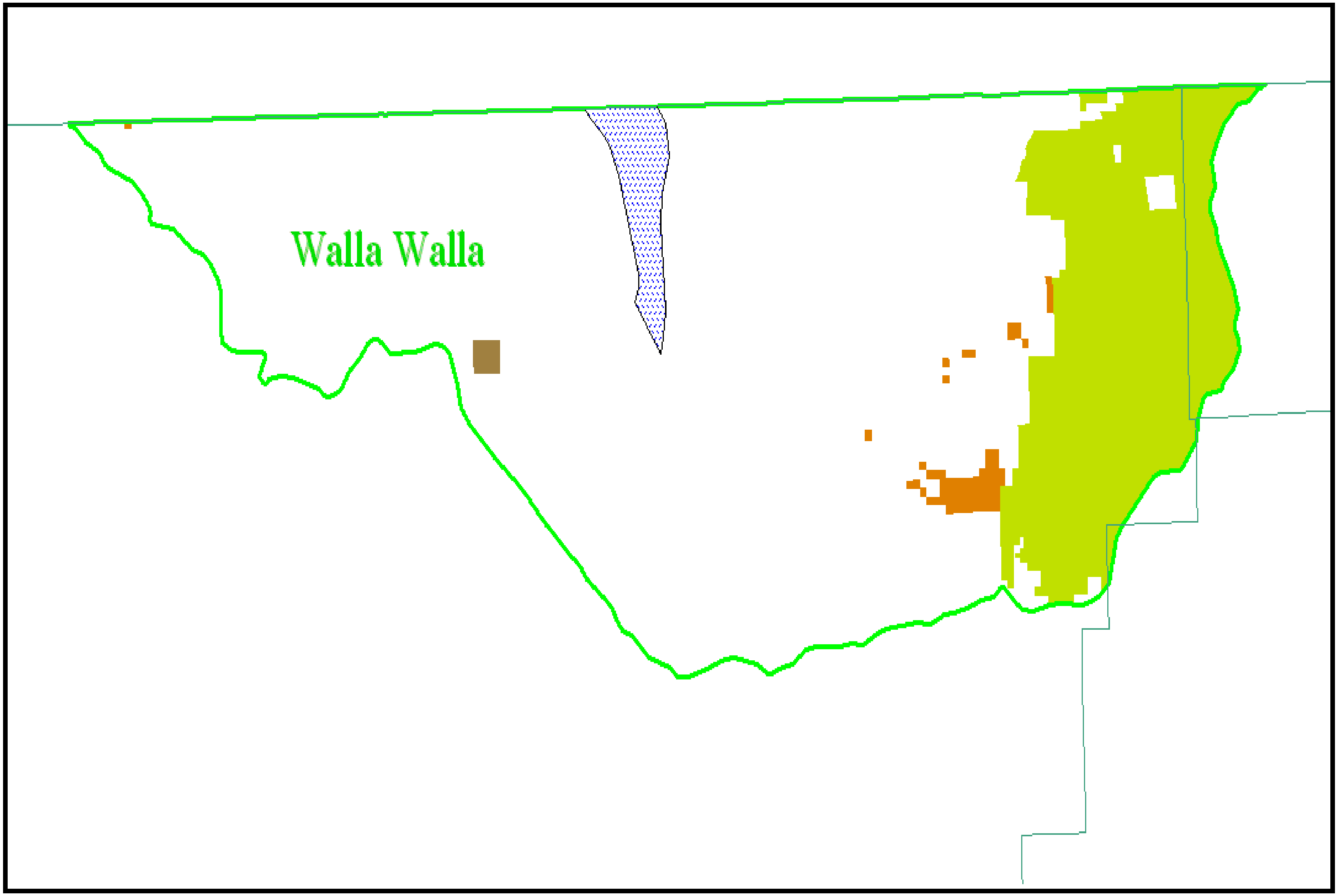

Figure 81. Oregon State ECA designations and public land ownership in the Walla Walla subbasin (ECA 2003).

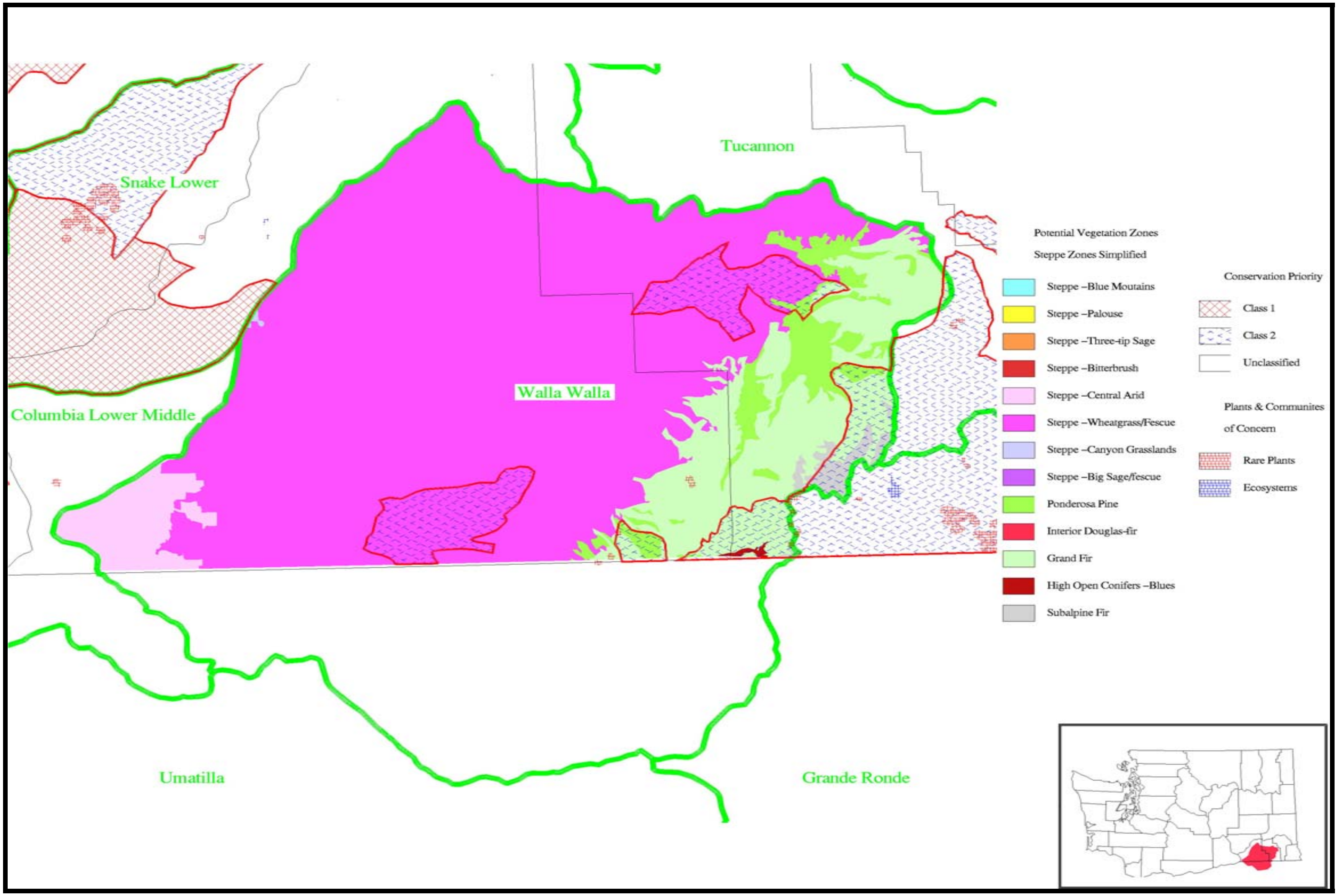

Figure 82. Washington State ECA priority areas and focal habitat types (WDFW 2004).

3.1.1 Rare Plant Communities

The Subbasin contains eight rare plant communities (Table_6). Approximately 35 percent of the rare plant communities are associated with grassland habitat, 15 percent with wetland habitats, and 50 percent with upland forest habitat. General locations of rare plant occurrence and plant communities of concern, disturbance factors, and ECA priority areas are illustrated in Figure_12 (Washington State only – Oregon data not provided). Rare plant sites are located primarily within forest and grassland ecotypes.

Table 64. Known high quality or rare plant communities and wetland ecosystems of the Walla Walla subbasin in Washington State (WNHP 2003).

Scientific Name	Common Name
POPULUS TREMULOIDES) / CRATAEGUS DOUGLASII / HERACLEUM MAXIMUM SHRUBLAND	(QUAKING ASPEN) / BLACK HAWTHORN / COW PARSNIP
ABIES GRANDIS / VACCINIUM MEMBRANACEUM FOREST	GRAND FIR / BIG HUCKLEBERRY
LARIX OCCIDENTALIS COVER TYPE	WESTERN LARCH FOREST
PINUS MONTICOLA / CLINTONIA UNIFLORA FOREST	WESTERN WHITE PINE / QUEEN'S CUP
POPULUS BALSAMIFERA SSP. TRICHOCARPA / CICUTA DOUGLASII FOREST	BLACK COTTONWOOD / WESTERN WATER HEMLOCK
ERIOGONUM NIVEUM / POA SECUNDA DWARF-SHRUB HERBACEOUS VEGETATION	SNOW BUCKWHEAT / SANDBERG'S BLUEGRASS
PSEUDOROEGNERIA SPICATA - FESTUCA IDAHOENSIS CANYON HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - IDAHO FESCUE CANYON
PSEUDOROEGNERIA SPICATA - POA SECUNDA HERBACEOUS VEGETATION	BLUEBUNCH WHEATGRASS - SANDBERG'S BLUEGRASS

3.1.2 Noxious Weeds

Changes in biodiversity have been closely associated with changes in land use. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed." Twenty-six species of noxious weeds occur in the Subbasin (Table_7).

Disturbance of grass and shrubland ecosystems by livestock has contributed to the spread of introduced grasses and weeds including cheatgrass and yellow starthistle (NPPC 2001). These invader species are native to the Mediterranean but thrive in the Subbasin due to similarities in climate (Quigley and Arbelbide 1997). All 55 transects sampled by WDFW in shrubsteppe ecosystems in the Columbia Basin contained exotic annual grasses and exotic forbs species (Dobler *et al.* 1996). Introduced vegetation species in the Subbasin often displace and/or compete with native plant species for available moisture, nutrients, and solar radiation; thus, reducing wildlife habitat suitability (Quigley and Arbelbide 1997).

Weed surveys conducted by the Columbia County Weed Board (2000) in the Touchet watershed found that 85 percent of upland range habitat was infested with yellow starthistle. Yellow starthistle displaces native plant communities and reduces plant diversity. It can accelerate soil erosion and surface runoff. Yellow starthistle forms solid stands that drastically reduce forage production for wildlife.

Spotted knapweed is another noxious weed increasing in prominence within the Subbasin. This noxious weed also reduces wildlife forage. Spotted knapweed infestations decreased

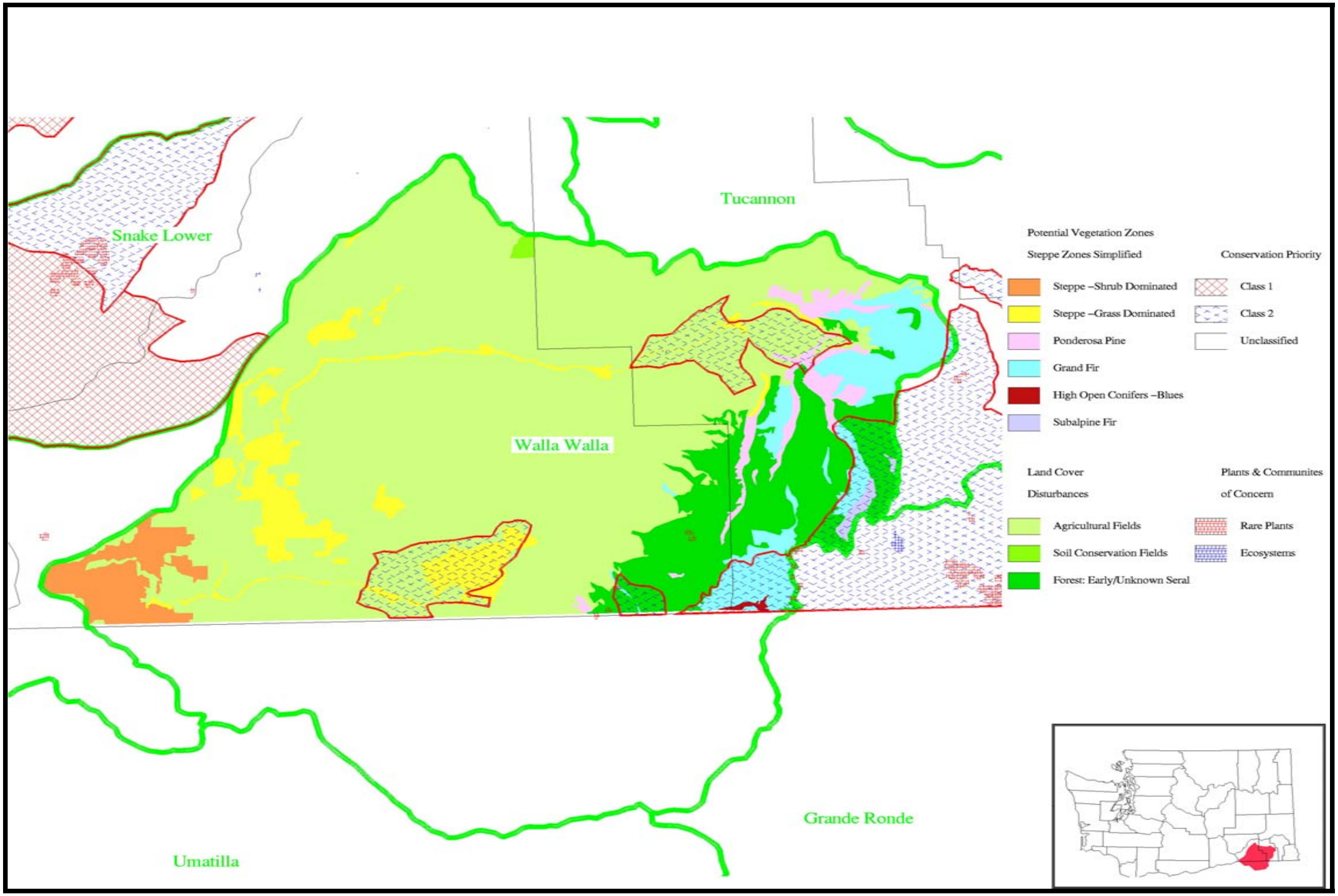

Figure 83. Rare plant occurrence in the Walla Walla subbasin (WNHP 2003).

Table 65. Noxious weeds in the Walla Walla subbasin (Callihan and Miller 1994).

Common Name	Scientific Name	Origin
Field bindweed	*Convolvulus arvensis*	Eurasia
Buffalobur nightshade	*Solanum rostratum*	Native to the Great Plains of the U.S
Pepperweed whitetop	*Cardaria draba*	Europe
Common crupina	*Crupina vulgaris*	Eastern Mediterranean region
Jointed goatgrass	*Aegilops cylindrica*	Southern Europe and western Asia
Meadow hawkweed	*Hieracium caespitosum*	Europe
Orange hawkweed	*Hieracium aurantiacum*	Europe
Poison hemlock	*Conium maculatum*	Europe
Johnsongrass	*Sorghum halepense*	Mediterranean
White knapweed	*Centaurea diffusa*	Eurasia
Russian knapweed	*Acroptilon repens*	Southern Russia and Asia
Spotted knapweed	*Centaurea bibersteinii*	Europe
Purple loosestrife	*Lythrum salicaria*	Europe
Mat nardusgrass	*Nardus stricta*	Eastern Europe
Silverleaf nightshade	*Solanum elaeagnifolium*	Central United States
Puncturevine	*Tribulus terrestris*	Europe
Tansy ragwort	*Senecio jacobaea*	Eurasia
Rush skeletonweed	*Chondrilla juncea*	Eurasia
Wolf's milk	*Euphorbia esula*	Eurasia
Yellow star thistle	*Centaurea solstitialis*	Mediterranean and Asia
Canadian thistle	*Cirsium arvense*	Eurasia
Musk thistle	*Carduus nutans*	Eurasia
Scotch cottonthistle	*Onopordum acanthium*	Europe
Dalmatian toadflax	*Linaria dalmatica*	Mediterranean
Yellow toadflax	*Linaria vulgaris*	Europe

bluebunch wheatgrass by 88 percent. Elk use was reduced by 98 percent on range dominated with spotted knapweed compared to bluebunch-dominated sites (Columbia County Weed Board 2000). Other problem exotic plant species in the Subbasin include rush skeletonweed, spikeweed (*Hemizonia pungens*), and perennial pepperweed (*Lepidium latifolium*).

Control of exotic plant species is critical to the maintenance of native shrubsteppe and grassland habitats, productive livestock rangelands, and the preservation of native wildlife species. The diversity of terrestrial birds was positively correlated with plant diversity. Surveys of shrubsteppe ecosystems conducted by WDFW showed that sage thrasher, sage sparrow, and white crowned sparrow occurrence was negatively correlated with percent cover of annual grass. None of the 15 bird and small mammal species in the study showed a positive correlation with percent annual grass cover (Dobler *et al.* 1996). Columbian sharp-tailed grouse prefer eating native vegetation rather than introduced species, although cultivated grains supplement their diet (Hays *et al.* 1998).

3.1.3 Vegetation Zones

Cassidy (1997) identified six historic (potential) vegetation zones (i.e., high open conifers, grand fir, sub-alpine fir, ponderosa pine, wheatgrass/fescue steppe, and shrub dominated central arid steppe) that occurred within the Washington State portion of the Subbasin (Figure_13). The ponderosa pine, central arid steppe (shrub dominated), and wheatgrass/fescue steppe vegetation zones are described in detail in section 4.1.7.3 in Ashley and Stovall (unpublished report, 2004). Three of the vegetation zones comprise focal habitat types (ponderosa pine, wheatgrass/fescue steppe, and central arid steppe). The eastside (interior) grassland focal habitat type corresponds to the wheatgrass/fescue steppe vegetation zone while the shrubsteppe focal habitat type is analogous to the central arid steppe vegetation zone.

Nearly 91 percent of the wheatgrass/fescue vegetation zone in Washington State is in agricultural production with most non-farmed areas grazed by livestock for at least a portion of the year. Considerably less (less than 3 percent) of the ponderosa pine vegetation zone has been converted to agriculture. Similarly, approximately 1 percent of the central arid steppe and grand fir vegetation zones are farmed (Figure_14). Although other vegetation zones are not currently in agriculture, grazing occurs in canyon grassland steppe, ponderosa pine, and other forested vegetation zones. In addition, much of the forested vegetation zones are in an early or unknown seral condition (Figure_14). Vegetation zone status is summarized in Table_8.

A comparison between acreage figures derived from Washington GAP data (Cassidy 1997) and NHI data (2003) is not possible because corollary GAP data from Oregon are not available. This data gap will be addressed in the near future as additional GIS support in both Oregon and Washington becomes available.

3.1.4 Wildlife Habitats

Thirteen habitat types are present in the Subbasin and are briefly described in Table_9 (NHI data include both Washington and Oregon). NHI data suggests that upland aspen forest (5,934 acres) and lodgepole pine forest and woodland (742 acres) habitat types historically occurred in the Subbasin, but are no longer present due largely to changes in seral forest communities. Detailed descriptions of habitat types are located in Appendix_B in Ashley and Stovall (unpublished report, 2004).

3.1.5 Changes in Wildlife Habitat

Dramatic changes in wildlife habitat have occurred throughout the Subbasin since pre-European settlement (circa 1850). In addition to agriculture and urban environments, conifer forest and shrubsteppe habitat types have increased significantly from historic levels.

Mixed conifer forest types have increased primarily because early seral forest communities have replaced logged forests, and fire protection measures have fostered conditions that allow development of dense forest understory and encroachment of conifers onto grassland habitats (USDA 1979). Similarly, fire control measures and plant community response to livestock grazing are primarily responsible for the significant increase in shrubsteppe habitat that has occurred since 1850. Habitat changes are illustrated in Figure_15 and Figure_16 (NHI 2003).

NHI (2003) data clearly documents the change (84 percent loss) in eastside (interior) grasslands due largely to conversion to agriculture (Figure_14). Upland lodgepole forest/woodlands and upland aspen forests have disappeared completely from the landscape over the preceding 150 years (NHI 2003). In both cases, periodic fires were

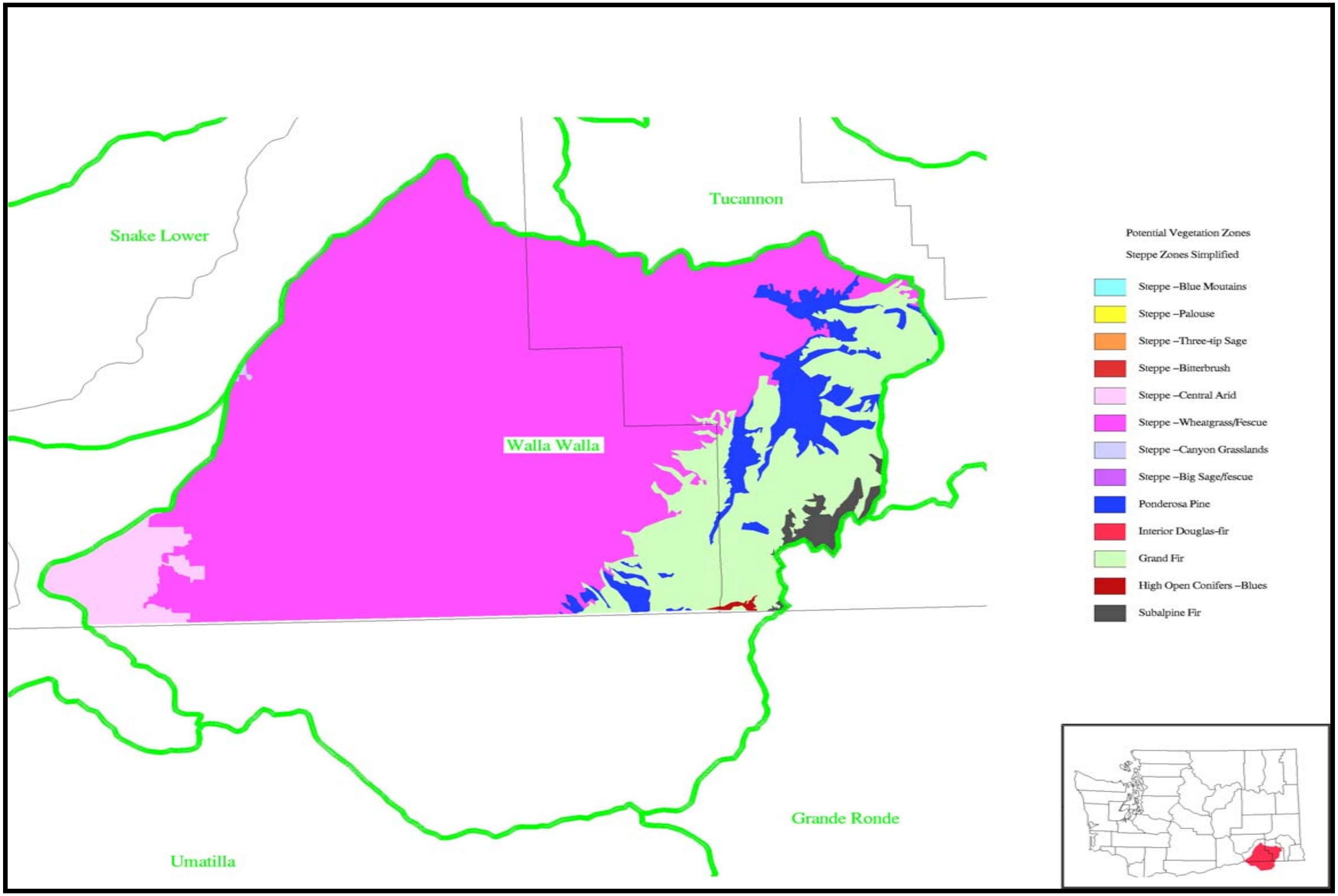

Figure 84. GAP vegetation zones in the Walla Walla subbasin (Cassidy 1997).

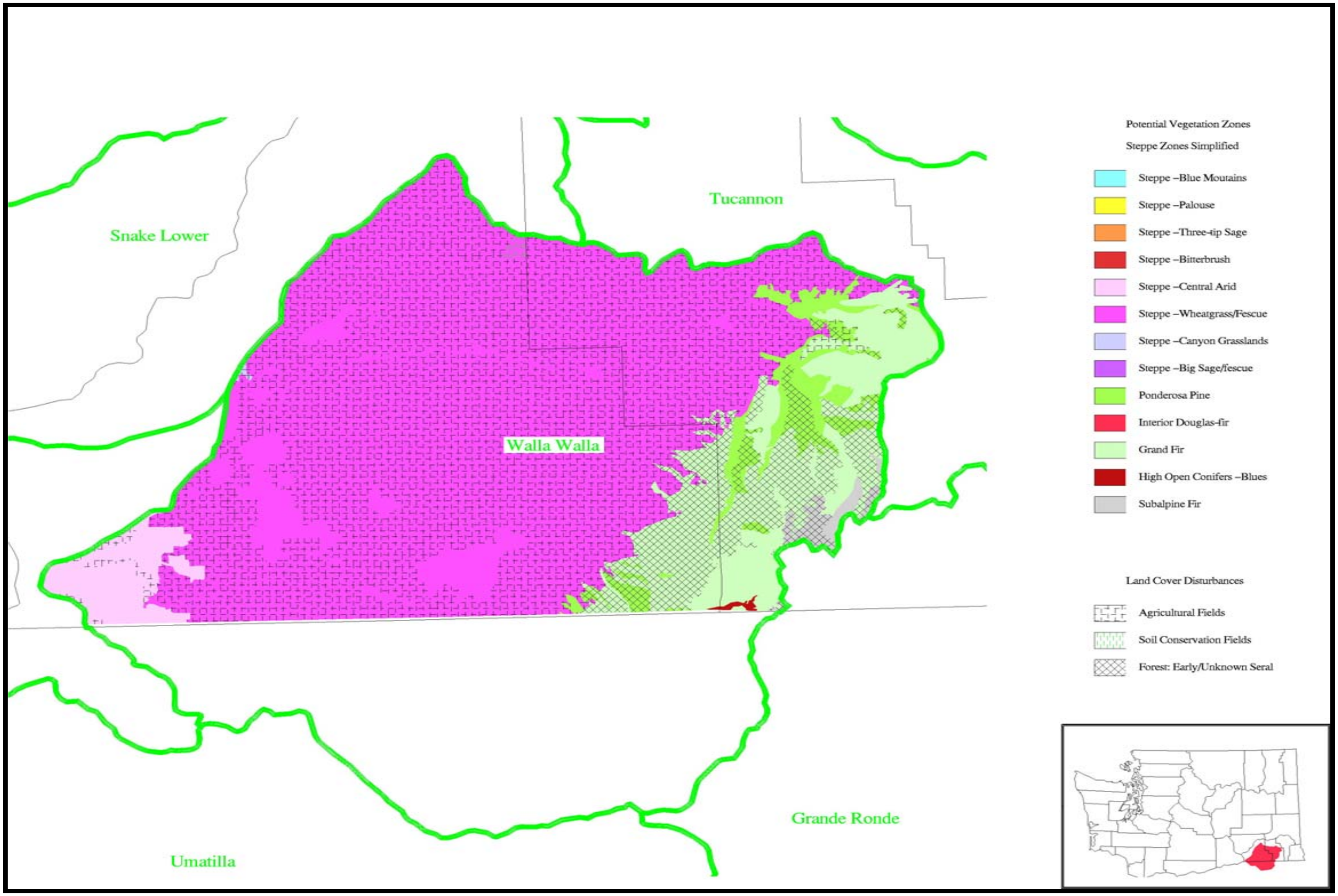

Figure 85. Relationship between vegetation zones and agriculture in the Walla Walla subbasin, Washington (Cassidy 1997).

Table 66. Historic and current extent of vegetation zones in the Walla Walla subbasin (Cassidy 1997).

Status	Vegetation Zone						
	Grand Fir (Acres)	High Open Conifers (Acres)	Subalpine Fir (Acres)	Ponderosa Pine (Acres)	Central Arid Steppe (Acres)	Wheatgrass Fescue Steppe (Acres)	Total (Acres)
Historic (potential)	118,943	710	9,379	40,569	31,533	606,971	808,105
Agriculture	-1,698	-0	-0	-940	-3,782	-551,056	-557,476
Current	117,245	710	9,379	39,629	27,751	55,915	250,629
Note: This table includes Washington State data only – Oregon data not available.							

Table 67. Wildlife habitat types in the Walla Walla subbasin (NHI 2003).

Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack; several species of conifer; understory typically shrub-dominated
Eastside (Interior) Mixed Conifer Forest	Coniferous forests and woodlands; Douglas-fir commonly present, up to 8 other conifer species present; understory shrub and grass/forb layers typical; mid-montane.
Ponderosa Pine and Interior White Oak Forest and Woodland	Ponderosa pine dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass understory; lower elevation forest above steppe, shrubsteppe.
Alpine Grasslands and Shrublands	Grassland, dwarf-shrubland, or forb dominated, occasionally with patches of dwarfed trees.
Eastside (Interior) Canyon Shrublands	A mix of tall to medium deciduous shrublands in a mosaic with bunchgrass or annual grasslands.
Eastside (Interior) Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogam crust.
Shrubsteppe	Sagebrush and/or bitterbrush dominated; bunchgrass understory with forbs, cryptogam crust.
Agriculture, Pasture, and Mixed Environs	Cropland, orchards, vineyards, nurseries, pastures, and grasslands modified by heavy grazing; associated structures.
Urban and Mixed Environs	High, medium, and low (10-29 percent impervious ground) density development.
Open Water – Lakes, Rivers, and Streams	Lakes, are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin Eastside Riparian Wetlands and Herbaceous Wetlands
Herbaceous Wetlands	Generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). Various grasses or grass-like plants dominate or co-dominate these habitats.
Montane Coniferous Wetlands	Occurs along stream courses, as patches, or adjacent to other wetlands; >30 percent tree cover dominated by conifers; shrubs-devil's club, stink currant, salmon berry, red-osier dogwood, spirea, alder etc.
Eastside (Interior) Riparian Wetlands	Shrublands, woodlands and forest, less commonly grasslands; often multi-layered canopy with shrubs, graminoids, forbs below.

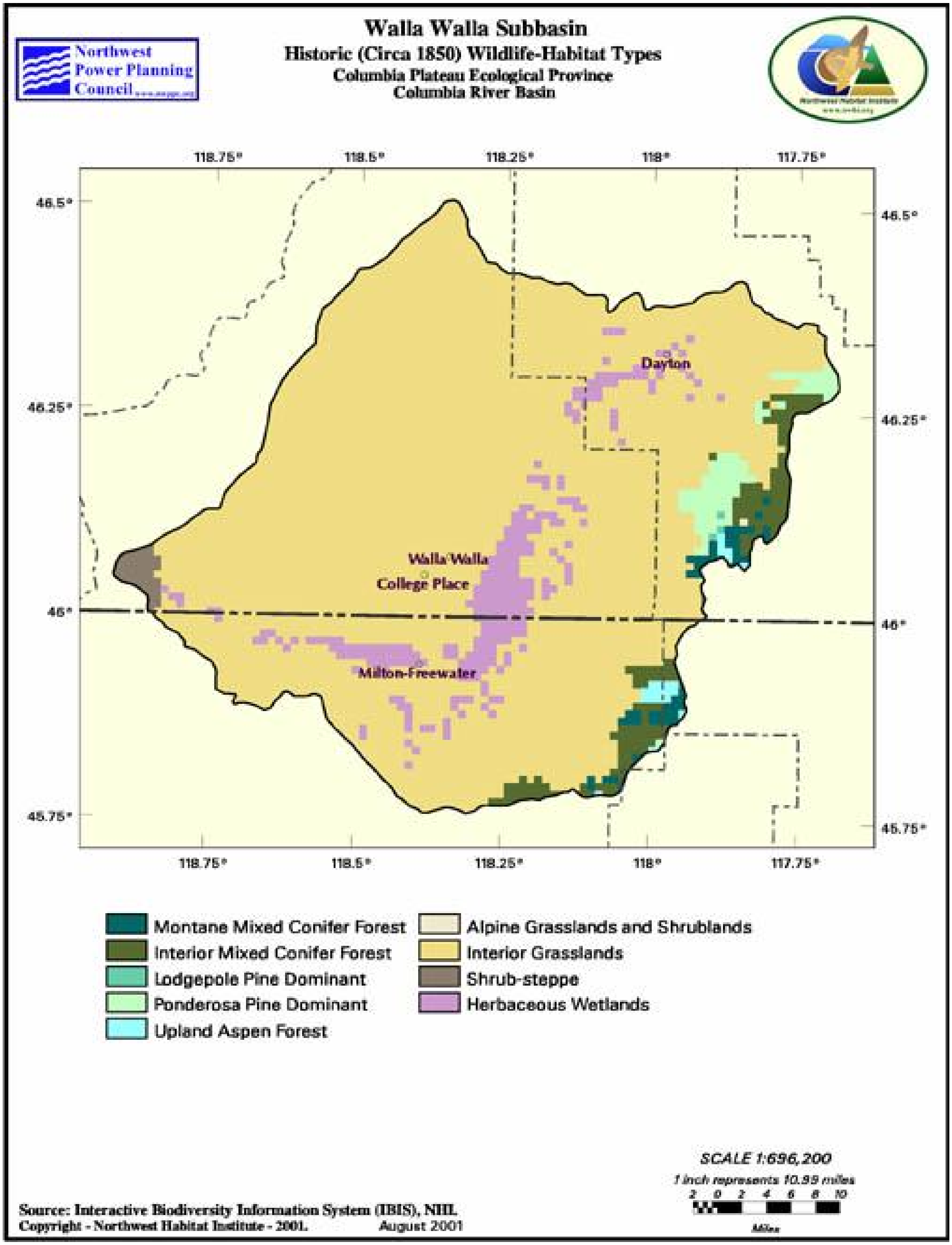

Figure 86. Historic wildlife habitat types of the Walla Walla subbasin (NHI 2003).

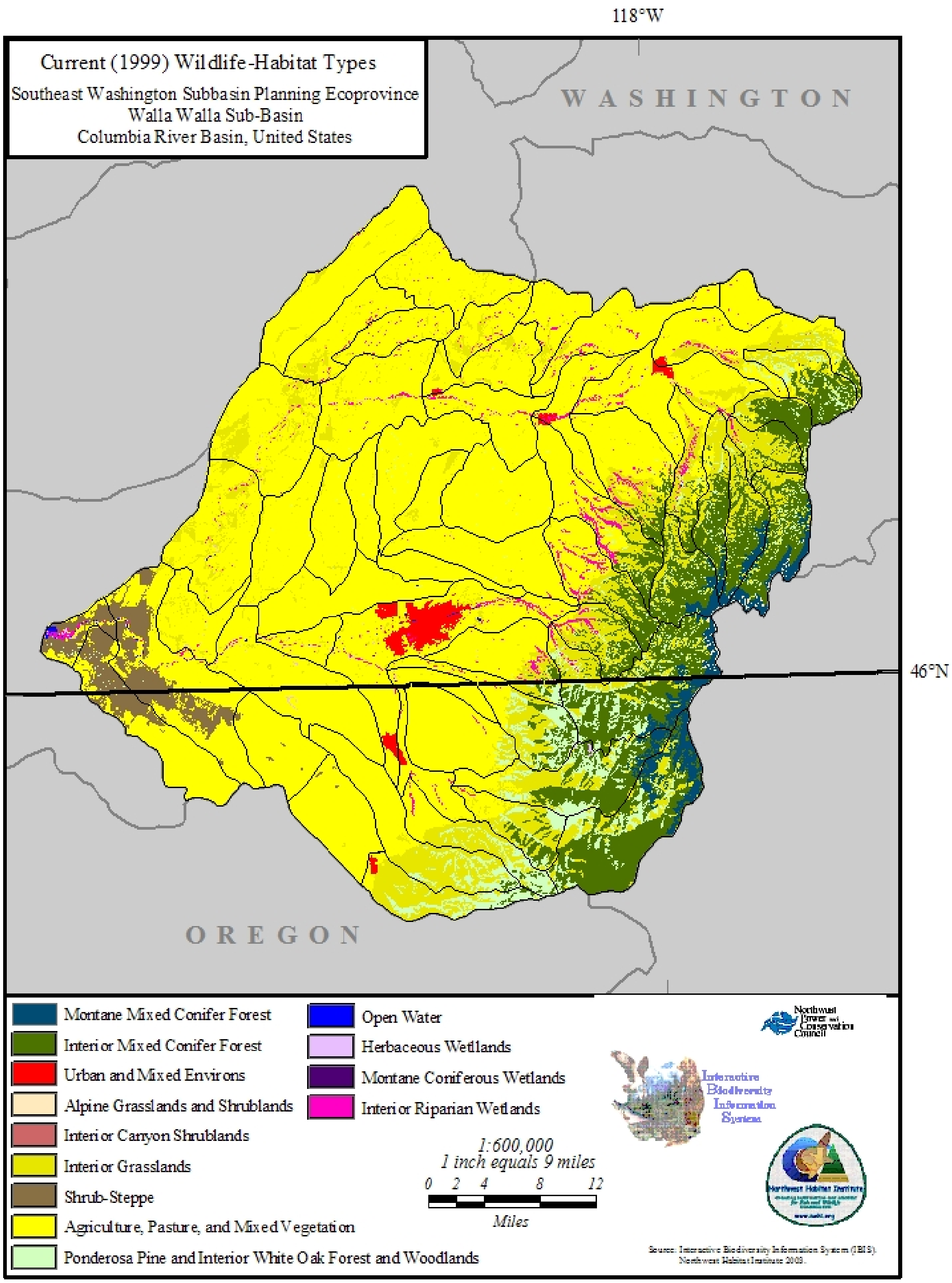

Figure 87. Current wildlife habitat types of the Walla Walla subbasin (NHI 2003).

necessary to regenerate and/or maintain stands. Fire suppression is likely the biggest contributor to the demise of these habitat types (Crawford and Kagen 2001). Quantitative changes in all Subbasin wildlife habitat types are listed in Table_10 and illustrated in Figure_17.

Ecoregion and subbasin planners believe that NHI (2003) herbaceous wetlands data and historic acreage figures for eastside riparian wetland habitat are inaccurate as listed in Table_10. Therefore, these data are not applied to management decisions in this subbasin. In addition, herbaceous wetland habitat displayed in Figure_15 historically did not exist based on Washington GAP data and expert opinion. A more realistic depiction of historic generalized habitat types, derived from Washington GAP data, is shown in Figure_18.

General subbasin hydrology is depicted in Figure_19. Historically, most subbasin wetlands were associated with perennial and intermittent streams (versus herbaceous wetlands) that drained rolling hills, much like what exists today.

3.1.5 Focal Habitats

The focal habitat selection and justification processes are described in section 4.1.3 in Ashley and Stovall (unpublished report, 2004). Focal habitats selected for the Subbasin are identical to Ecoregion focal habitats [ponderosa pine, eastside (interior) grasslands, shrubsteppe, and eastside (interior) riparian wetlands]. The number of extant acres for each focal habitat type is compared by subbasin in Table_11.

Ponderosa pine, eastside (interior) grassland, and shrubsteppe focal habitat types and agriculture (a habitat of concern) are illustrated in Figure_20. As shown, agriculture has displaced significant amounts of native grassland habitat.

3.1.6 Focal Habitat Summaries

Focal wildlife habitat types are fully described in section 4.1.7 in Ashley and Stovall (unpublished report, 2004). Only subbasin-specific focal habitat type anomalies and differences are described in this section.

3.1.6.1 Ponderosa Pine

The ponderosa pine habitat type is described in section 4.1.7.1 in Ashley and Stovall (unpublished report, 2004). Changes in ponderosa pine distribution in the Washington portion of the Subbasin from circa 1850 to 1999 are illustrated in Figure_15 and Figure_16.

Historically (circa 1850), the ponderosa pine habitat type covered approximately 23,000 acres in the foothills of the Blue Mountains (NHI 2003). Since ponderosa pine is a valuable timber resource, large mature stands were among the first to be harvested after European settlement (USFS 1990). The thick bark of ponderosa pine allows it to withstand ground fires better than the thin-barked true firs, giving it an advantage in areas with a short fire return interval. Fire suppression has allowed the shade-tolerant fir species time to establish in the understory of ponderosa pine forest. Fir will eventually become dominant when the canopy becomes dense enough that the shade-intolerant ponderosa pine seedlings cannot survive (Johnson 1994). Extant ponderosa pine habitat within the Subbasin currently covers a wide range of seral conditions.

Today, more than twice the historical amount (nearly 50,000 acres) of ponderosa pine habitat occurs in the Subbasin with the vast majority located in Oregon (NHI 2003). Forest management and fire suppression have led to the replacement of old-growth ponderosa pine forests by younger forests with a greater proportion of Douglas-fir than ponderosa pine (Habeck

Table 68. Changes in wildlife habitat types from circa 1850 (historic) to 1999 (current) in the Walla Walla subbasin (NHI 2003).

Subbasin	Status	Montane Mixed Conifer Forest	Interior Mixed Conifer Forest	Lodgepole Pine Forest & Woodlands	Ponderosa Pine	Upland Aspen Forest	Alpine Grasslands and Shrublands	Interior Canyon Shrublands	Eastside (Interior) Grasslands	Shrub-steppe	Agriculture, Pasture, and Mixed Environs	Urban and Mixed Environs	Lakes, Rivers, Ponds, and Reservoirs	Herbaceous Wetlands (1)	Montane Coniferous Wetlands	Eastside (Interior) Riparian Wetlands
Walla Walla	Historic	13,351	43,515	742	23,241	5,934	247	0	962,275	6,676	0	0	0	70,217	0	22,283
	Current	22,003	120,484	0	49,904	0	872	544	154,619	29,252	719,877	11,473	768	1,135	51	15,217
	Change (acres)	+8,652	+76,969	-740	+26,663	-5,934	+625	+544	-807,656	+22,576	+719,877	+11,473	+768	-68,083	51	-7,066
	Change (%)	+65	+177	-100	+115	-100	+253	999	-84	+338	999	999	999	-98	999	-32

Note: Values of 999 indicate a positive change from historically 0 (habitat not present or not mapped in historic data). (1). No confidence in data. NHI eastside (interior) riparian wetland data are inaccurate, so StreamNet data (2003) were used.

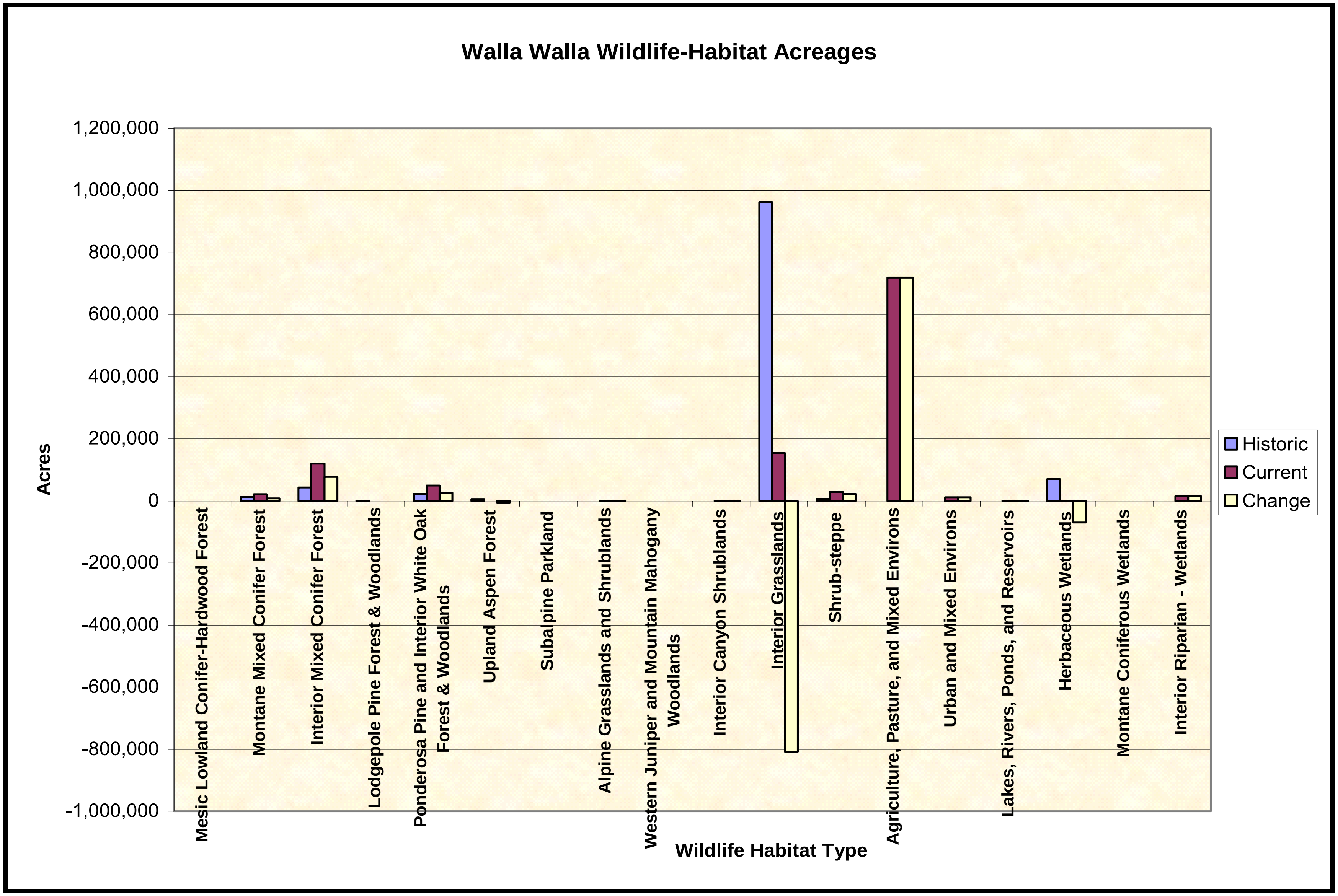

Figure 88. Wildlife habitat acreage and associated change in the Walla Walla subbasin (NHI 2003).

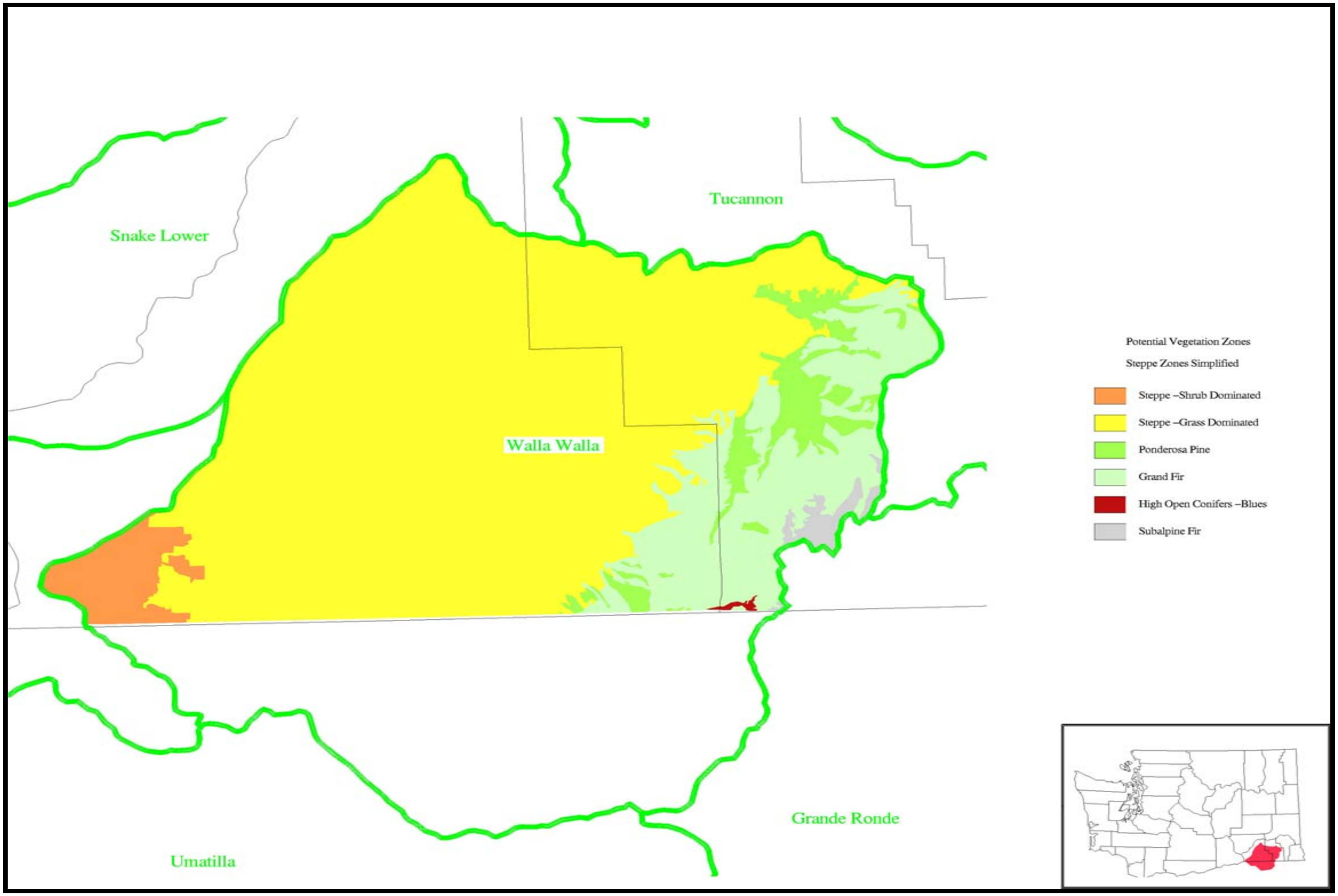

Figure 89. Historic (potential) habitat types, based on Washington GAP data (Cassidy 1997).

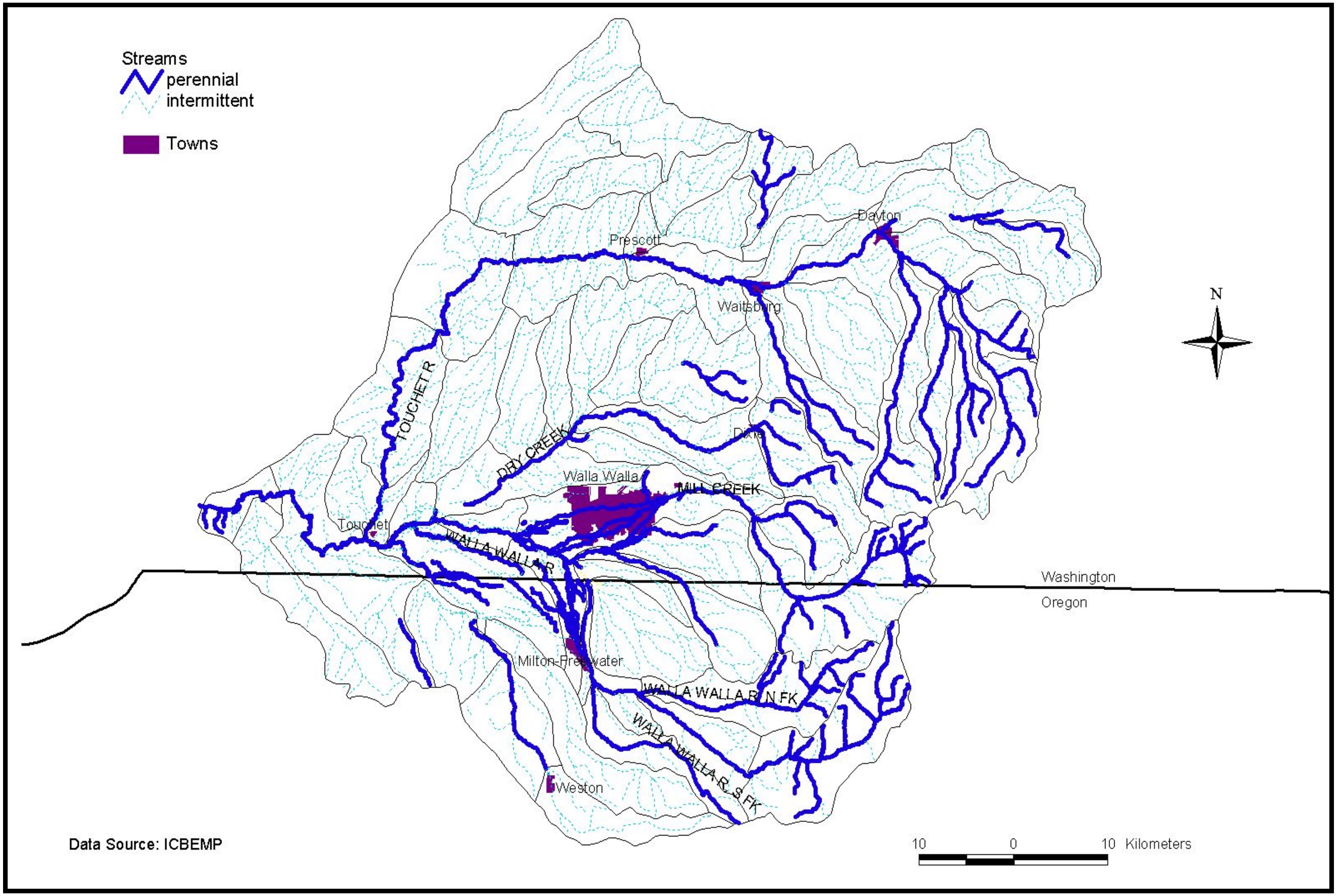

Figure 90. Walla Walla subbasin hydrology (NPPC 2001).

Table 69. A subbasin comparison of the current extent of focal habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003, StreamNet 2003).

Subbasin	Focal Habitat			
	Ponderosa Pine (Acres	Shrubsteppe (Acres)	Interior Grassland (Acres)	Riparian Wetland (Acres)
Asotin	14,997	0	134,789	1,687
Palouse	48,343	159,305	356,638	7,923
Lower Snake	1,014	6,505	416,207	3,180
Tucannon	9,918	0	114,263	4,512
Walla Walla	49,904	29,252	154,619	15,217

1990). Clear-cut logging and subsequent reforestation have converted many older stands of ponderosa pine/Douglas-fir forest to young structurally simple ponderosa pine stands (Wright and Bailey 1982).

Moreover, introduced annuals, especially cheatgrass, and invading shrubs under heavy grazing pressure (Agee 1993), have replaced native herbaceous understory species. Four exotic knapweed species are spreading rapidly through the ponderosa pine zone and threatening to replace cheatgrass as the dominant increaser after grazing (Roche and Roche 1988). Dense cheatgrass stands eventually change the fire regime of these stands often resulting in stand replacing, catastrophic fires. Bark beetles, primarily of the genus *Dendroctonus* and *Ips*, kill thousands of pines annually and are the major mortality factor in commercial saw timber stands (Schmid 1988 in Howard 2001).

The Subbasin clearly supports the most positive change in ponderosa pine habitat within the Ecoregion as illustrated in Figure 21. Flammulated owls are one of the many species dependent on mature ponderosa pine forests. Their current population status is unknown; however, wildlife biologists suspect that populations have declined as the vast majority of ponderosa pine habitat is in an early seral stage. *From and Ecoregion perspective, strategies that protect intact ponderosa pine habitats, foster mature ponderosa pine forest conditions, and reduce competition from fir trees should be pursued by wildlife/land managers.*

Current and historic acreages and percent change for the ponderosa pine habitat type are compared by subbasin in Figure 22. Ponderosa pine habitat has increased more than 100 percent in the Walla Walla and Lower Snake subbasins since 1850 while the Tucannon, Asotin, and Palouse subbasins have experienced a significant loss (greater than 50 percent) of ponderosa pine habitat (NHI 2003).

3.1.6.1.1 Protection Status

The protection status of the ponderosa pine habitat type for Ecoregion subbasins is compared in Figure 23. The protection status of remaining ponderosa pine habitats in all subbasins fall primarily within the “low” to “no protection” status categories. As a result, this habitat type will likely suffer further degradation, disturbance, and/or loss in all Ecoregion subbasins. Protection status of ponderosa pine habitat within the Subbasin is listed in Table 12.

3.1.6.1.2 Factors Affecting Ponderosa Pine Habitat

Factors affecting ponderosa pine habitat are described in section section 4.1.7.1 in Ashley and Stovall (unpublished report, 2004) and summarized below.

- Timber harvesting, particularly at low elevations, has reduced the amount of old growth forest and associated large diameter trees and snags

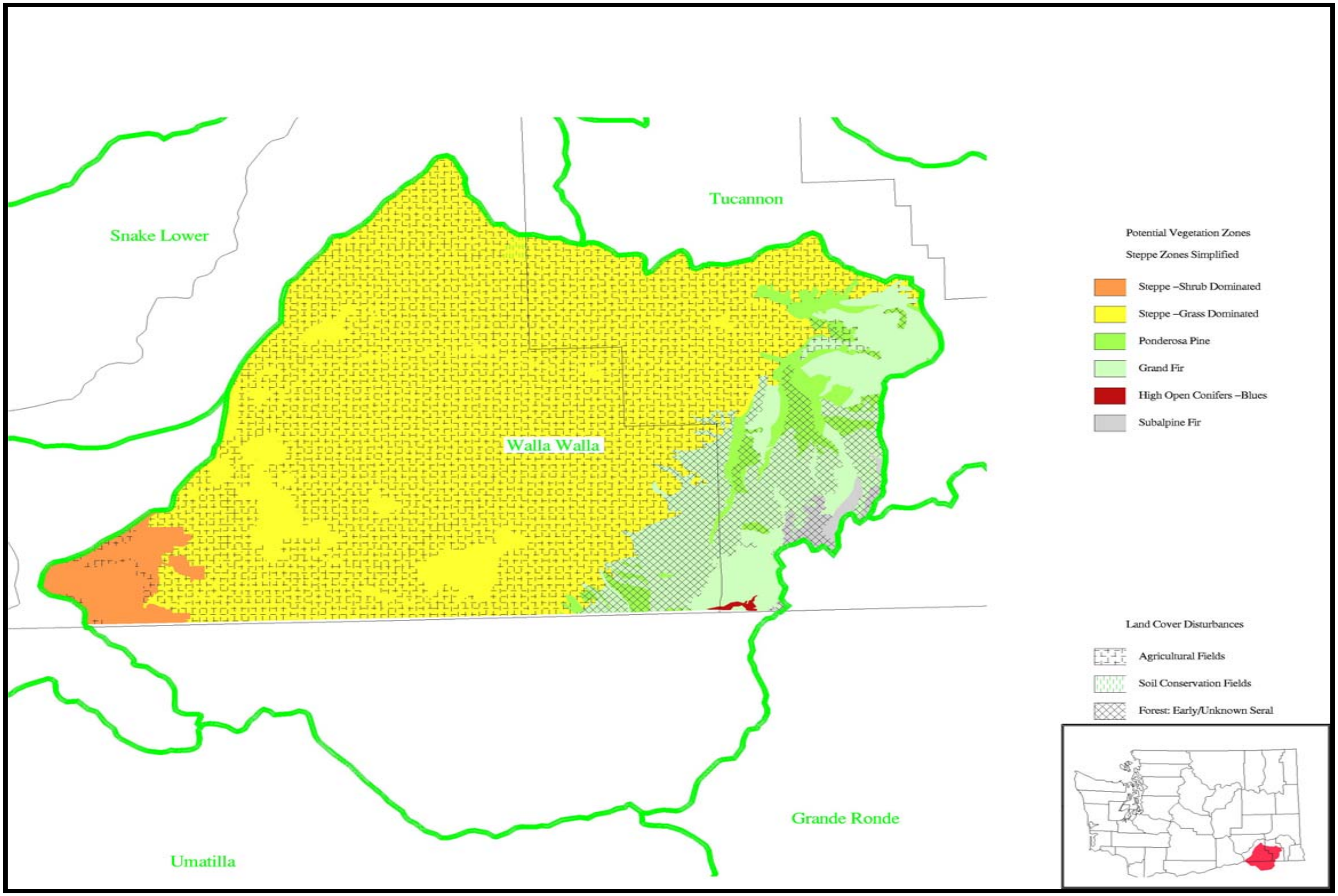

Figure 91. Ponderosa pine, grassland, and shrubsteppe habitat types and land cover disturbances in the Walla Walla subbasin, Washington (Cassidy 1997).

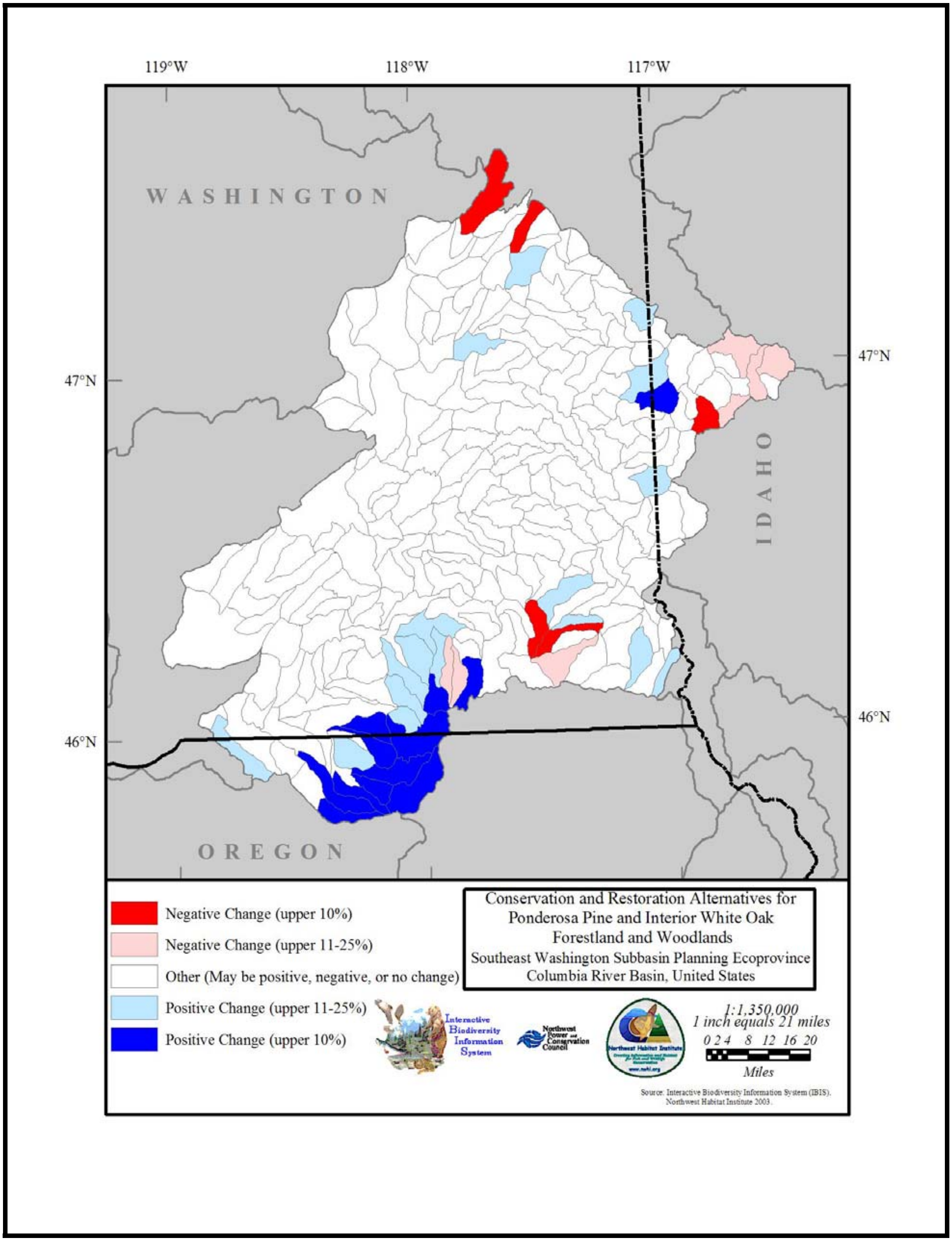

Figure 92. Ponderosa pine habitat change in the Ecoregion (NHI 2003).

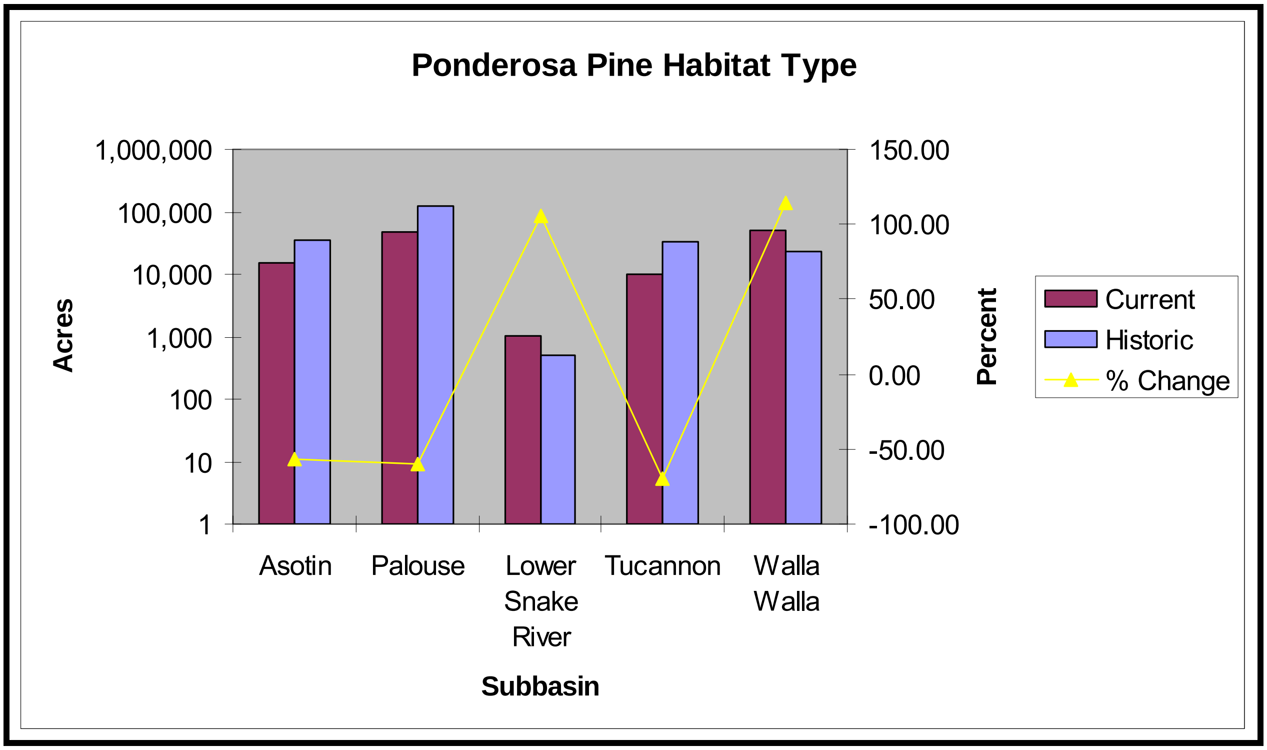

Figure 93. A subbasin comparison of the ponderosa pine habitat type in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

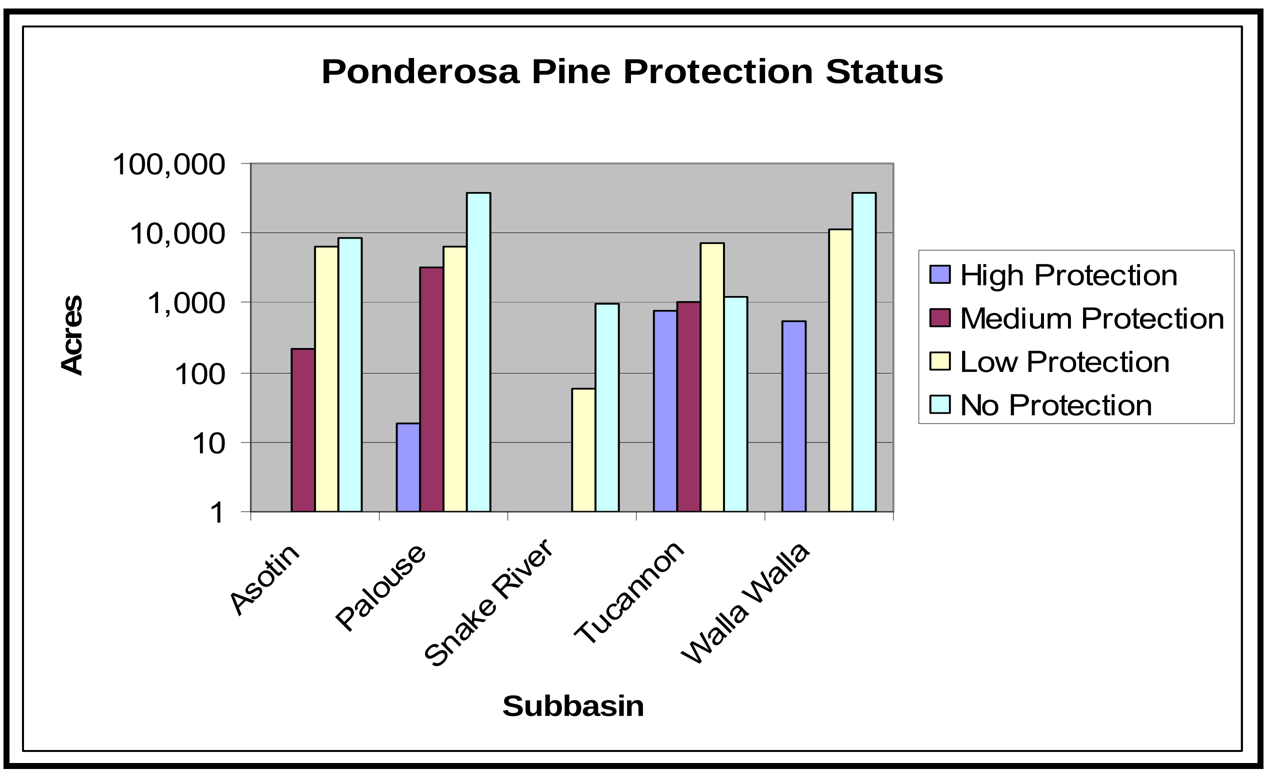

Figure 94. Ponderosa pine GAP protection status in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 70. Ponderosa pine habitat GAP protection status in the Walla Walla subbasin (NHI 2003).

Gap Protection Status	Acres
High Protection	544
Medium Protection	0
Low Protection	11,229
No Protection	38,130

- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees
- High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines
- Invasion of exotic plants has altered understory conditions and increased fuel loads
- Fragmentation of remaining tracts has negatively impacted species with large area requirements

3.1.6.1.3 Recommended Future Condition

Recommended future conditions are described in section 4.1.7.1.3 in Ashley and Stovall (unpublished report, 2004). Recommended conditions for the ponderosa pine habitat type are identical to those described for the Ecoregion and are summarized in the ensuing paragraphs.

Condition 1 – mature ponderosa pine forest: Large patches (greater than 350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 and 50 percent and nesting stumps and snags greater than 31 inches DBH.

*Condition 2 – multiple canopy ponderosa pine mosaic: M*ultiple canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Low to intermediate canopy closure, two-layered canopies, tree density of 508 trees/acre (9-foot spacing), basal area of 250 $ft.^2$/acre, and snags greater than 20 inches DBH 3-39 feet tall. At least one snag greater than 12 inches DBH/10 acres and 8 trees/acre greater than 21 inches DBH.

Condition 3 – Dense canopy closure ponderosa pine forest: Greater than 70 percent canopy closure of trees greater than 40 feet in height.

3.1.6.2 Eastside (Interior) Grassland

The eastside (interior) grassland habitat type is fully described in section 4.1.7.3 in Ashley and Stovall (unpublished report, 2004). Grassland habitat in the Subbasin is comprised of the wheatgrass/fescue vegetation zone (Figure_13). Oregon vegetation zones are included in Appendix_A.

Dominant perennial grasses, on undisturbed sites, consist of bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The eastern lowlands of the subbasin receive more precipitation and were historically dominated by Idaho fescue (Clarke and Bryce 1997). Although limited, shrubs including rabbitbrush and sagebrush are scattered across the landscape. A large number of forbs are also present. Balsamroot, cinquefoil, and old man's whiskers (*Geum triflorum*) are among those with the highest mean cover (Daubenmire 1970; Franklin and Dyrness 1973).

On disturbed grassland sites, agricultural crops replaced native grasslands. Livestock graze most of the historic grassland habitat not cultivated (NPPC 2001). Livestock overgrazing and competition from introduced weed species such as cheatgrass, knapweed, and yellow starthistle have dramatically altered native plant communities. Overgrazing leads to replacement of native vegetation by exotic annuals, particularly cheatgrass and yellow starthistle (Mack 1986; Roche and Roche 1988). A 1981 survey of vegetation zone conditions rated wheatgrass/fescue grasslands poor to fair (Aller *et al.* 1981; Harris and Chaney 1984).

Heavy grazing pressure, combined with little emphasis on range management, has seriously deteriorated rangeland condition (USDA 1991). Range transects conducted since the 1991 survey has confirmed the degraded condition of rangeland in the subbasin (C. Smith, NRCS, personal communication, 1995). Native bluebunch wheatgrass, Idaho fescue, and forbs that once dominated the landscape are largely displaced by introduced weed species. Today, perennial bunchgrass/shrub communities exist only on a few “eyebrows” on steep slopes surrounded by wheat fields, or in non-farmed canyon slopes and bottoms within agricultural areas (Figure_20).

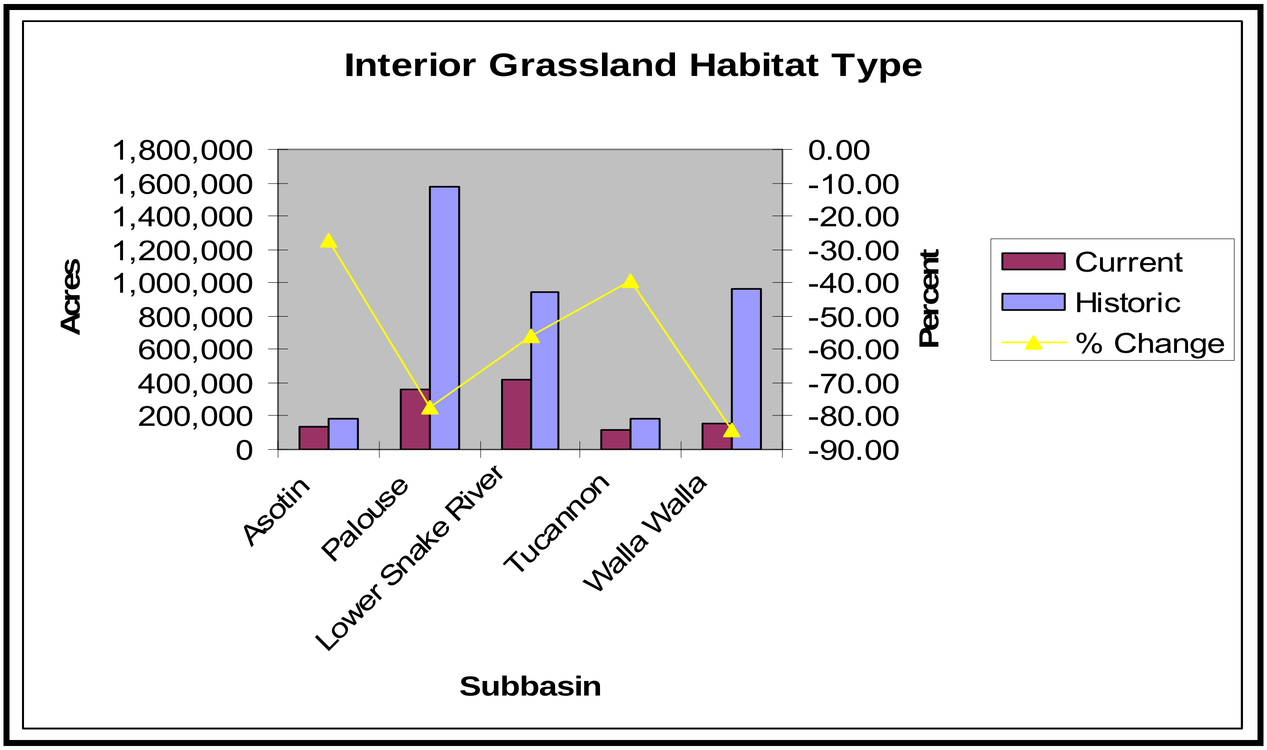

Figure 95. A subbasin comparison of the eastside (interior) grassland habitat type in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Current and historic acreages and percent change for the eastside (interior) grassland habitat type are compared by subbasin in Figure_24. The extent of grassland habitat has declined in all Ecoregion subbasins. GAP data indicates nearly 91 percent of all grassland habitats within the Washington portion of the Subbasin are cultivated (Cassidy 1997). Similarly, NHI (2003) data suggest that grasslands throughout the entire Subbasin have declined by 84 percent due primarily to conversion to agriculture. Although significant amounts of grassland habitat came under cultivation in the Palouse subbasin, the highest relative negative change within the entire Ecoregion occurred in the Walla Walla subbasin. Grassland habitats decreased the least in the Tucannon and Asotin subbasins largely because topoedaphic features including steep canyons and shallow soils made farming difficult and/or unprofitable.

Change in Ecoregion grassland habitats is graphically summarized in Figure_25. With exception of the Asotin and Tucannon subbasins, Ecoregion subbasins have experienced between a 50 percent and 100 percent loss in grassland habitats.

3.1.6.2.1 Protection Status

The protection status of the eastside (interior) grassland habitat type is compared by Ecoregion subbasin in Figure_26. The Subbasin has over 1,400 acres of grassland in high protection status. A similar amount of grassland is under high protection status in the Tucannon subbasin. In contrast, high protection status grasslands are non-existent in the Asotin and Palouse subbasins. While the extent of medium protection grasslands is similar for all Ecoregion subbasins except the Walla Walla, which has none, the vast majority of Ecoregion grassland habitat is not protected and is at risk for further degradation and/or conversion to other uses. The GAP protection status of grasslands in the Subbasin is listed in Table_13.

Grassland habitats established through CRP implementation receive short-term/high protection. The number of acres protected by CRP is compared by county in Figure_27 and listed in Table_5. The contribution of CRP relative to providing grassland structural conditions and wildlife habitat is significant at both the subbasin and Ecoregion levels.

Table 71. Eastside (interior) grassland GAP protection status in the Walla Walla subbasin (NHI 2003).

GAP Protection Status	Acres
High Protection	1,478
Medium Protection	0
Low Protection	16,457
No Protection	136,674

3.1.6.2.2 Factors Affecting Eastside (Interior) Grassland Habitat

Factors affecting grassland habitat are described in section 4.3.9.2 in Ashley and Stovall (2004) and summarized below:

- Extensive permanent habitat conversions of grassland habitats
- Fragmentation of remaining tracts of moderate to good quality grassland habitat
- Degradation of habitat from intensive grazing and invasion of exotic plant species, particularly cheatgrass, knapweed, and yellow-star thistle
- Degradation and loss of properly functioning grassland ecosystems resulting from the encroachment of urban and residential development and conversion to agriculture
- Conversion of Conservation Reserve Program (CRP) lands back to cropland
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of grassland communities
- Fire management, either suppression, wildfires, or over-use
- Invasion and seeding of crested wheatgrass and other introduced plant species that reduces wildlife habitat quality and/or availability

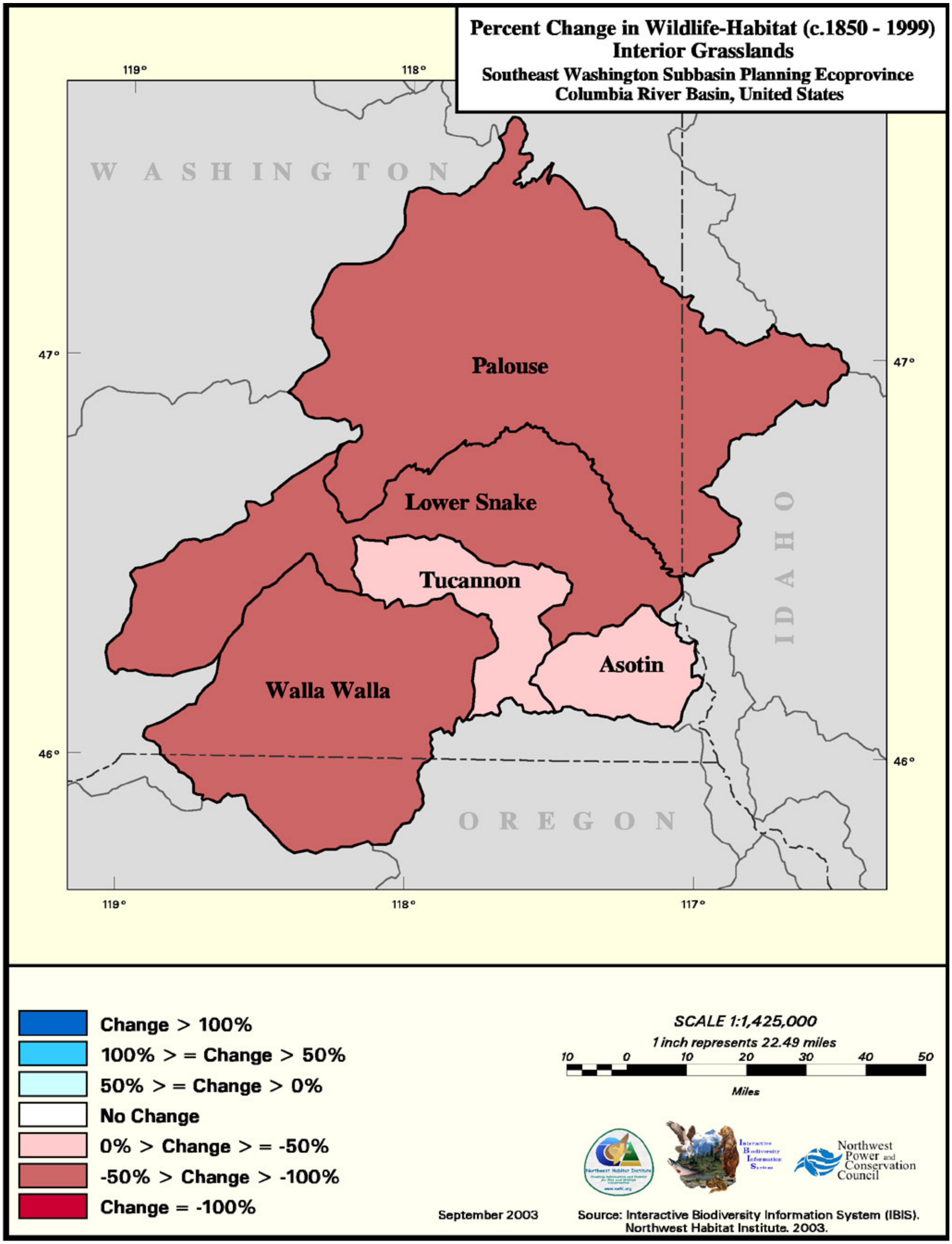

Figure 96. Changes in eastside (interior) grassland in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

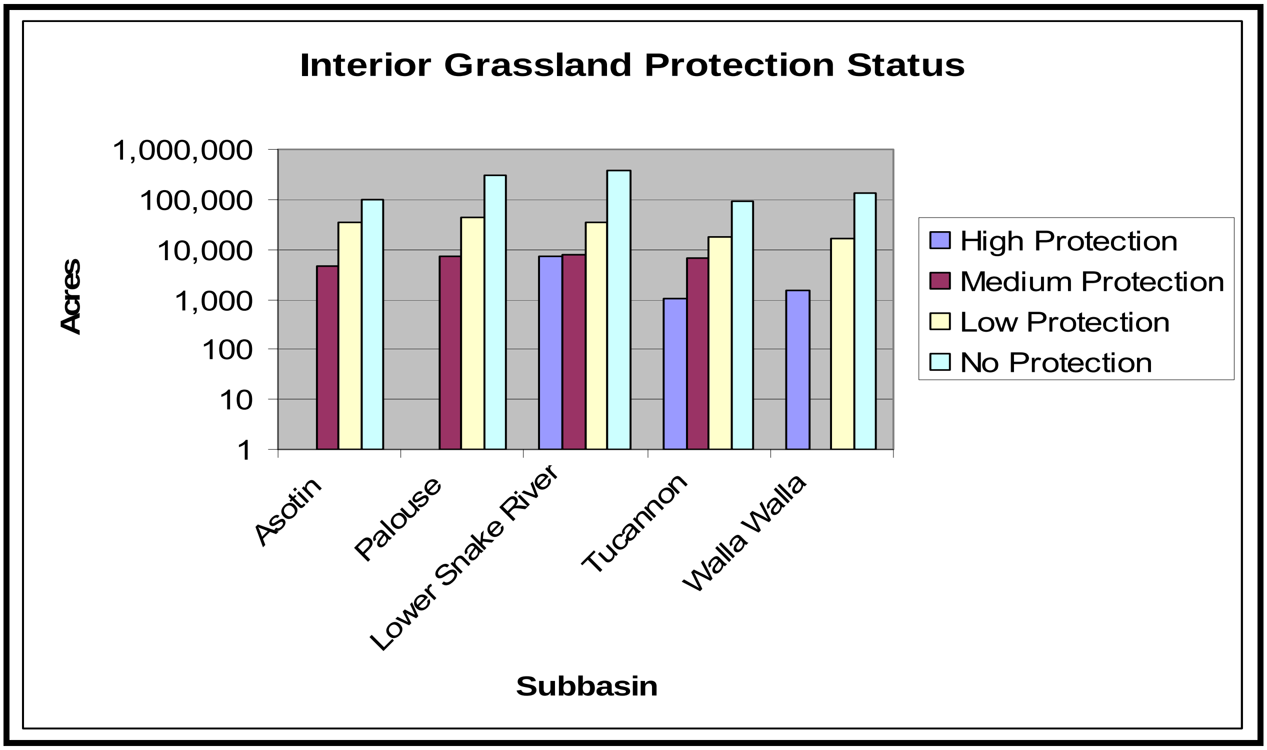

Figure 97. Eastside (interior) grassland GAP protection status in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

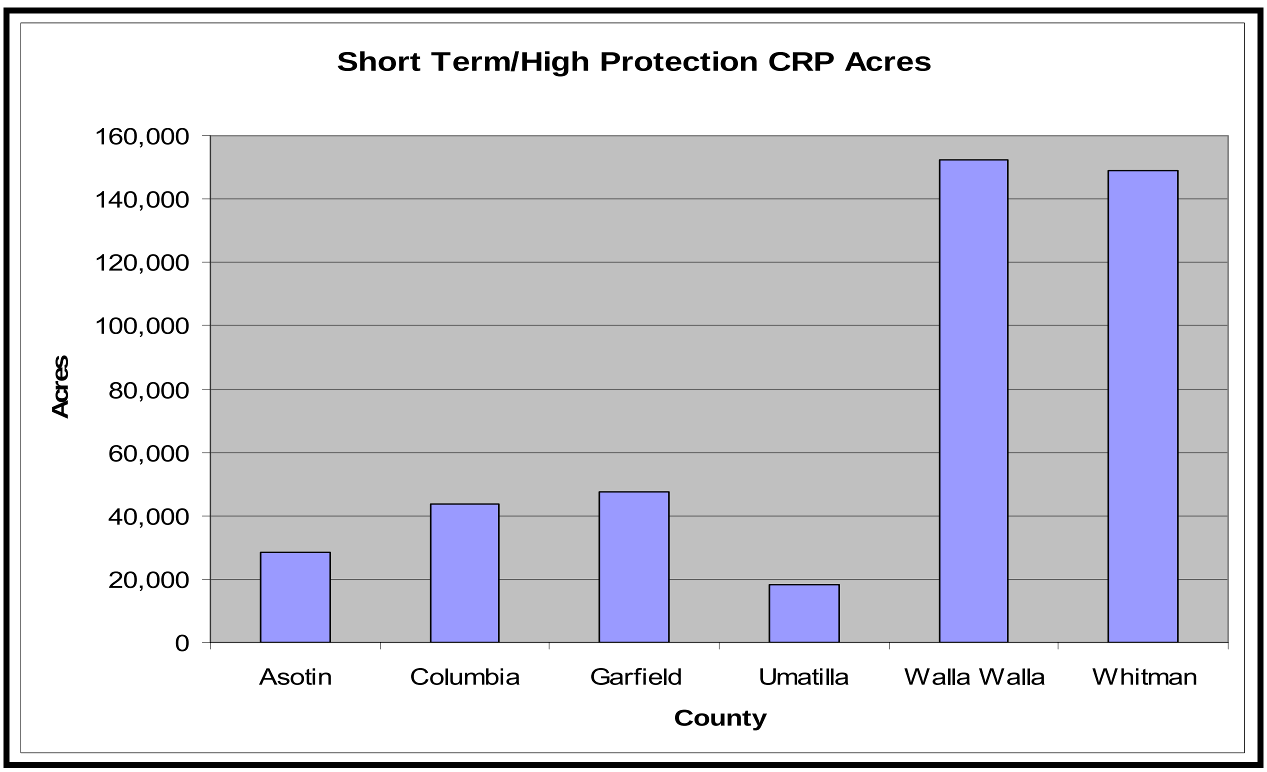

Figure 98. The number of acres of grassland habitat protected through CRP (FSA, unpublished data).

3.1.6.2.3 Recommended Future Condition

Recommended future conditions are described in detail in section 4.1.7.3.3 in Ashley and Stovall (unpublished report, 2004). General recommended conditions for eastside (interior) grassland habitat in the Subbasin include contiguous tracts of native bunchgrass and forbs plant communities with less than 5 percent shrub cover and less than 10 percent exotic vegetation. In xeric, brittle environments and sites dominated by shallow lithosols soils, areas between bunchgrass culms should support mosses and lichens (cryptogamic crust). In contrast, mesic (greater than 12 inches annual precipitation), deep soil sites could sustain dense stands (greater than 75 percent cover) of native grasses and forbs (conclusions drawn from Daubenmire 1970). Specific recommendations for management of grassland habitat include:

- Native bunchgrass greater than 40 percent cover
- Native forbs 10 percent to 30 percent cover
- Herbaceous vegetation height greater than 10 inches
- Visual obstruction readings (VOR) at least 6 inches
- Native non-deciduous shrubs less than 10 percent cover
- Exotic vegetation/noxious weeds less than 10 percent cover
- Multi-structured fruit/bud/catkin producing deciduous trees and shrubs dispersed throughout the landscape (at least 10 percent of the total area)

3.1.6.3 Shrubsteppe

The Shrubsteppe habitat type is fully described in section section 4.1.7.2 in Ashley and Stovall (unpublished report, 2004). Shrubsteppe habitat in the Washington portion of the Subbasin is comprised entirely of the central arid steppe vegetation zone (Figure_13).

Only a small percentage of the central arid steppe vegetation zone occurs in the Ecoregion (Walla Walla, Lower Snake, and Palouse subbasins). See Figure_22 in Ashley and Stovall (unpublished report, 2004). Historically (circa 1850), approximately 12,252 acres of central arid steppe occurred in the Washington portion of the Subbasin, while another 30,923 acres extended into the Lower Snake subbasin. Cassidy (1997) further estimated there was 6 acres of central arid steppe in the Palouse subbasin.

Big sagebrush, bluebunch wheatgrass, and Sandberg bluegrass dominate shrubsteppe climax vegetation (Daubenmire 1970). Other grass species occur in much smaller amounts including needle-and-thread, Thurbers needlegrass, Cusick's bluegrass, and/or bottlebrush squirreltail grass. Forbs play a minor role. A cryptogamic crust of lichens and mosses grows between the dominant bunchgrasses and shrubs. Without disturbance, particularly trampling by livestock, the cryptogamic crust often completely covers the space between vascular plants.

In areas with a history of heavy grazing and fire suppression, true shrublands are common and may even be the predominant cover on non-agricultural land. Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock. Grazing eventually leads to replacement of the bunchgrasses with cheatgrass, Nuttall's fescue, eight flowered fescue, and Indian wheat (Harris and Chaney 1984). Several highly invasive knapweeds have become increasingly widespread. Yellow starthistle is particularly widespread, especially along and near major watercourses (Roche and Roche 1988). A 1981 assessment of range conditions rated most shrubsteppe rangelands to be in poor to fair range condition, but ecological condition is usually worse than range condition (Harris and Chaney 1984).

Most of the remaining shrubsteppe habitats occur on shallow soils or near rock outcroppings where farming is difficult. Shrubsteppe habitat is usually privately owned, relatively small, disjunct fragments of land surrounded by agriculture (Dobler *et al.* 1996). These small shrubsteppe remnants are particularly prominent in the southern part of the Subbasin between Athena and the Washington State border (Kagan *et al.* 2000). Fragmentation compounds the negative effect of habitat loss on the shrubsteppe obligate species of the subbasin, as many areas are too small or isolated to support viable populations (NPPC 2001) and may be population sinks for some obligate species.

Current and historic acreages and percent change for shrubsteppe habitat are compared by subbasin in Figure 28. The Walla Walla subbasin is the only subbasin where shrubsteppe habitat has increased beyond historic amounts. This increase is likely the result of encroachment of shrubs due to fire suppression and changes in grassland plant communities following heavy, prolonged livestock grazing and invasion of introduced herbaceous species.

The shrubsteppe habitat type historically did not occur, nor is it present today in the Asotin or Tucannon subbasins (NHI 2003). Note that shrubsteppe habitat has decreased more than 50 percent in the other subbasins where it occurred historically (Figure 29).

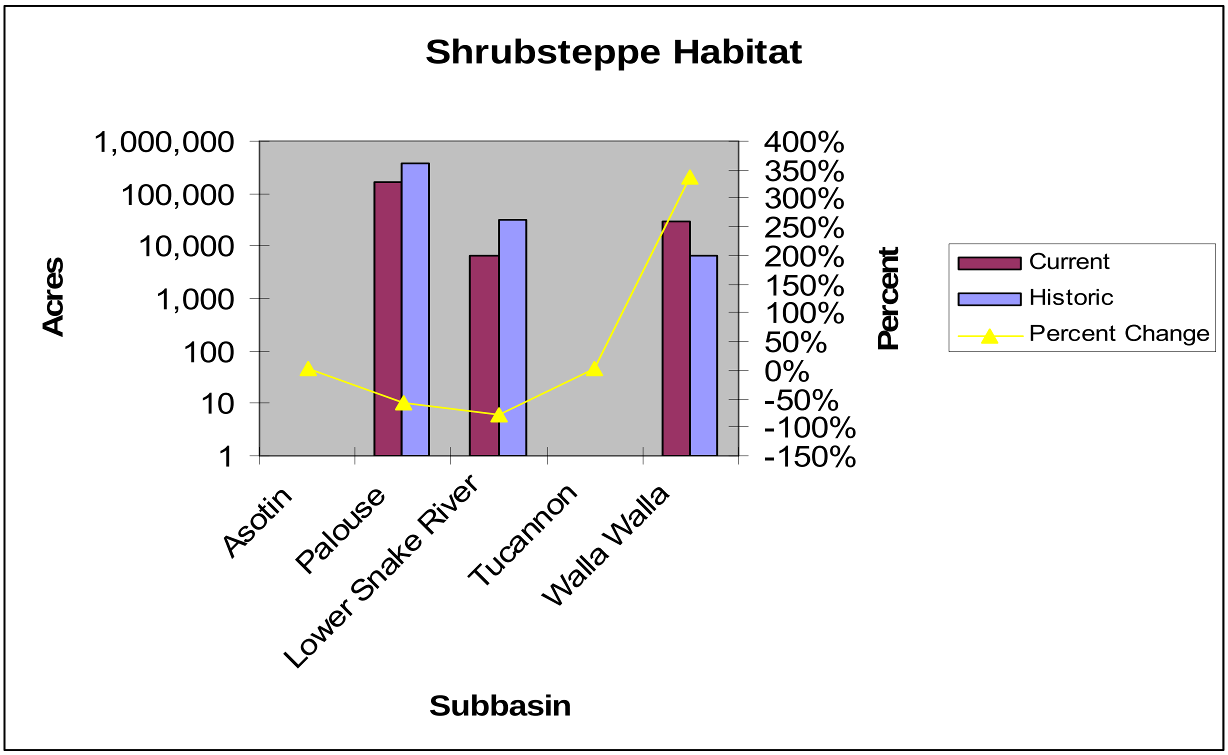

Figure 99. A subbasin comparison of shrubsteppe habitats and percent change in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

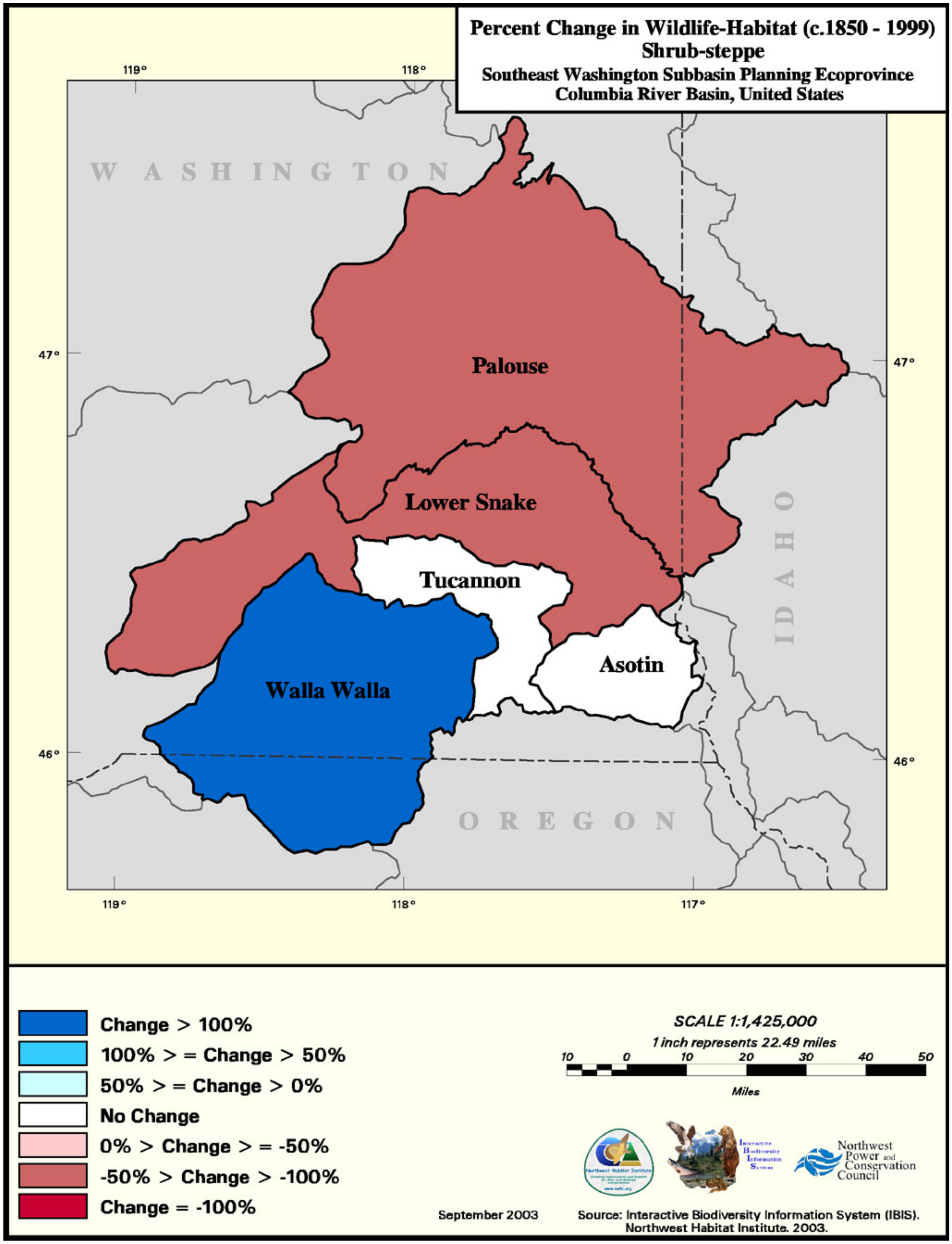

Figure 100. Change in shrubsteppe habitat in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

3.1.6.2.1 Protection Status

The GAP protection status of Ecoregion shrubsteppe habitats is compared in Figure_30. Shrubsteppe habitat in the high protection status category does not exist in the Ecoregion. In contrast, shrubsteppe habitat in the medium protection status category occurs only in the Lower Snake subbasin, primarily along the Snake River corridor. The vast majority of shrubsteppe habitat throughout the entire Ecoregion is designated low or no protection status and is at risk for further degradation and/or conversion to other uses. The protection status of shrubsteppe habitat in the Subbasin is summarized in Table_14.

Shrubsteppe habitats may be re-established directly through implementation of the Conservation Reserve Program i.e., by application of specific cover practices, or passively through protection of shrubs that invade CRP grasslands from adjacent areas. As in grasslands, CRP provides short-term/high protection to shrubsteppe habitats. The current number of CRP acres in shrubsteppe habitat is unknown and is a data gap; however, CRP grasslands may potentially provide additional shrubsteppe habitat if allowed to reach climax community conditions over time. CRP acreage is compared by county in Figure_27 and listed in Table_5.

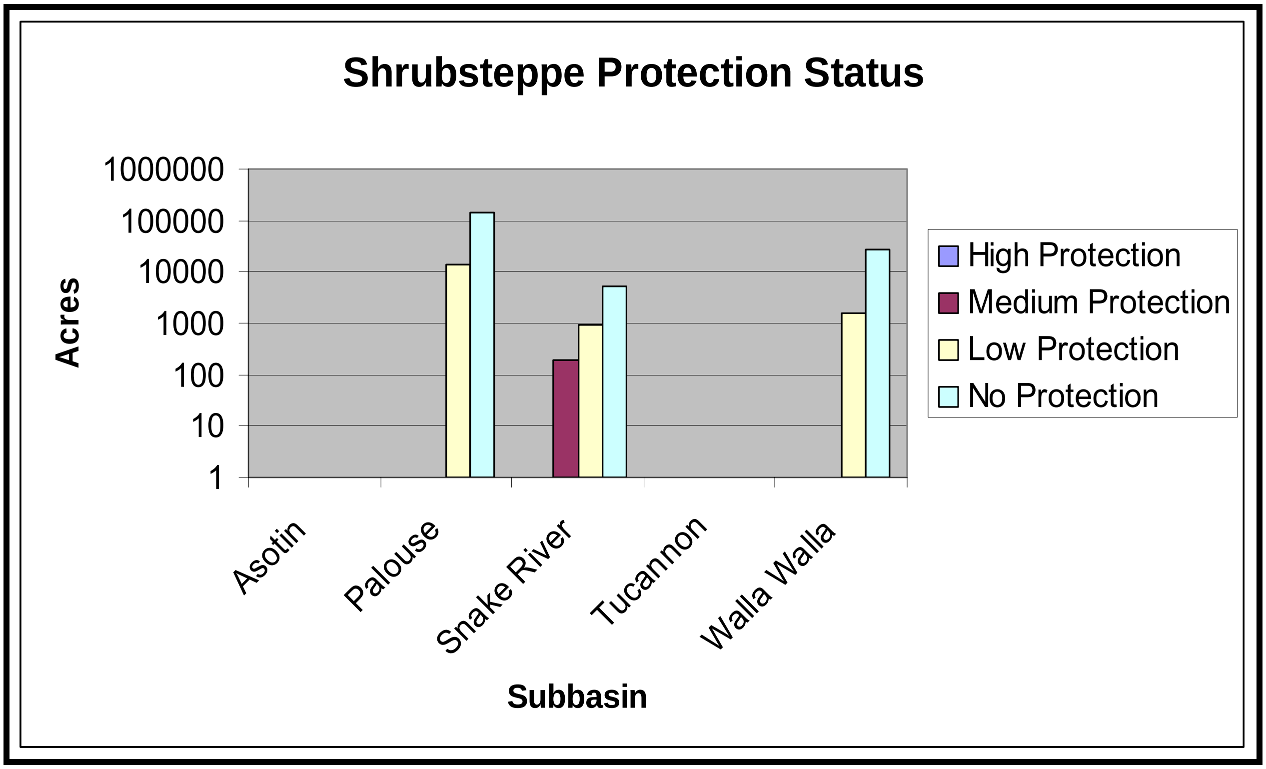

Figure 101. Shrubsteppe GAP protection status in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 72. Shrubsteppe GAP protection status in the Walla Walla subbasin (NHI 2003).

GAP Protection Status	Acres
High Protection	0
Medium Protection	0
Low Protection	1,555
No Protection	27,691

3.1.6.2.2 Factors Affecting Shrubsteppe Habitat

Factors affecting shrubsteppe habitat are almost identical to factors described for grassland habitats. For more information, see section 4.3.9.2 in Ashley and Stovall (unpublished report, 2004). Disturbance factors are summarized below:

- Extensive permanent habitat conversions of shrubsteppe habitats
- Fragmentation of remaining tracts of moderate to good quality shrubsteppe habitat
- Degradation of habitat from intensive grazing and invasion of exotic plant species, particularly cheatgrass, knapweed, and yellow-star thistle
- Degradation and loss of properly functioning shrubsteppe ecosystems resulting from the encroachment of urban and residential development and conversion to agriculture
- Conversion of Conservation Reserve Program (CRP) lands back to cropland
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe communities
- Fire management, either suppression, wildfires, or over-use
- Invasion and/or inter-seeding of crested wheatgrass and other introduced plant species that reduces wildlife habitat quality and/or availability

3.1.6.2.3 Recommended Future Condition

Recommended future conditions are described in detail in section 4.1.7.2.3 in Ashley and Stovall (unpublished report, 2004). Recommended conditions for shrubsteppe habitat are identical to those described for the Ecoregion and are summarized below.

Recommended future conditions include expansive contiguous areas of high quality multi-structured sagebrush patches with a diverse understory of native grasses and forbs (non-native herbaceous vegetation less than 10 percent), and shrub cover between 10 and 30 percent with mosses and lichens forming cryptogamic crust in areas between taller plants. The following shrubsteppe habitat conditions/guidelines will be used to develop habitat protection and restoration objectives and measures.

Condition 1 – Sagebrush dominated shrubsteppe habitat: Sagebrush dominated habitat comprised of tall sagebrush within large tracts of shrubsteppe habitat. Suitable habitat conditions include 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover.

Condition 1a - Sagebrush-dominated sites supporting a patchy distribution of sagebrush clumps 10 to 30 percent cover, lower sagebrush height (between 20 and 28 inches, native grass cover 10 to 20 percent, non-native herbaceous cover less than 10 percent, and bare ground greater than 20 percent.

Condition 2 – Diverse shrubsteppe habitat: Diverse, dense (30 to 60 percent shrub cover less than 5 feet tall) comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species with a herbaceous understory exceeding 30 percent cover.

3.1.6.4 Eastside (Interior) Riparian Wetlands

The eastside (interior) riparian wetlands habitat type refers only to riverine and adjacent wetland habitats in both the Ecoregion and individual subbasins. For more information, see section 4.3.9.3 in Ashley and Stovall (unpublished report, 2004). Other wetland habitat types that occur within the subbasin were not included as focal habitat types because of limited extent, although equally important.

Historic (circa 1850) and, to a lesser degree, current data concerning the extent and distribution of riparian wetland habitat are a significant data gap at both the Ecoregion and subbasin scales. The lack of data is a major challenge as Ecoregion and subbasin planners attempt to quantify habitat changes from historic conditions and develop strategies that address limiting factors and management goals and objectives.

The principal challenge is to estimate the historic extent of riparian habitat. To accomplish this, Ecoregion planners obtained approximations of linear stream miles for each Ecoregion subbasin based on StreamNet data provided by WDFW staff (M. Hudson, WDFW, personal communication, 2003). Ecoregion planners conservatively estimated the average width of the historic riparian habitat buffer at 50 feet. The average width was multiplied by an estimated 3,653 linear miles of stream in the Subbasin and then converted to acres (Figure_31).

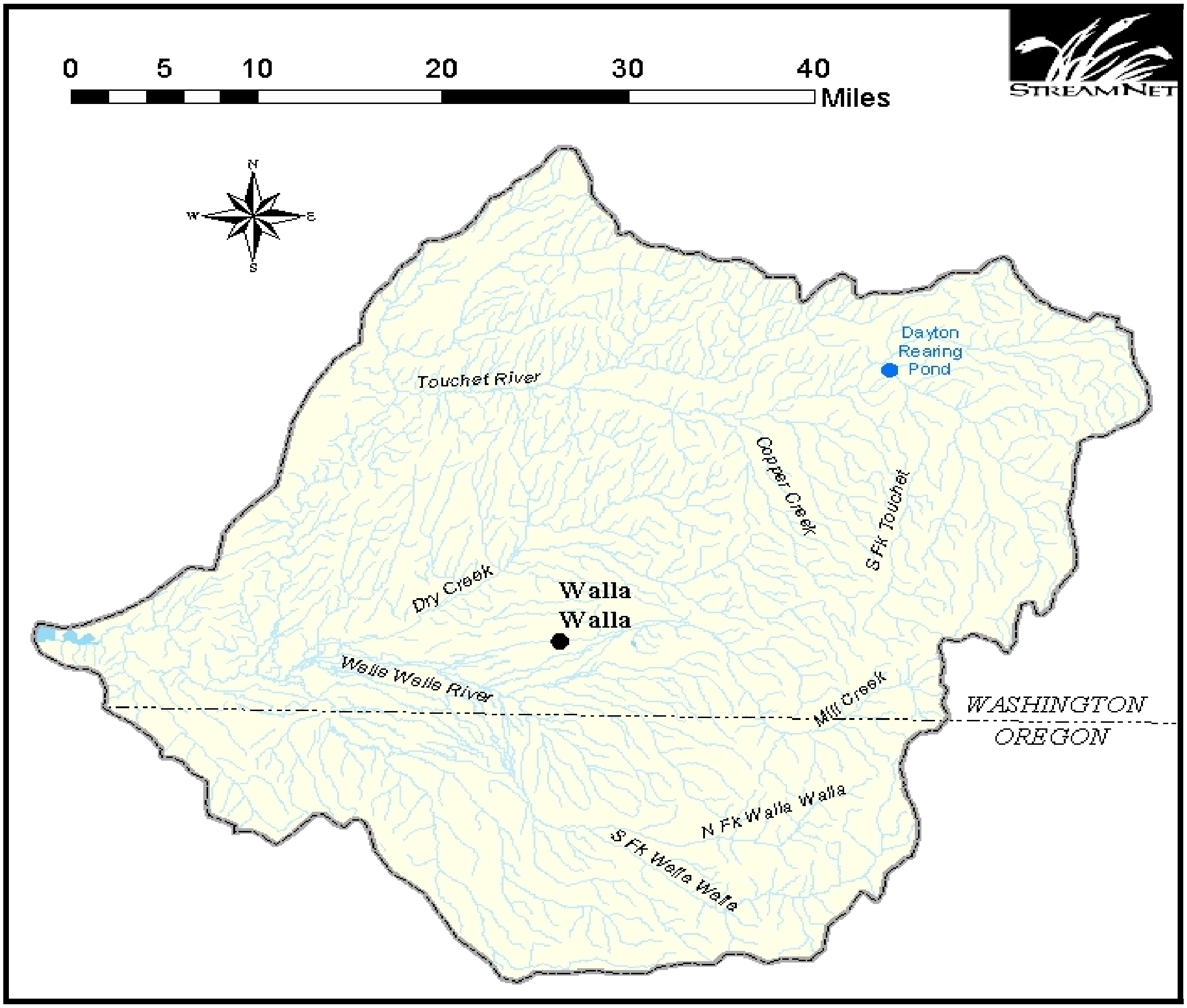

Figure 102. Perennial and intermittent streams and rivers in the Walla Walla subbasin (StreamNet 2003).

Using this method, Ecoregion planners estimate at least 22,283 acres of riparian wetland habitat historically occurred in the Subbasin. The change in extent of riparian habitat is significant (Table_15).

Table 73. Estimated historic and current acres and percent change in riparian wetland habitat in the Walla Walla subbasin (StreamNet 2003; NHI 2003).

Historic Acres	Current Acres	Change Acres	Percent Change
22,283	15,217	-7,066	-32
Note: Current acreage includes some, but not all, riparian/riverine habitats re-established/protected through CREP. FSA reports CREP acreage by county only making extrapolation to subbasins extremely time consuming and difficult.			

Although Ecoregion planners believe that historic estimates generated through the use of StreamNet data are more accurate than NHI-based amounts, estimates derived from StreamNet are still of low confidence value. The actual number of acres or absolute magnitude of the change is less important than recognizing that the trend is loss of riparian habitat and the lack of permanent protection continues to place this habitat type at further risk.

Historically, riparian wetland habitat was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly, or in some combination by grass-forbs, shrub thickets, and mature forests with tall deciduous trees. Beaver activity and natural flooding are two ecological processes that affected the quality and distribution of riparian wetlands.

Today, riparian wetland areas contain the most biologically diverse habitats in the Subbasin because of their variety of structural features, including live and dead vegetation and the close proximity of riparian areas to water bodies. This combination of habitat features provides a wide array of habitats for numerous terrestrial species. Common deciduous trees and shrubs in riparian areas include cottonwood, alder, willow, and red osier dogwood (USFS and BLM 2000). Riparian vegetation is used by more species than any other habitat (Quigley and Arbelbide 1997).

Cottonwood, white alder, and willow dominate the riparian community in the lowlands (USACE 1997). These species also occur in the riparian zone of the uplands, where coniferous species increase in prominence. Both the extent and quality of riparian vegetation in the Subbasin has been severally degraded (NPPC 2001). Only 37 percent of the Touchet River riparian zone remains in native riparian vegetation (USACE 1997). Along the Oregon portion of the Walla Walla River, 70 percent of the existing riparian zone is in poor condition (USACE 1997).

Agricultural conversion, livestock grazing, altered stream channel morphology, and water withdrawal have played significant roles in changing the character and function of streams and associated riparian wetlands throughout the Subbasin. Riparian wetlands have been altered, fragmented, and/or lost because of agricultural development (Ashley and Stovall, unpublished report, 2004). Moreover, grazing has suppressed woody vegetation while introduction of Kentucky bluegrass, reed canarygrass, and other weed species has significantly changed native plant communities. The largest remaining expanse of relatively high quality riparian habitat exists on the 1,525-acre USACE-managed Wallula Habitat Management Unit, located at the confluence of the Walla Walla River and Lake Wallula, behind McNary Dam (USACE 1997).

3.1.6.4.1 Protection Status

The protection status of riparian habitat is compared by subbasin in Figure_32. Unlike CREP, naturally occurring riparian wetland habitats are not provided high protection status anywhere in the Ecoregion. The Subbasin has the most unprotected riparian wetland habitat in the Ecoregion. The vast majority of Ecoregion riparian wetland habitat is designated low or no protection status and is at risk for further degradation and/or conversion to other uses. The GAP protection status of riparian wetland habitat in the Subbasin is listed in Table_16.

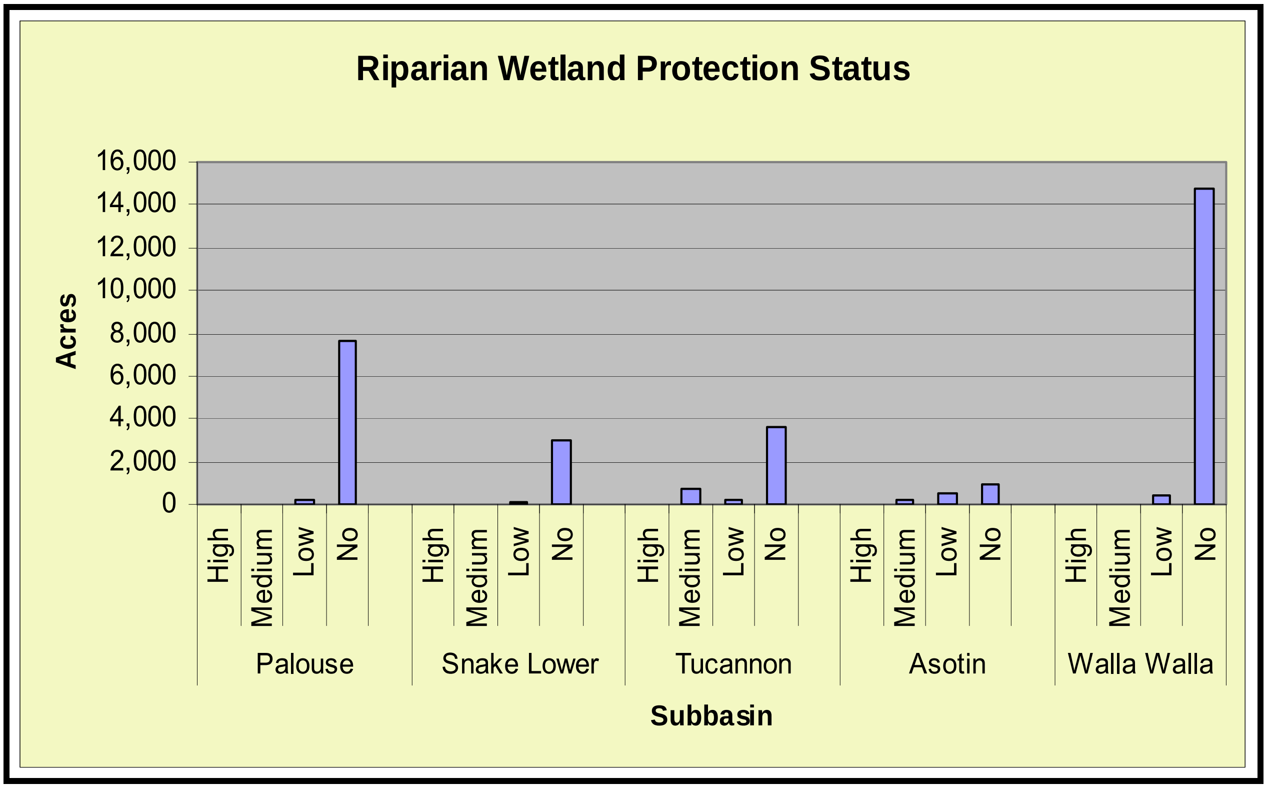

Figure 103. Eastside (interior) riparian wetlands GAP protection status in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 74. Eastside (interior) riparian wetlands GAP protection status in the Walla Walla subbasin (NHI 2003).

GAP Protection Status	Acres
High Protection	8,211
Medium Protection	8,500
Low Protection	124,645
No Protection	993,342

Additional short-term high protection of riparian habitat is provided by CREP (CP22). The number of acres enrolled in CREP is compared by county in Figure_33 and listed in Table_6. CREP is considered an additive value in this assessment and is not included in historic and current riparian wetland data derived from NHI (2003) and/or StreamNet (2003) data.

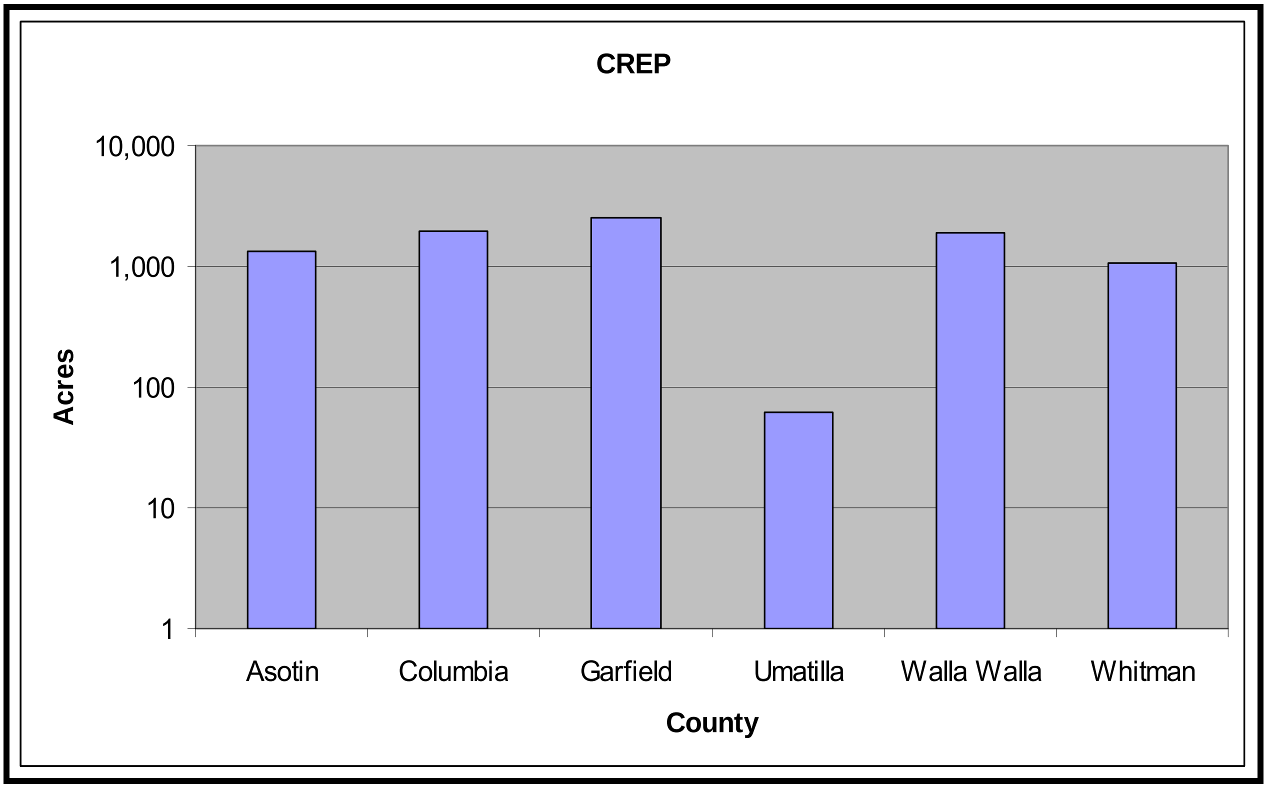

Figure 104. A county comparison of acreage protected by the Conservation Reserve Enhancement Program/CP22 (FSA, unpublished data, 2003).

3.1.6.3.2 Factors Affecting Eastside (Interior) Riparian Wetland Habitat

Factors affecting riparian wetland habitat are explained in detail in section 4.3.9.3 in Ashley and Stovall (unpublished report, 2004) and summarized below:

- Riverine recreational developments and cutting and spraying of riparian vegetation
- vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, and willows
- Hydrological diversions and control of natural flooding regimes (e.g., dams, diking) resulting in reduced stream flows and reduction of extent of riparian habitat, loss of
- Water rights/withdrawals have the potential to negatively impact the extent and quality of riparian vegetation by significantly altering the hydrology on over allocated streams and rivers
- Stream bank stabilization activities and incising which narrows stream channels, reduces/alters the flood plain, and reduces extent of riparian vegetation
- Livestock overgrazing which can widen channels, raise water temperatures, reduce understory cover, etc.
- Conversion of native riparian shrub and herbaceous vegetation to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, thistle, knapweeds, and Russian olive
- Catastrophic flood events resulting in near complete removal of riparian vegetation and scouring of hydric soils (complicated by the inability of altered upland sites/vegetation to absorb/slow runoff)
- Fragmentation and loss of linear contiguous tracts of riparian habitat

3.1.6.3.3 Recommended Future Condition

Recommended future conditions are described in detail in section 4.1.7.4.3 in Ashley and Stovall (unpublished report, 2004). Recommended conditions for riparian wetland habitat are identical to those described for the Ecoregion and are summarized in the following paragraphs.

Current riparian conditions within the Subbasin range from optimal to poor with most falling below "fair" condition (H. Ferguson, WDFW, personal communication, 2003). Recognizing the variation between extant riparian habitat and the dynamic nature of this habitat type, Ecoregion planners recommend the following range of conditions for the specific riparian wetland habitat attributes described below.

- Greater than 40 percent tree canopy closure (cottonwood and other hardwood species)
- Multi-structure/age tree canopy (includes trees less than 6 inches DBH and mature/decadent trees)
- Woody vegetation within 328 feet of shoreline (where applicable)
- Tree groves greater than 1 acre within 800 feet of water (where applicable)
- Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs)
- Multi-structured shrub canopy greater than 3 feet in height
- Minimal disturbance within 800 feet of habitat type

3.1.6.5 Agriculture (Habitat of Concern)

Farming operations in the Subbasin include dryland/irrigated agricultural crops, fruit orchards, and irrigated and non-irrigated pasture (alfalfa and hay). Cultivated crops are primarily annual grains such as wheat, oats, barley, and rye. Wheat and barley are produced on upland and rolling hilly terrain without irrigation throughout much of the Subbasin. Irrigation is used, however, to produce crops wherever feasible.

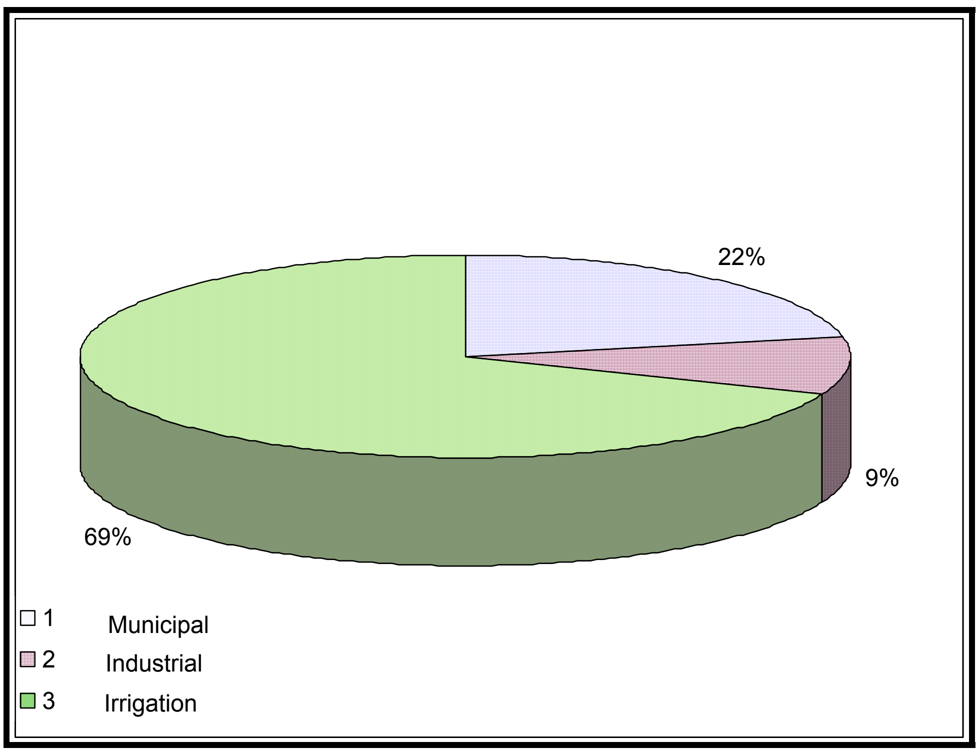

Figure 105. Water use in the Walla Walla subbasin (USACE 1997).

The Walla Walla River valley is extensively and intensively irrigated (Figure 34 and Figure 35). Irrigated lands occur in the narrow lowland portions of the Subbasin, representing the largest use of surface and groundwater in the Subbasin. The proportion of surface water versus groundwater allocated for irrigation currently represents a data gap. The BOR (1999) estimated that in Oregon there are 14,000 acres irrigated from surface flows and shallow wells and about 2,000 acres irrigated from deep wells. An in-depth, basin wide study examining respective volumes of surface and groundwater used for irrigation purposes is warranted (NPPC 2001).

There has been a steady increase in the acres of irrigated croplands in the Subbasin since the mid 1900s. The estimated area of irrigated land in Walla Walla County in 1987 was 75,333 acres, compared to 97,136 acres a decade later (National Agricultural Statistics Service 1997, 1999). The vicinities of Touchet, Gardena Farms, Walla Walla, and College Place hold the largest proportions of alfalfa and wheat, the Subbasin's dominant irrigated crops. The primary water sources include the Touchet and Walla Walla Rivers, East-West Canal, Gardena Canal, Lowden Canals, gravel aquifers, and the basalt system.

In addition to irrigated grain crops, fruit crops such as orchards and vineyards, represent a growing portion of irrigated agriculture in the Subbasin. Irrigated orchard acreage in Walla Walla County, for example, has increased from 6,910 acres in 1992 to 8,003 acres in 1997 (National Agricultural Statistics Service 1997). Irrigated orchard acreage in Oregon (Umatilla County) has essentially remained unchanged between 1992 and 1997 (4,984 acres vs. 4,743 acres respectively). Other irrigated crops include asparagus, beans, onions, pasture, and potatoes (James *et al.* 1991).

Conversion of native habitats to agriculture altered and/or destroyed vast amounts of grassland habitat and fragmented riparian/floodplain habitats throughout much of the Subbasin. The loss of grassland and riparian wetland habitats has resulted in the decline of wildlife populations that are dependent on this habitat type (NPCC 2001).

Although the conversion of native habitats to agriculture severely affected native wildlife species such as the sharp-tailed grouse, agriculture did provide new habitat niches quickly filled by introduced wildlife species including the ring-necked pheasant, chukar, and gray partridge. Introduced parasitic wildlife species such as European starlings also thrived as more land was converted to agriculture.

Native ungulate and waterfowl populations took advantage of new food sources provided by croplands and either expanded their range or increased in number (J. Benson, WDFW, personal communication, 1999). Indigenous wildlife species and populations that adapted to and/or thrived on "edge" habitats increased with the introduction of agriculture except in areas where "clean farming" practices and crop monocultures dominated the landscape.

In addition to crops, agricultural lands provide and support hunting and wildlife viewing opportunities, which promotes local economic growth. Conversely, crop depredation by elk and deer is an issue in some areas of the subbasin with a number of landowners desiring reductions in ungulate herds.

The Subbasin has the highest relative percentage of land dedicated to agriculture within the Ecoregion (Figure 36). Farming generally occurs wherever steep topography, shallow soils, and/or federal, state, and/or public land ownership does not preclude it.

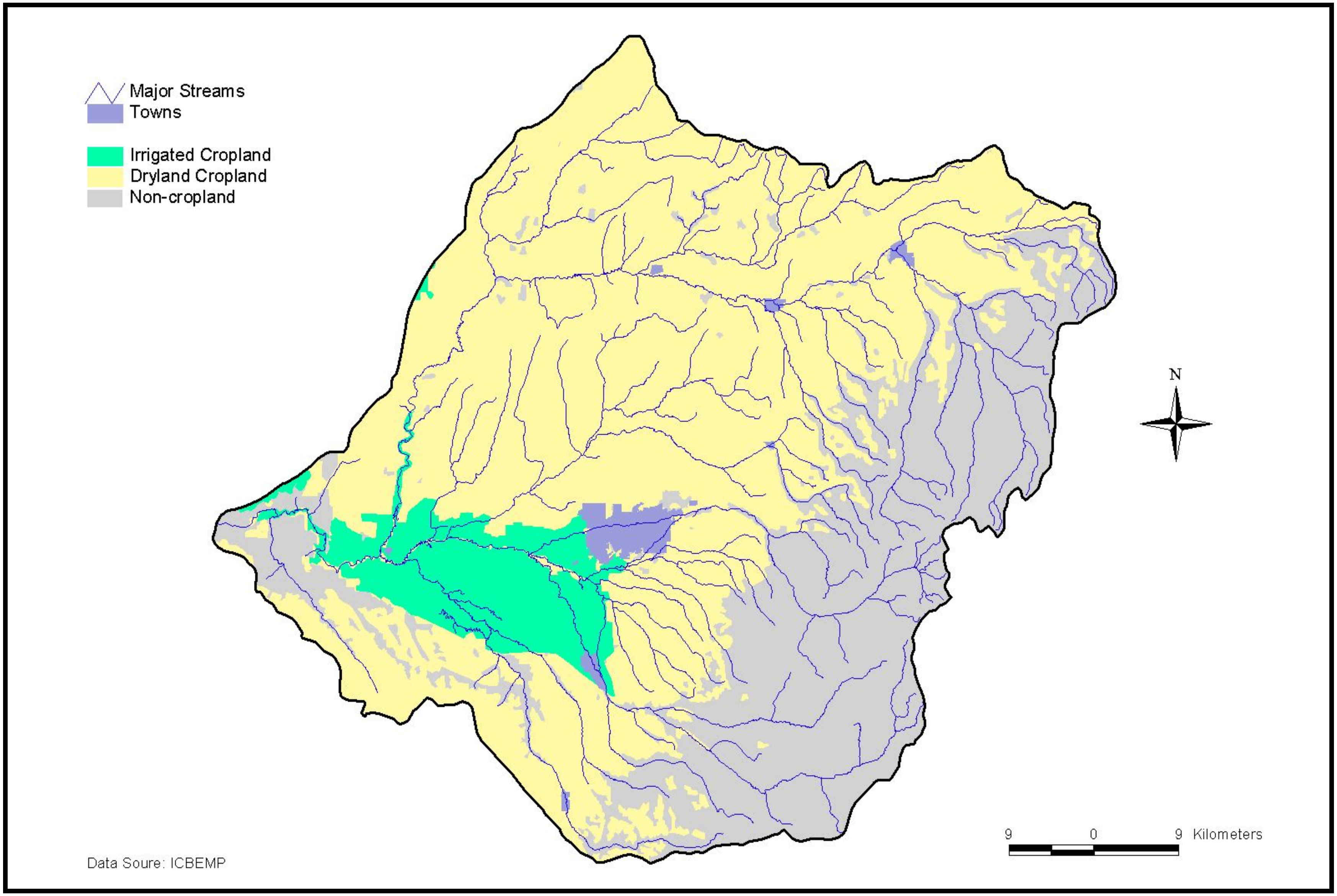

Figure 106. Irrigated and non-irrigated cropland in the Walla Walla subbasin (NPPC 2001).

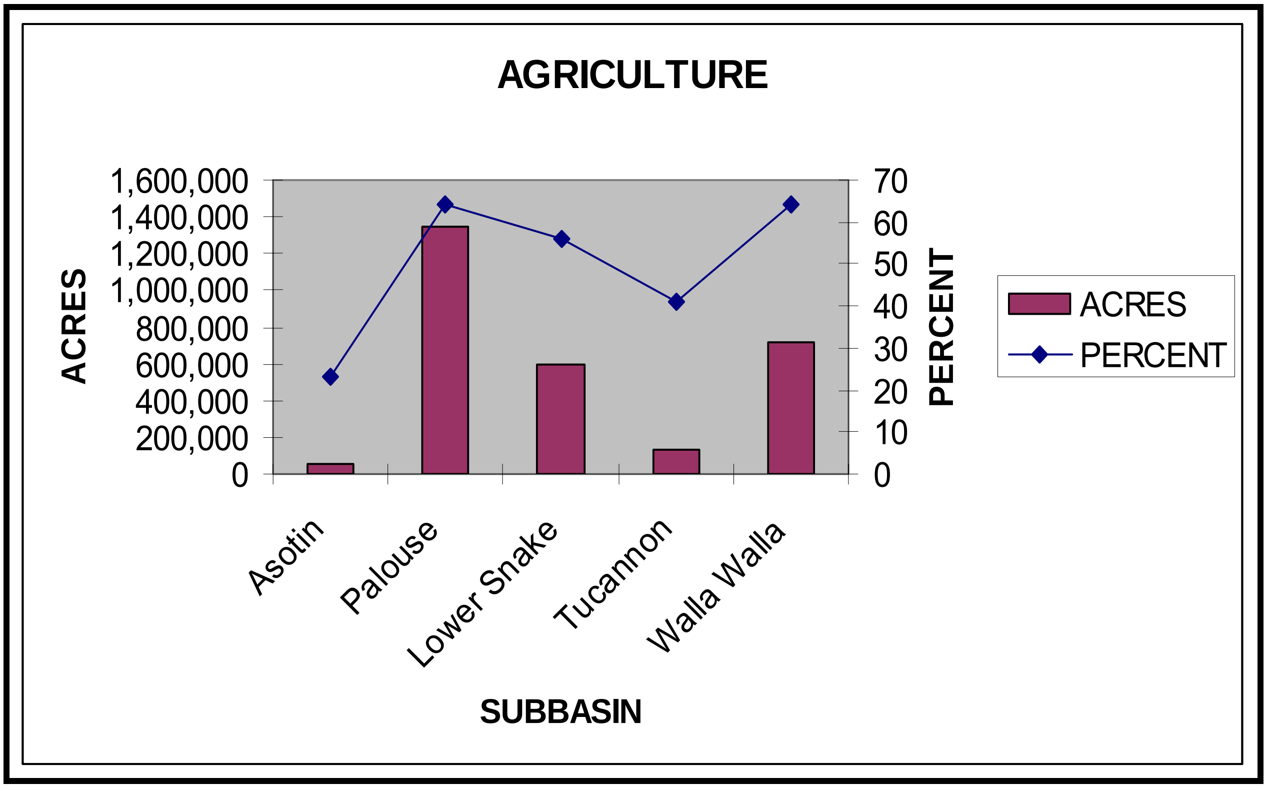

Figure 107. Ecoregion agricultural land use comparison (NHI 2003).

3.1.6.4.1 Protection Status

The protection status of agricultural habitat is compared by subbasin in Figure_36. NHI (2003) data clearly indicate that nearly all of this cover type has no protection status across the Ecoregion. Small amounts of agricultural lands, however, receive low and medium protection status. Low and medium protection is limited to lands enrolled in conservation easements, or under other development restrictions such as county planning ordinances and university controlled experimental stations. The GAP protection status of agricultural habitat in the Subbasin is listed in Table_17.

3.1.6.6 Summary of Changes in Focal Wildlife Habitats

Changes in the extent of focal habitats within the Subbasin are summarized in Table_18 and compared to other Ecoregion subbasins in Figure_38. For additional information regarding habitat changes throughout the Ecoregion, see section 4.1.6 in Ashley and Stovall (unpublished report, 2004).

The extent of both ponderosa pine and shrubsteppe habitat types has increased more than 100 percent from historic estimates. Similarly, the amount of ponderosa pine habitat in the Lower Snake subbasin has increased significantly (greater than 100 percent). Shrubsteppe habitat, on the other hand, has increased only in the Walla Walla subbasin. Agricultural conversion accounts for nearly 100 percent of the total change (loss) in eastside (interior) grassland habitats in the Subbasin and throughout the Ecoregion (NHI 2003).

Riparian wetland habitat data are incomplete and limited in value. As a result, riparian wetlands are not well represented in NHI (2003) map products and databases. Accurate habitat type maps and data sets, especially those detailing historic riparian wetland habitats, are needed

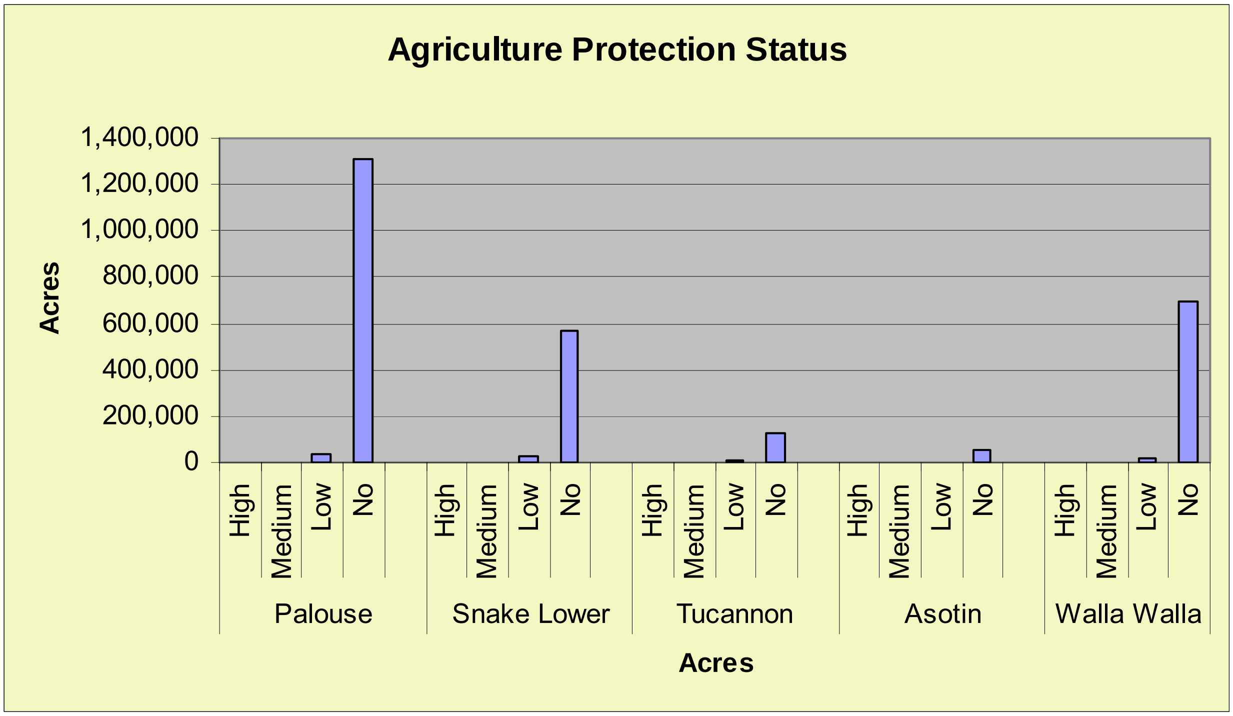

Figure 108. Agriculture GAP protection status in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

Table 75. Agriculture GAP protection status in the Walla Walla subbasin (NHI 2003).

GAP Protection Status	Acres
High Protection	0
Medium Protection	0
Low Protection	20,567
No Protection	699,316

Table 76. Changes in focal wildlife habitat types in the Walla Walla subbasin from circa 1850 (historic) to 1999 (current) (NHI 2003).

Focal Habitat Type	Historic (Acres)	Current (Acres)	Change (Acres)	Change (%)
Ponderosa Pine	23,241	49,904	+26,663	+115
Shrubsteppe	6,676	29,252	+22,576	+338
Eastside (Interior) Grassland	962,275	154,619	-807,656	-84
Eastside (Interior) Riparian Wetlands	22,283	15,217	-7,066	-32
Agriculture	0	719,625	+719,625	+100

to improve assessment quality and support management strategies/actions. Subbasin wildlife managers, however, believe that significant physical and functional losses have occurred to these important riparian habitats from hydroelectric facility construction and inundation, agricultural development, and livestock grazing.

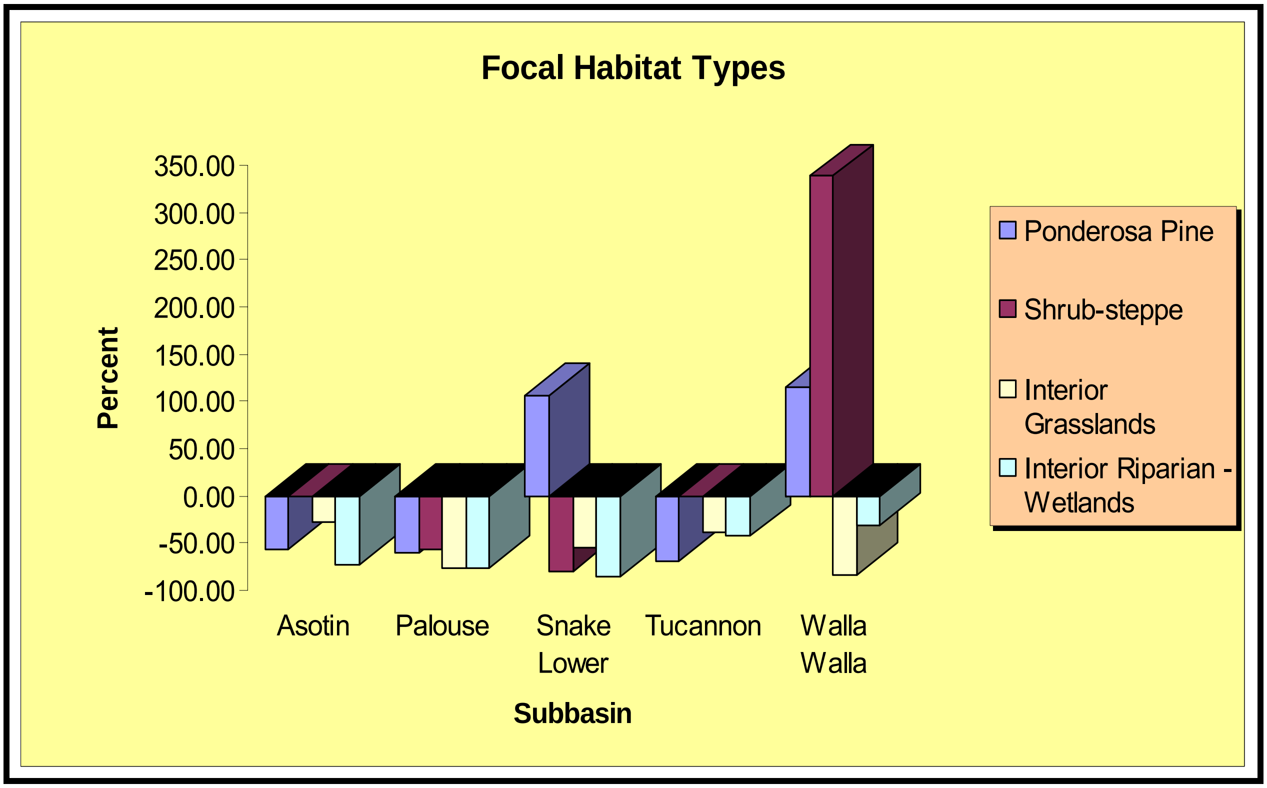

Figure 109. Changes in focal habitat types in the Southeast Washington Subbasin Planning Ecoregion (NHI 2003).

4.0 Biological Features

4.1 Focal Species/Assemblages

4.1.1 Focal Wildlife Species Assemblage Selection and Rationale

The focal species selection process is described in section 5.1 in Ashley and Stovall (unpublished report, 2004) while important habitat attributes are summarized in Table 31 (Ashley and Stovall, unpublished report, 2004). Ecoregion and subbasin planners identified focal species assemblages for each focal habitat type (Table 19).

Eight bird species and four mammalian species were selected to represent four focal habitats and one habitat type of interest (canyon grasslands) in the Subbasin (except as noted, species selected for this subbasin are identical to those for the Ecoregion). As a result of discussions by subbasin technical team staff, mule deer were added to the grassland species assemblage to capture the importance of CRP grasslands. WDFW biologists report that mule deer populations in all Ecoregion subbasins have responded positively to the addition of CRP (P. Fowler, WDFW, pers comm. 2004).

Similarly, ODFW and the Umatilla Tribe added bighorn sheep to represent canyon grassland habitat (a subset of interior grasslands). Bighorn sheep are culturally significant to the Umatilla Tribe and are an important managed species in Oregon (Appendix B_5).

Life requisite habitat attributes for each species assemblage were pooled to characterize a range of management conditions, to guide planners in development of habitat management strategies, goals, and objectives. Establishment of conditions favorable to focal species will benefit a wider group of species with similar habitat requirements. Wildlife species associated with focal habitats including agriculture are listed in Table B-2. Stakeholders identified alkali bees as important to the agriculture community because it is a significant crop pollinator. A brief species account is included in Appendix B_6.

General habitat requirements, limiting factors, distribution, population trends, and analyses of structural conditions, key ecological functions, and key environmental correlates for individual focal species are included in section 5.2 in Ashley and Stovall (unpublished report, 2004). The reader is further encouraged to review additional focal species life history information in Appendix_F in Ashley and Stovall (unpublished report, 2004).

Table 77. Focal species selection matrix for the Walla Walla subbasin.

Common Name	Focal Habitat[1]	Status[2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
White-headed woodpecker	Ponderosa pine	n/a	C	Yes	Yes	Yes	No
Flammulated owl		n/a	C	Yes	Yes	Yes	No
Rocky Mountain elk		n/a	n/a	Yes	Yes	No	Yes
Sage sparrow	Shrubsteppe	n/a	C	Yes	Yes	Yes	No
Sage thrasher		n/a	C	Yes	Yes	Yes	No
Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
Mule deer		n/a	n/a	Yes	Yes	No	Yes
Yellow warbler	Eastside (Interior) Riparian Wetlands	n/a	n/a	Yes	No	Yes	No
American beaver		n/a	n/a	Yes	No	No	Yes
Great blue heron		n/a	n/a	Yes	Yes	No	No
Grasshopper sparrow	Eastside (Interior) Grassland	n/a	n/a	Yes	No	Yes	No
Mule Deer*		SC	T	Yes	Yes	Yes	No
Bighorn Sheep*							

[1] SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine
[2] C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

*Per subbasin level discussions

4.2 Wildlife Species

An estimated 385 wildlife species occur in the Subbasin (Table B-1). Of these species, 138 are closely associated with wetland habitat and 86 consume salmonids during some portion of their life cycle. Fourteen species in the Subbasin are non-native. Nine wildlife species that occur in the subbasin are federally listed and 83 species are listed in Washington and Oregon as threatened, endangered, or candidate species (Table B-3). Seventy-eight bird species are listed as Washington or Oregon State Partners in Flight priority and focal species (Table B-4). Fifty-seven wildlife species are managed as game species in Washington and Oregon (Table_20).

Table 78. Wildlife game species of the Walla Walla subbasin (NHI 2003).

Common Name	Oregon Game Species	Washington Game Species
Bullfrog	Game Fish	Game Species
Greater White-fronted Goose	Game Bird	Game Bird
Snow Goose	Game Bird	Game Bird
Ross's Goose	Game Bird	Game Bird
Canada Goose	Game Bird	Game Bird
Wood Duck	Game Bird	Game Bird

Common Name	Oregon Game Species	Washington Game Species
Gadwall	Game Bird	Game Bird
Eurasian Wigeon	Game Bird	Game Bird
American Wigeon	Game Bird	Game Bird
Mallard	Game Bird	Game Bird
Blue-winged Teal	Game Bird	Game Bird
Cinnamon Teal	Game Bird	Game Bird
Northern Shoveler	Game Bird	Game Bird
Northern Pintail	Game Bird	Game Bird
Green-winged Teal	Game Bird	Game Bird
Canvasback	Game Bird	Game Bird
Redhead	Game Bird	Game Bird
Ring-necked Duck	Game Bird	Game Bird
Greater Scaup	Game Bird	Game Bird
Lesser Scaup	Game Bird	Game Bird
Harlequin Duck	Game Bird	Game Bird
Surf Scoter	Game Bird	Game Bird
Bufflehead	Game Bird	Game Bird
Common Goldeneye	Game Bird	Game Bird
Barrow's Goldeneye	Game Bird	Game Bird
Hooded Merganser	Game Bird	Game Bird
Common Merganser	Game Bird	Game Bird
Red-breasted Merganser	Game Bird	Game Bird
Ruddy Duck	Game Bird	Game Bird
Chukar	Game Bird	Game Bird
Gray Partridge	Game Bird	Game Bird
Ring-necked Pheasant	Game Bird	Game Bird
Ruffed Grouse	Game Bird	Game Bird
Sage Grouse	Game Bird	
Spruce Grouse	Game Bird	Game Bird
Blue Grouse	Game Bird	Game Bird
Wild Turkey	Game Bird	Game Bird
Mountain Quail	Game Bird	Game Bird
California Quail	Game Bird	Game Bird
Northern Bobwhite	Game Bird	Game Bird
American Coot	Game Bird	Game Bird
Wilson's Snipe	Game Bird	Game Bird
Band-tailed Pigeon	Game Bird	Game Bird
Mourning Dove	Game Bird	Game Bird
Eastern Cottontail		Game Mammal
Nuttall's (Mountain) Cottontail		Game Mammal
Snowshoe Hare		Game Mammal
White-tailed Jackrabbit		Game Mammal
Black-tailed Jackrabbit		Game Mammal
Muskrat	Game Mammal	
Black Bear	Game Mammal	Game Mammal
Mountain Lion	Game Mammal	Game Mammal

Common Name	Oregon Game Species	Washington Game Species
Rocky Mountain Elk	Game Mammal	Game Mammal
Mule Deer	Game Mammal	Game Mammal
White-tailed Deer (Eastside)	Game Mammal	Game Mammal
Moose		Game Mammal
Pronghorn Antelope	Game Mammal	Game Mammal
Rocky Mountain Bighorn Sheep	Game Mammal	Game Mammal

Ninety-six percent of the wildlife species that occur in the Ecoregion occur in the Subbasin (Table 21). Furthermore, 100 percent of the reptiles that occur in the Ecoregion are present in the Subbasin.

Table 79. Species richness and associations for the Walla Walla subbasin (NHI 2003).

Class	Walla Walla	% of Total	Total (Ecoregion)
Amphibians	10	77	**13**
Birds	280	99	**282**
Mammals	79	89	**89**
Reptiles	16	100	**16**
Total	**385**	**96**	**400**
Association			
Riparian Wetlands	81	98	**83**
Other Wetlands (Herbaceous and Montane Coniferous)	57	63	**90**
All Wetlands	138	80	**173**
Salmonids	86	91	**94**

5.0 Assessment Synthesis

Subbasin assessment conclusions are identical to those found at the Ecoregion level for focal habitat types and species. An assessment synthesis is included in section 6.0 in Ashley and Stovall (unpublished report, 2004)].

6.0 Inventory

This section includes information on current management activities, programs, regulatory measures, and plans designed to protect and/or restore wildlife habitats and populations within the Subbasin. Additional Inventory information is included in Appendix B_7. Although many government and non-governmental entities have an ardent interest in the Subbasin, the focus of this section is on the organizations and programs that have the greatest impact on addressing factors that affect wildlife habitats, limit wildlife populations, and support subbasin strategies, goals, and objectives. Additional inventory information is provided in the Subbasin *Walla Walla Subbasin Summary* (NPPC 2001).

6.1 Local Level

Local groups involved in fish and wildlife protection projects within the Subbasin include:

- Agricultural Community

6.1.1 Agricultural Community

Private landowners manage the vast majority of interior grassland and riparian wetland habitat in the Subbasin. Many landowners protect, enhance, and maintain privately owned/controlled grasslands and riparian habitats through active participation in CRP and CREP.

Most of the sediment delivered to the Walla Walla River and its tributaries comes from upland agricultural areas. Agriculturalists apply BMPs to croplands to reduce the amount of soil leaving these areas. The BMPs include: upland sediment basins designed to catch sediment; terraces to direct runoff to sediment basins or grassed waterways and filter strips; strip cropping; and direct seeding of crops reducing summer-fallow acres and reducing erosion by 95 percent on those acres. Landowners also control noxious weeds, which severely affect wildlife habitats and populations.

6.2 State Level

At the state level, many agencies are involved in protection of fish and wildlife habitats within the Subbasin including:

- Washington Department of Fish and Wildlife
- Washington Conservation Commission
- Washington Department of Natural Resources
- Washington Department of Ecology
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- Oregon Division of State Lands
- Oregon State Police
- Oregon Land Conservation and Development Commission
- Oregon Department of Transportation
- Oregon Department of Environmental Quality

6.2.1 Washington Department of Fish and Wildlife

The WDFW is responsible for protecting and enhancing Washington fish and wildlife and their habitats for present and future generations. Washington Department of Fish and Wildlife co-manages fish and wildlife resources with CTUIR and jointly implements the BPA-funded Walla Walla Subbasin Salmon and Steelhead Production Plan. Management of the harvest of fish and wildlife by non-Indians in the Washington portion of the Walla Walla River subbasin is the responsibility of WDFW. Habitat management for fish and wildlife is done collaboratively with private landowners, CTUIR, and public land management agencies.

6.2.1.1 Upland Restoration Program

Washington Department of Fish and Wildlife has worked with private landowners to restore habitat within the Subbasin since the early 1960s. The Habitat Development Program established small (0.5 to 3 acres) habitat plots for upland game birds on unfarmed areas usually on poor or rocky soils. In the 1980s, partnerships between WDFW, NRCS, conservation districts, and private landowners made possible habitat restoration projects at the watershed scale. Today, this multi-agency/private landowner partnership continues to enhance, protect, maintain, and increase wildlife habitat throughout the Subbasin (S. Gilmore, Resource Planning Unlimited, Inc, personal communication 2003).

Through cooperative agreements with private landowners, Upland Restoration Program biologists improve and restore riparian, upland, and shrubsteppe habitats used by both resident and migratory wildlife species. Projects typically include establishing riparian grass buffers, planting shrubs and trees for thermal and escapement cover, seeding wildlife food plots, developing water sources (e.g., guzzlers, ponds, spring developments), and maintaining winter game bird feeders.

The CRP has provided WDFW with another opportunity to work with local conservation agencies and landowners to improve wildlife habitat throughout the subbasin. Washington Department of Fish and Wildlife biologists assist landowners with selecting and/or planting herbaceous seed mixes, trees, and shrubs.

While habitat restoration is WDFW's main priority within the Subbasin, the Upland Restoration Program requires all cooperators to sign public access agreements in conjunction with habitat projects. Landowners voluntarily open their land to hunting, fishing, and/or wildlife viewing in return for habitat enhancements. *The Upland Restoration Program, in conjunction with CREP* *and CRP, has increased the extent and/or protection and enhancement of riparian wetlands, shrubsteppe, and grassland habitats within the Subbasin.*

6.2.1.2 Species Management Plans

The Washington Department of Fish and Wildlife has several wildlife species management or recovery plans on file in the Olympia office, including the following:

- Blue Mountain Elk Herd Management Plan
- Statewide Elk Management Plan
- Bighorn Sheep Herd and Statewide Management Plan
- Black Bear Management Plan
- Ferruginous Hawk Recovery Plan
- Sharp-tailed Grouse Recovery Plan
- Bald Eagle Recovery Plan

6.2.1.3 Hydraulic Code (RCW 75.20.100-160)

This law requires that any person, organization, or government agency that conducts any construction activity in or near state waters must comply with the terms of a Hydraulic Project Approval permit issued by WDFW. State waters include all marine waters and fresh waters. The law's purpose is to ensure that needed construction is done in a manner that prevents damage to the state's fish, shellfish, and their associated habitat(s).

6.2.1.4 Strategy to Recover Salmon

The Strategy is intended to be a guide, and it articulates the mission, goals, and objectives for salmon recovery. The goal is to restore salmon, steelhead, and trout populations to healthy harvestable levels and improve those habitats on which the fish rely. The early action plan identifies specific activities related to salmon recovery that state agencies will undertake in the 1999-2001 biennium and forms the first chapter in a long-term implementation plan currently under development. The early actions are driven by the goals and objectives of the Strategy. Many of the expected outcomes from the early actions will directly benefit regional and local recovery efforts.

6.2.1.5 The Washington Priority Habitats and Species Program

This Program is a guide to management of fish and wildlife "critical areas" habitat on all State and private lands as they relate to the Growth Management Act of 1990. The recommendations address upland as well as riparian habitat and place emphasis on managing for the most critical species and its habitat.

6.2.2 Washington Conservation Commission

The Washington Conservation Commission (WCC) supports conservation districts in Washington; promoting conservation stewardship by funding natural resource projects. The WCC provides basic funding to conservation districts as well as implementation funds, professional engineering grants, and Dairy Program grants and loans to prevent the degradation of surface and ground waters. The Agriculture Fish and Wildlife Program is a collaborative process aimed at voluntary compliance. The AFWP involves negotiating changes to the existing NRCS *Field Office Technical Guide* and the development of guidelines for irrigation districts to enhance, restore, and protect habitat for endangered fish and wildlife species, and address state water quality needs. This two-pronged approach has developed into two processes, one involving agricultural interests and the second concerning irrigation districts across the state (S. Gilmore, Resource Planning Unlimited, Inc., personal communication, 2003).

6.2.3 Washington Department of Natural Resources

The Washington Department of Natural Resources (WDNR) manages state land throughout the Subbasin. These lands are generally located in sections 16 and 36 within each township. The main goal of the WDNR is to maximize monetary returns from state lands in order to fund school construction. This type of management often reduces the habitat value for wildlife on WDNR lands. The WDNR also enforces and monitors logging practices on private lands. The WDNR manages 2,394 acres of state land throughout the Subbasin.

6.2.4 Washington Department of Ecology

The Washington Department of Ecology (WDOE) is charged with managing water resources to ensure that the waters of the state are protected and used for the greatest benefit. The WDOE allocates and regulates water use within the Subbasin. Permits are required to divert surface water and ground water withdrawals in excess of 5,000 gallons per day. The WDOE also acts as trustee for instream trust water rights issued to the State of Washington and held in trust.

The WDOE regulates surface and ground water quality within the Subbasin. The 1972 Federal Clean Water Act authorizes and requires states to establish water quality standards for specific pollutants. Every two years, the WDOE is required to list in Section 303(d) of the Clean Water Act those water bodies that do not meet surface water quality standards. The WDOE utilizes data collected by agency staff as well as data from tribal, state, local governments, and industries to determine whether a water body is listed on the 303(d) list. Total Maximum Daily Loads (TMDLs) must be completed for every parameter that exceeds state water quality standards on listed water bodies.

The WDOE proposes several changes to surface water quality standards and the classification system. The revised standards must be applied so that they support the same uses covered under the current classification structure. Changes to the surface water quality standards will affect many programs, including monitoring, permits, TMDLs and the 303(d) list.

6.2.5 Oregon Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife (ODFW) is responsible for protecting and enhancing Oregon fish and wildlife and their habitats for present and future generations. The ODFW co-manages fish and wildlife resources with the CTUIR and jointly implements the BPA-funded *Walla Walla River Subbasin Salmon and Steelhead Production Plan*. Fish and wildlife harvest by non-Indians in the Walla Walla subbasin is the responsibility of ODFW. Habitat management for fish and wildlife is done collaboratively with private landowners, CTUIR, and public land management agencies.

Oregon Department of Fish and Wildlife policies and plans applicable to the Subbasin include the Oregon Administrative Rules on wild fish management and natural production (ODFW 1990a, 1992a) and management plans for elk, mule deer, and cougar (ODFW 1990b, 1992c, 1993b). These plans present systematic approaches to conserving aquatic and wildlife resources and establish management priorities within the Subbasin.

6.2.6 Oregon Department of Forestry

The Oregon Department of Forestry enforces the Oregon Forest Practices Act (OFPA), which regulates commercial timber projection and harvest on state and private lands. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities that address stream buffers, riparian management, road maintenance, and construction standards.

6.2.7 Oregon Division of State Lands

The Oregon Division of State Lands regulates the removal and filling of material in waterways. Permits are required for projects involving 50 cubic yards or more of material. Permit applications are reviewed by ODFW and may be modified or denied based on project impacts on fish populations.

6.2.8 Oregon State Police

The Oregon State Police patrols the Subbasin to enforce laws and regulations designed to protect fish and wildlife. Specific area and resource protection action plans are developed each year in consultation with ODFW.

6.2.9 Oregon Land Conservation and Development Commission

The Oregon Land Conservation and Development Commission regulates land use on a statewide level. County land use plans must comply with statewide land use goals, but enforcement against negligent counties appears minimal. Effective land use plans and policies are essential tools to protect against permanent fish and wildlife habitat losses and degradation, particularly excessive development along streams, wetlands, floodplains, and sensitive wildlife areas.

6.2.10 Oregon Department of Transportation

The Oregon Department of Transportation maintains highways that cross streams in the Subbasin. Under the initiative of the Oregon Plan for Salmon and Watersheds, efforts to improve protection and remediation of fish habitat impacted by state highways are ongoing.

6.2.11 Oregon Department of Environmental Quality

The Oregon Department of Environmental Quality (ODEQ) is responsible for implementing the Clean Water Act and enforcing state water quality standards for protection of aquatic life and other beneficial uses. The mission of the ODEQ is to lead in the restoration and maintenance of Oregon's quality of air, water and other environmental media. With regard to watershed restoration, ODEQ is guided by Section 303(d) of the Federal Clean Water Act and Oregon statute to establish Total Maximum Daily Loads (TMDLs) for pollutants and implement water quality standards as outlined in Oregon Administrative Rules 340-041. The ODEQ focuses on stream conditions and inputs and advocates for other measures in support of fish populations (D. Butcher, ODEQ, personal communication, 2001).

6.3 Federal Level

Many federal agencies are involved in protection of fish and wildlife resources including:

- Natural Resources Conservation Service
- Farm Services Agency
- U. S. Forest Service
- U.S. Bureau of Reclamation
- Bureau of Land Management
- U.S. Army Corps of Engineers
- U. S. Fish and Wildlife Service
- Bonneville Power Administration
- Columbia Basin Fish and Wildlife Authority
- Environmental Protection Agency

6.3.1 Natural Resource Conservation Service

One of the purposes of the NRCS is to provide consistent technical assistance to private land users, tribes, communities, government agencies, and conservation districts. The NRCS assists in developing conservation plans, provides technical field-based assistance including project design, and encourages the implementation of conservation practices to improve water quality and fisheries habitat. Programs include the CRP, River Basin Studies, Forestry Incentive Program, Wildlife Habitat Improvement Program, the Environmental Quality Incentives Program, and Wetlands Reserve Program (S. Gilmore, Resource Planning Unlimited, Inc., personal communications). The USDA Farm Services Administration (FSA) and the NRCS administer and implement the federal CRP and Continuous CRP.

6.3.1.1 Conservation Reserve Program

The enrollment of agricultural land with a previous cropping history into CRP has removed highly erodible land from commodity production. The land is converted into permanent herbaceous or woody vegetation to reduce soil and water erosion. Conservation Reserve Program contracts are for a maximum of 10 years per sign-up period (the contracts may be extended) and have resulted in an increase in wildlife habitat.

CRP cover practices (CP) include planting introduced or native grasses, wildlife cover, conifers, filter strips, grassed waterways, riparian forest buffers, and field windbreaks. Not all CPs are equal, nor benefit wildlife to the same degree. For example, CP1 (permanent introduced grasses) usually equates to monocultures of crested wheatgrass with minimal wildlife value. In contrast, CP2 (permanent native grasses and legumes) provides much more habitat structural and floristic diversity, which clearly benefits wildlife more than introduced grass monocultures. Cover Practices are summarized and compared in Table_22.

Conservation Reserve Program contract approval is based, in part, on the types of vegetation landowners are willing to plant. Cover Practice planting combinations are assigned points based on the potential value to wildlife. For example, cover types more beneficial to wildlife are awarded higher scores. Seed mixes containing diverse native species generally receive the highest scores (FSA 2003).

Table 80. Cover practice descriptions (FSA 2003).

Cover Practice (CP)	Description
CP1 - Permanent Introduced Grasses and Legumes	Planting of 2 to 3 species of an introduced grass species, or mixture (minimum of 4 species) of at least 3 introduced grasses and at least 1 forbs or legume species best suited for wildlife in the area.
CP2 - Establishment of permanent native grasses	Mixed stand (minimum of 3 species) of at least 2 native grass species and at least 1 forbs or legume species beneficial to wildlife, or mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forbs, or legume species best suited for wildlife in the area.
CP3 -Tree planting (general)	Northern conifers (softwoods) - Conifers/softwoods planted at a rate of 750 to 850 trees per acre depending upon the site index with 10 to 20 percent openings managed to a CP4D wildlife cover, or western pines (softwoods) planted at a rate of 550 to 650 per acre depending upon the site index with 10 to 20 percent openings managed to a CP4D wildlife cover.
CP4B - Permanent wildlife habitat (corridors), non-easement	Mixed stand (minimum of 4 species) of grasses, trees, shrubs, forbs, or legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the participant (more points awarded for a minimum of 5 species). Only native grasses are authorized.
CP4D - Permanent wildlife habitat	Mixed stand (minimum of 4 species) of either grasses, trees, shrubs, forbs, *or* legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the

	participant (additional points awarded for a minimum of 5 species). Only native grasses are authorized.
CP-10 - Vegetative cover: grass – already established	A solid stand of 1 to 3 species of introduced grasses, a solid stand of 1 to 3 species of native grasses, or mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forbs, or legume species best suited to Wildlife in the area (native vegetation maximizes points).
CP11 – Vegetative cover: trees – already established	Solid stand of pine/softwood or solid stand of non-mast producing hardwood species, solid stand of a single hard mast producing species, or mixed stand (2 or more species) of hardwoods best suited for wildlife in the area. Pine/softwood established at, or thinned to provide 15 to 20 percent openings of native herbaceous cover and/or shrub plantings/ natural regeneration best suited for wildlife in the area is awarded additional points.
CP 15 – Contour grass strips	Contour grass strips to reduce erosion and control runoff.

FSA cover practice data, reported on a county basis, is compared for Washington State counties in Figure 39. Although more expensive and often harder to establish, landowners throughout the Ecoregion have chosen to apply cover practices such as CP2 and CP4 that significantly benefit wildlife over less beneficial practices like CP1.

Conservation Reserve Program and associated cover practices that emphasize wildlife habitat increase the extent of grassland habitats, provide connectivity/corridors between extant native grasslands and other habitat types, reduce habitat fragmentation, contribute towards control of noxious weeds, increase landscape habitat diversity and edge effect, reduce soil erosion and stream sedimentation, and provide habitat for a myriad of wildlife species.

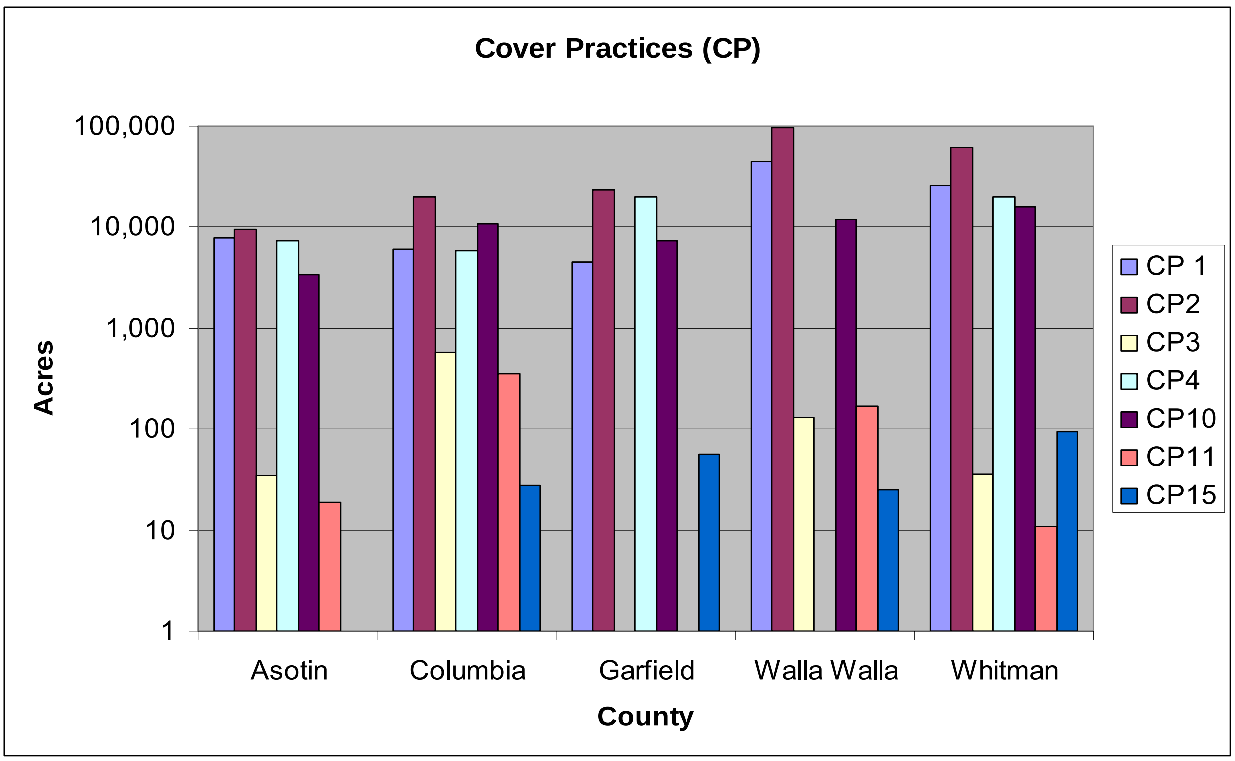

Figure 110. A county comparison of Conservation Reserve Program cover practices, Washington (FSA 2003).

6.3.1.2 Conservation Reserve Enhancement Program

The CREP, established in 1998, is a partnership between USDA and the States of Washington and Oregon and is administered by FSA and the WCC. The CREP provides incentives to restore and improve salmon and steelhead habitat on private land. Program participation is voluntary. Under 10 or 15-year contracts, landowners remove fields from production, remove grazing, and plant trees and shrubs to stabilize stream banks. This also provides wildlife habitat, reduces sedimentation, shades stream corridors, and improves riparian/riverine wetland function.

Landowners receive annual rent, incentive and maintenance payments, and cost share for practice installations. Payments made by FSA and WCC, can result in no cost to the landowner for participation. The number of acres enrolled in CREP is compared by county in Figure_40.

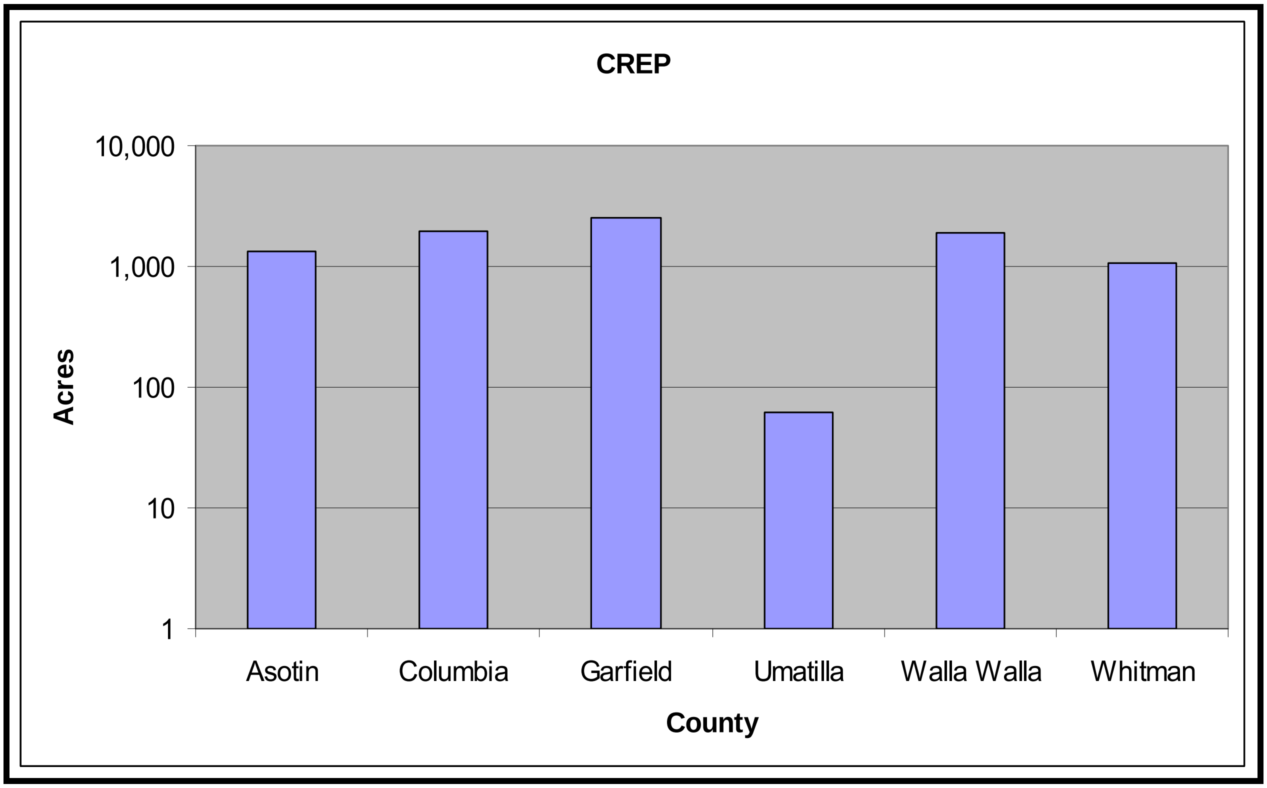

Figure 111. A county comparison of acreage protected by the Conservation Reserve Enhancement Program (FSA 2003).

CRP and CREP utilize herbaceous seedings, shrubs, and trees to accomplish conservation measures that provide short-term high protection for wildlife habitats. Program/protection acreage is summarized and compared by county for both programs in Figure_41.

6.3.1.3 Continuous Conservation Reserve Program

The CCRP focuses on the improvement of water quality and riparian areas. Practices include shallow water areas with associated wetland and upland wildlife habitat, riparian forest buffers, filter strips, grassed waterways and field windbreaks. Enrollment for these practices is not limited to highly erodible land, as is required for the CRP, and carries a longer contract period (10 - 15 years), higher installation reimbursement rate, and higher annual annuity rate.

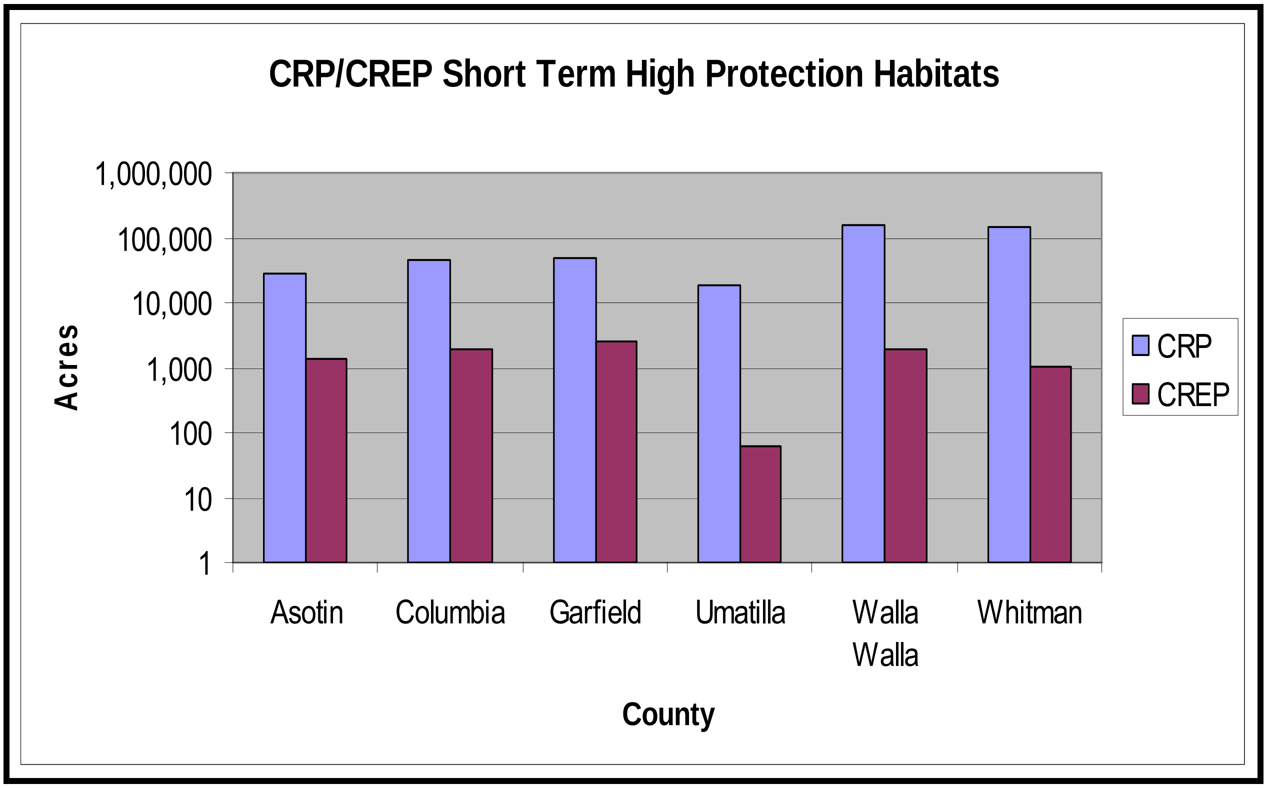

Figure 112. Short term/high protection CRP and CREP lands (FSA 2003).

6.3.1.4 Wildlife Habitat Incentive Program

The Wildlife Habitat Incentive Program (WHIP) is administered and implemented by NRCS and provides financial incentives to develop wildlife habitat on private lands. Participants agree to implement a wildlife habitat development plan and NRCS agrees to share the cost of assistance for the initial implementation of wildlife habitat development practices. The NRCS and program participants enter into a cost-share agreement for wildlife habitat development. This agreement generally lasts a minimum of 10 years.

6.3.1.5 Environmental Quality Incentives Program

The Environmental Quality Incentives Program is administered and implemented by the NRCS and provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program assists farmers and ranchers with federal, state, and tribal environmental compliance, and encourages environmental stewardship. The program is funded through the Commodity Credit Corporation.

Program goals and objectives are achieved through the implementation of a conservation plan that incorporates structural, vegetative, and land management practices on eligible land. Eligible producers commit to 5 to 10-year contracts. Cost-share payments are paid for implementation of one or more eligible structural or vegetative practices such as terraces, filter strips, tree planting, and permanent wildlife habitat. Furthermore, incentive payments are made for implementation of one or more land management practices such as nutrient management, pest management, and grazing land management.

6.3.1.6 Wetlands Reserve Program

This voluntary program is designed to restore wetlands. Participating landowners can establish permanent or 30-year conservation easements, or they can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetlands. The 30-year easement payment is 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The voluntary agreements are a minimum of 10 years in duration and provide for 75 percent of the cost of restoring the involved wetlands. Easements and restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the easement or agreement.

6.3.2 Farm Service Administration

The Farm Service Administration (FSA) was set up when the USDA was reorganized in 1994. Functions similar to the FSA have been part of USDA programs since the 1930s. Federal farm programs are administered through local FSA offices. Farmers who are eligible to participate in these programs elect a committee of three to five representatives to review county office operations and make decisions on federal farm program application. Conservation program payments that FSA administers include CRP and EQIP. Technical assistance for these programs is provided by the NRCS.

6.3.3 U. S. Forest Service

The USFS is responsible for the management of all National Forests and National Grasslands in the United States. The multiple use mandate of the USFS was emphasized in the Multiple Use Sustained Yield Act of 1960. The forest planning process that has been in force for over the last 20 years was established under the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 and National Forest Management Act (NFMA) of 1976. The USFS land allocation, management standards, and guidelines for the Subbasin are specified in the Umatilla National Forest land and resource management plan (NPPC 2001).

6.3.4 U. S. Bureau of Reclamation

The primary activity of the BOR is to provide irrigation water. The BOR is involved with water management and irrigation in the Subbasin, as well as multiple use resource management on its lands and facilities, including recreation and wildlife conservation.

6.3.5 Bureau of Land Management

Lands administered by the Bureau of Land Management (BLM) consist primarily of dry grasslands and desert. These lands are currently managed for multiple-use under authority of the *Federal Land Policy and Management Act* (FLPMA) of 1976. Primary commodity uses of these lands are grazing and mining. Wildlife, wilderness, archaeological and historic sites, and recreation are also managed on BLM lands. The BLM is also responsible for mineral leasing on all public lands.

6.3.6 U. S. Army Corps of Engineers

The USACE is responsible for planning, designing, building and operating water resources and other civil works projects. The Federal Water Pollution Control Act of 1972 gave the USACE authority to enforce section 404 of the Act dealing with discharge of dredged or fill material into waters of the U. S., including wetlands. Amendments to the Act in 1977 exempted most farming, ranching, and forestry activities from 404 permit requirements (Dana and Fairfax 1980). The USACE is also responsible for flood protection by such means as building and maintaining levies, channelization of streams and rivers, and regulating flows and reservoir levels.

6.3.7 U. S. Fish and Wildlife Service

The U. S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act for resident fish and wildlife species. The USFWS is also responsible for enforcing the *North American Migratory Bird Treaty Act and Lacey Act* (1900) to prevent interstate commerce in wildlife taken illegally. The USFWS distributes monies to state fish and wildlife departments raised through federal taxes on the sale of hunting and fishing equipment under the authority of the *Pitman-Robertson Federal Aid in Fish and Wildlife Restoration Act* (1937) and the *Dingle-Johnson Act*. The USFWS also manages a national system of wildlife refuges and provides funding that emphasizes restoration of riparian areas, wetlands, and native plant communities through the Partners in Wildlife Program.

The USFWS budgets for and administers the operation, maintenance, and evaluation of the Lower Snake River Fish and Wildlife Compensation Program (LSRFWCP) spring and fall chinook, steelhead, and rainbow trout programs in the Walla Walla subbasin. The LSRFWCP was authorized by the *Water Resources Development Act* of 1976, Public Law 94-587, to offset losses caused by the four Lower Snake River dam and navigation lock projects. The WDFW operates LSRFWCP facilities in the Subbasin and are co-managers with the CTUIR.

6.3.8 Bonneville Power Administration

The Bonneville Power Administration (BPA) is a federal agency established to market power produced by the federal dams in the Columbia River Basin. The BPA provides funding for fish and wildlife protection and enhancement to mitigate for the loss of habitat resulting from hydroelectric construction and operations.

6.3.9 Columbia Basin Fish and Wildlife Authority

The Columbia Basin Fish and Wildlife Authority (CBFWA) developed the *Columbia River Fish Management Plan* (Plan)*.* The Plan is an agreement among the tribal, state and federal parties with jurisdiction over Pacific salmon originating in the Columbia River Basin. The Plan provides procedures whereby the parties co-manage anadromous fish harvest, production and habitat (CRITFC 1995). The Plan stems from the treaty fishing rights lawsuit, U. S. v. Oregon. Although the Plan expired in 1999, the co-managers are currently developing another plan. The interim, short-term agreements on managing the fisheries have been entered into prior to execution of the specific fishery (spring or fall). The Plan and further agreements emphasize the importance of artificial propagation actions to accomplish the goals of rebuilding natural salmon runs. Agreements struck in the U. S. v. Oregon forum often determine the number, purpose and location of fish released from various hatcheries.

6.3.10 Environmental Protection Agency

The Environmental Protection Agency (EPA) was formed in 1970 and administers the federal Air, Water, and Pesticide Acts. The EPA sets national air quality standards, an important provision of which requires states to prevent deterioration of air quality in rural areas below the national standards for that particular area (depending on its EPA classification). The EPA also sets national water quality standards (TMDLs) for water bodies that the states must enforce. These standards are segregated into “point” and “nonpoint” source water pollution, with point sources requiring permitting. Although controversial, most farming, ranching, and forestry practices are considered non-point sources and thus do not require permitting by the EPA. The EPA provides funding through Section 319 of the Clean Water Act for TMDL implementation projects. Section 319 funds are administered by WDOE by the ODEQ.

6.4 Native American Tribes

- The Confederated Tribes of the Umatilla Indian Reservation

6.4.1 The Confederated Tribes of the Umatilla Indian Reservation

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) is responsible for protecting and enhancing treaty fish and wildlife resources and habitats for present and future generations. Members of the CTUIR have federal reserved treaty fishing and hunting rights pursuant to the 1855 Treaty with the United States government. The CTUIR co-manages fish and wildlife resources with state fish and wildlife managers and individually and/or jointly implements restoration and mitigation activities throughout areas of interest and influence in northeast Oregon and southeast Washington. These lands include but are not limited to the entire Subbasin in which CTUIR held aboriginal title. CTUIR fish and wildlife activities relate to all aspects of management (habitat, fish passage, hatchery actions, harvest, research, etc.). CTUIR policies and plans applicable to Subbasin management include the Columbia Basin Salmon Policy (CTUIR 1995), Wy-Kan-Ush-Mi Wa-Kish-Wit: Spirit of the Salmon (CRITFIC 1996a, 1996b), and the CTUIR Wildlife Mitigation Plan for the John Day and McNary Dams (Childs *et al.* 1997).

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Appendix K: Oregon GAP Vegetation Zones

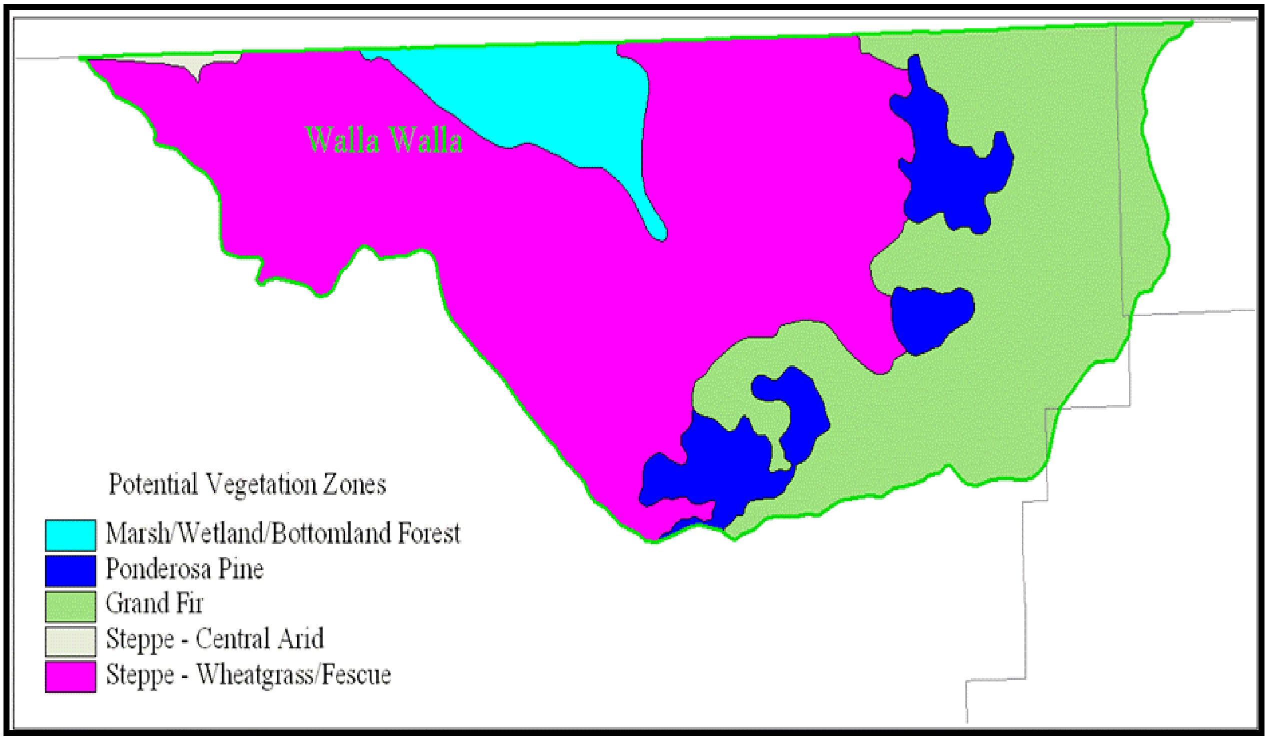

Figure A-1. Historic (potential) vegetation zones of the Southeast Washington Subbasin Planning Ecoregion, Oregon (Cassidy 1997).

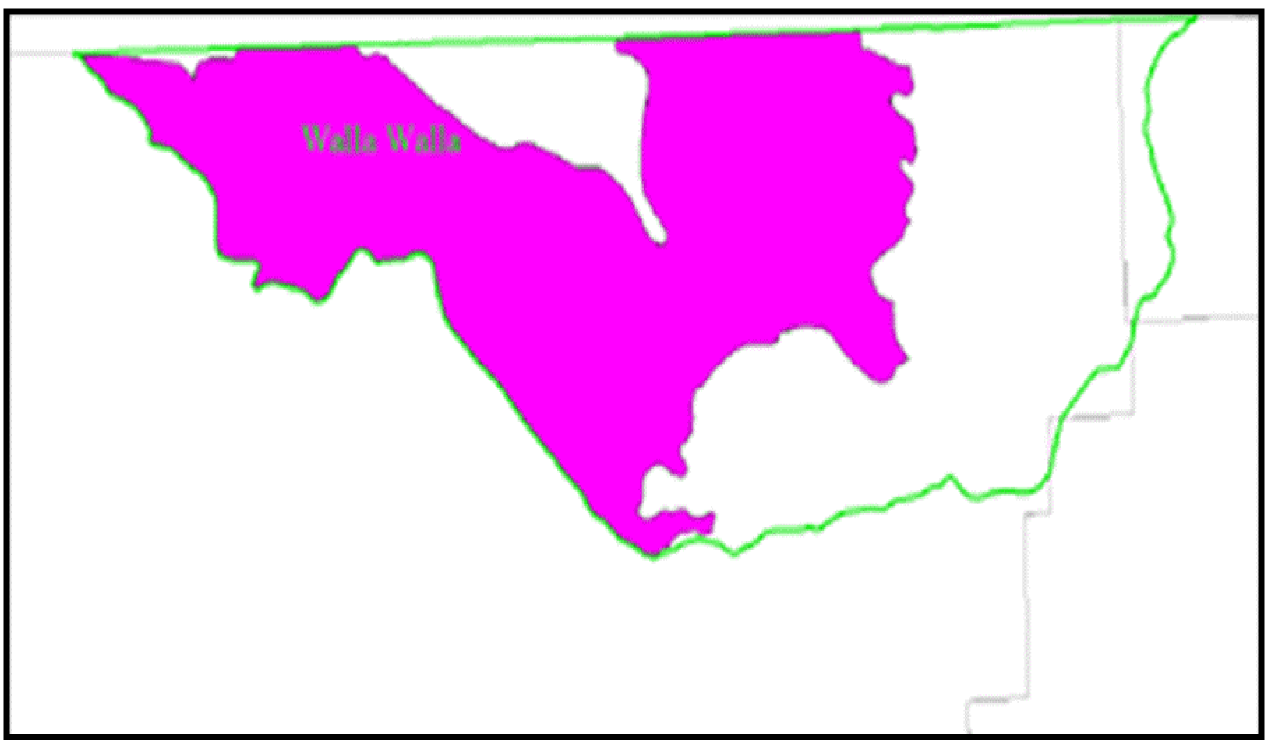

Figure A-2. Historic (potential) wheatgrass/fescue steppe vegetation zone in the Southeast Washington Subbasin Planning Ecoregion, Oregon (Cassidy 1997).

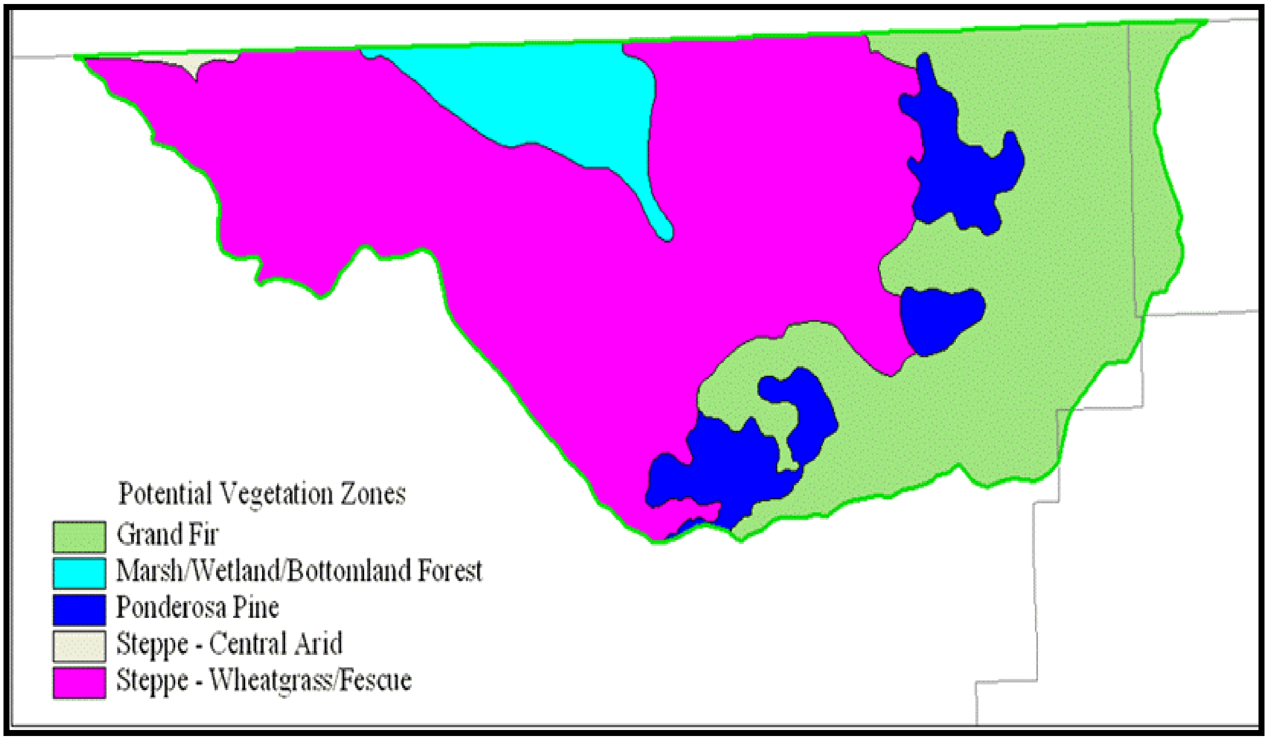

Figure A-3. Pre-agricultural vegetation zones of the Southeast Washington Subbasin Planning Ecoregion, Oregon (Cassidy 1997).

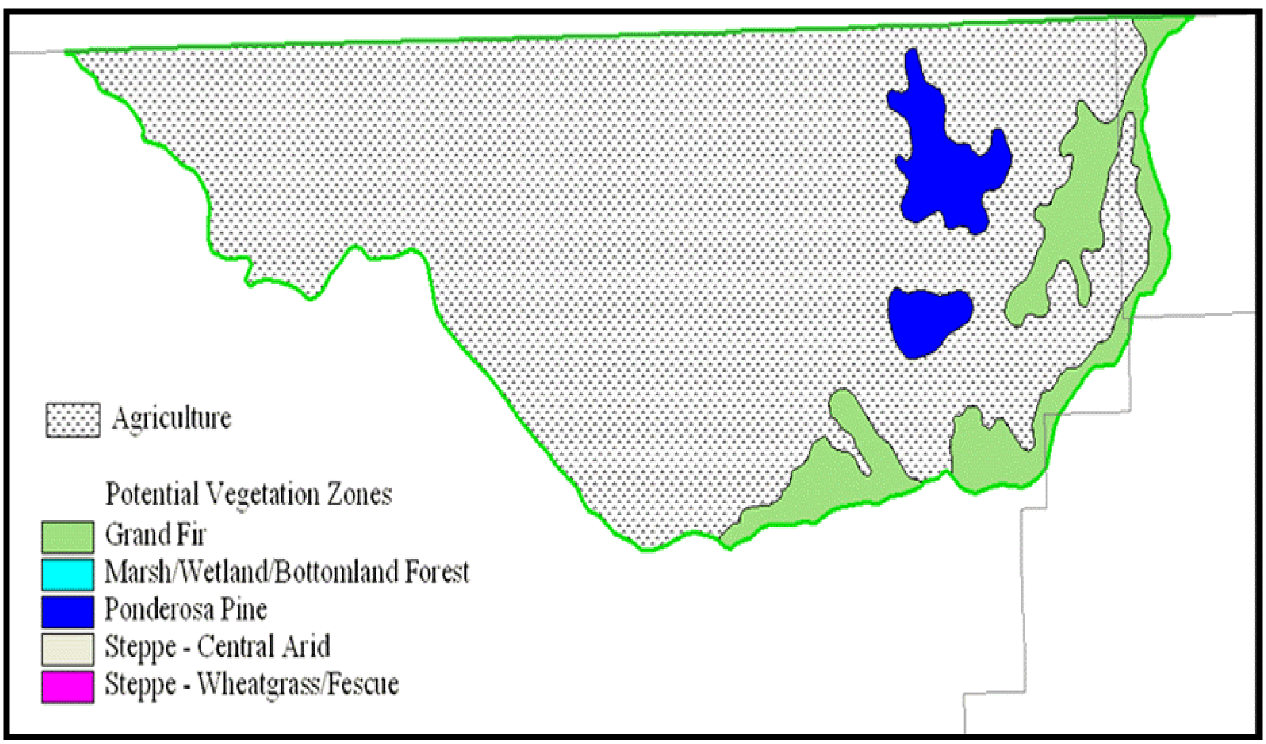

Figure A-4. Post-agricultural vegetation zones of the Southeast Washington Subbasin Planning Ecoregion, Oregon (Cassidy 1997).

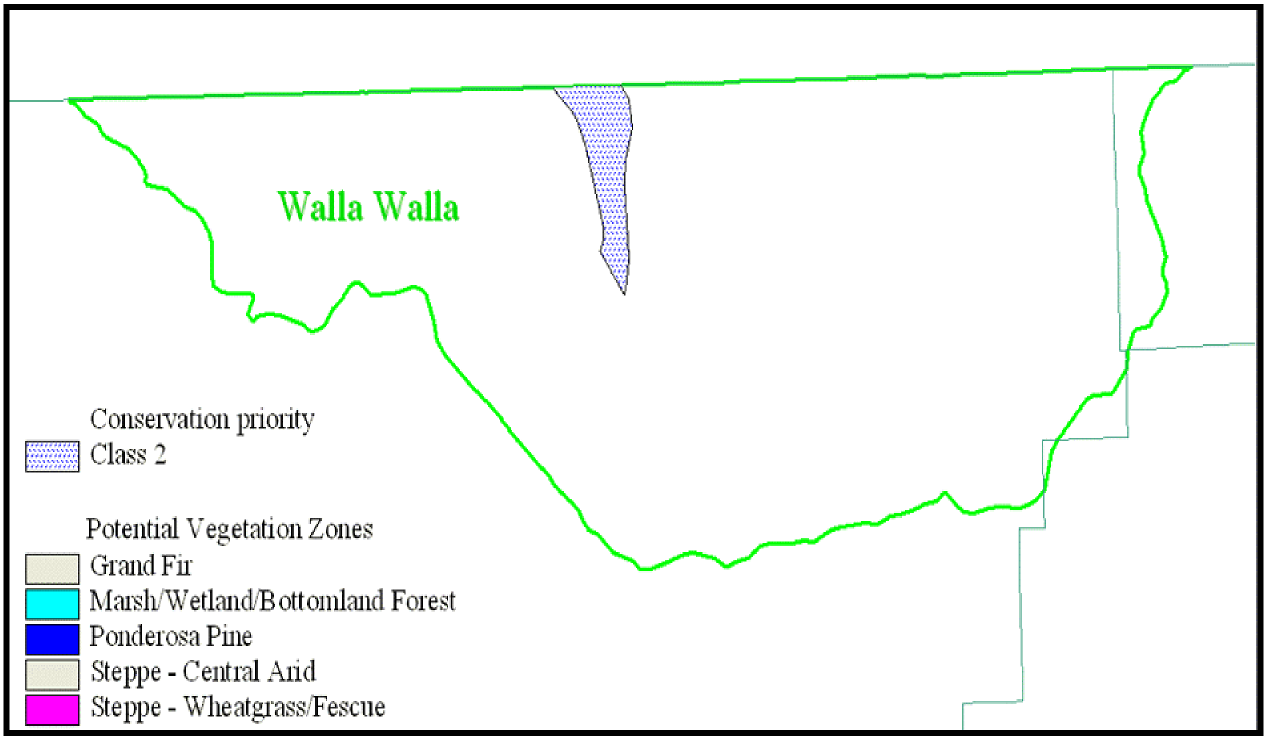

Figure A-5. ECA land classes in the Southeast Washington Subbasin Planning Ecoregion (Cassidy 1997).

Appendix L: Wildlife Species

Table B-1. Wildlife species occurrence for the Walla Walla subbasin (NHI 2003).

	Common Name	Scientific Name		Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
Amphibians						
	Tiger Salamander	*Ambystoma tigrinum*			Yes	Yes
	Long-toed Salamander	*Ambystoma macrodactylum*			Yes	Yes
	Tailed Frog	*Ascaphus truei*			Yes	
	Great Basin Spadefoot	*Scaphiopus intermontanus*			Yes	Yes
	Western Toad	*Bufo boreas*			Yes	Yes
	Woodhouse's Toad	*Bufo woodhousii*			Yes	Yes
	Pacific Chorus (Tree) Frog	*Pseudacris regilla*			Yes	Yes
	Columbia Spotted Frog	*Rana luteiventris*			Yes	Yes
	Northern Leopard Frog	*Rana pipiens*			Yes	Yes
Non-native	Bullfrog	*Rana catesbeiana*			Yes	Yes
	Total Amphibians:	**10**	**Total:**	**0**	**10**	**9**
Birds						
	Common Loon	*Gavia immer*		Yes		Yes
	Pied-billed Grebe	*Podilymbus podiceps*		Yes		Yes
	Horned Grebe	*Podiceps auritus*		Yes		Yes
	Red-necked Grebe	*Podiceps grisegena*		Yes		Yes
	Eared Grebe	*Podiceps nigricollis*				Yes
	Western Grebe	*Aechmophorus occidentalis*		Yes		Yes
	Clark's Grebe	*Aechmophorus clarkii*		Yes		Yes
	American White Pelican	*Pelecanus erythrorhynchos*		Yes		
	Double-crested Cormorant	*Phalacrocorax auritus*		Yes	Yes	
	American Bittern	*Botaurus lentiginosus*				Yes
	Great Blue Heron	*Ardea herodias*		Yes	Yes	
	Great Egret	*Ardea alba*		Yes	Yes	
	Cattle Egret	*Bubulcus ibis*				
	Green Heron	*Butorides virescens*		Yes	Yes	
	Black-crowned Night-heron	*Nycticorax nycticorax*		Yes	Yes	
	Turkey Vulture	*Cathartes aura*		Yes		
	Greater White-fronted Goose	*Anser albifrons*				
	Snow Goose	*Chen*				

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
		Ccaerulescens			
	Ross's Goose	*Chen rossii*			
	Canada Goose	*Branta canadensis*			Yes
	Trumpeter Swan	*Cygnus buccinator*	Yes		Yes
	Tundra Swan	*Cygnus columbianus*			
	Wood Duck	*Aix sponsa*		Yes	
	Gadwall	*Anas strepera*			Yes
	Eurasian Wigeon	*Anas penelope*			
	American Wigeon	*Anas americana*			Yes
	Mallard	*Anas platyrhynchos*	Yes	Yes	Yes
	Blue-winged Teal	*Anas discors*			Yes
	Cinnamon Teal	*Anas cyanoptera*			Yes
	Northern Shoveler	*Anas clypeata*			Yes
	Northern Pintail	*Anas acuta*			Yes
	Green-winged Teal	*Anas crecca*	Yes		Yes
	Canvasback	*Aythya valisineria*	Yes		Yes
	Redhead	*Aythya americana*			Yes
	Ring-necked Duck	*Aythya collaris*		Yes	
	Greater Scaup	*Aythya marila*	Yes		
	Lesser Scaup	*Aythya affinis*			Yes
	Harlequin Duck	*Histrionicus histrionicus*	Yes	Yes	
	Surf Scoter	*Melanitta perspicillata*	Yes		
	Bufflehead	*Bucephala albeola*			
	Common Goldeneye	*Bucephala clangula*	Yes		
	Barrow's Goldeneye	*Bucephala islandica*	Yes		
	Hooded Merganser	*Lophodytes cucullatus*	Yes	Yes	
	Common Merganser	*Mergus merganser*	Yes	Yes	
	Red-breasted Merganser	*Mergus serrator*	Yes		
	Ruddy Duck	*Oxyura jamaicensis*			Yes
	Osprey	*Pandion haliaetus*	Yes		
	Bald Eagle	*Haliaeetus leucocephalus*	Yes		
	Northern Harrier	*Circus cyaneus*			
	Sharp-shinned Hawk	*Accipiter striatus*			
	Cooper's Hawk	*Accipiter cooperii*			
	Northern Goshawk	*Accipiter gentilis*			
	Swainson's Hawk	*Buteo swainsoni*			
	Red-tailed Hawk	*Buteo jamaicensis*	Yes		

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Ferruginous Hawk	*Buteo regalis*			
	Rough-legged Hawk	*Buteo lagopus*			
	Golden Eagle	*Aquila chrysaetos*	Yes		
	American Kestrel	*Falco sparverius*			
	Merlin	*Falco columbarius*			
	Gyrfalcon	*Falco rusticolus*	Yes		
	Peregrine Falcon	*Falco peregrinus*	Yes		
	Prairie Falcon	*Falco mexicanus*			
Non-native	Chukar	*Alectoris chukar*			
Non-native	Gray Partridge	*Perdix perdix*			
Non-native	Ring-necked Pheasant	*Phasianus colchicus*		Yes	
	Ruffed Grouse	*Bonasa umbellus*		Yes	
	Sage Grouse	*Centrocercus urophasianus*			
	Spruce Grouse	*Falcipennis canadensis*			
	Blue Grouse	*Dendragapus obscurus*		Yes	
	Sharp-tailed Grouse	*Tympanuchus phasianellus*			
Non-native	Wild Turkey	*Meleagris gallopavo*			
	Mountain Quail	*Oreortyx pictus*			
	California Quail	*Callipepla californica*			
Non-native	Northern Bobwhite	*Colinus virginianus*			
	Virginia Rail	*Rallus limicola*			Yes
	Sora	*Porzana carolina*			Yes
	American Coot	*Fulica americana*			Yes
	Sandhill Crane	*Grus canadensis*			Yes
	Black-bellied Plover	*Pluvialis squatarola*			
	Pacific Golden-Plover	*Pluvialis fulva*			
	Semipalmated Plover	*Charadrius semipalmatus*			
	Killdeer	*Charadrius vociferus*	Yes		
	Black-necked Stilt	*Himantopus mexicanus*			Yes
	American Avocet	*Recurvirostra americana*			Yes
	Greater Yellowlegs	*Tringa melanoleuca*	Yes		
	Lesser Yellowlegs	*Tringa flavipes*			
	Solitary Sandpiper	*Tringa solitaria*			
	Willet	*Catoptrophorus*			Yes

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
		semipalmatus			
	Spotted Sandpiper	*Actitis macularia*	Yes		
	Upland Sandpiper	*Bartramia longicauda*			
	Long-billed Curlew	*Numenius americanus*			
	Marbled Godwit	*Limosa fedoa*			
	Sanderling	*Calidris alba*			
	Semipalmated Sandpiper	*Calidris pusilla*			
	Western Sandpiper	*Calidris mauri*			
	Least Sandpiper	*Calidris minutilla*			
	Baird's Sandpiper	*Calidris bairdii*			
	Pectoral Sandpiper	*Calidris melanotos*			
	Dunlin	*Calidris alpina*			
	Stilt Sandpiper	*Calidris himantopus*			
	Short-billed Dowitcher	*Limnodromus griseus*			
	Long-billed Dowitcher	*Limnodromus scolopaceus*			
	Common Snipe	*Gallinago gallinago*			Yes
	Wilson's Phalarope	*Phalaropus tricolor*			Yes
	Red-necked Phalarope	*Phalaropus lobatus*			
	Bonaparte's Gull	*Larus philadelphia*	Yes		
	Mew Gull	*Larus canus*	Yes		
	Ring-billed Gull	*Larus delawarensis*	Yes		
	California Gull	*Larus californicus*	Yes		
	Herring Gull	*Larus argentatus*	Yes		
	Thayer's Gull	*Larus thayeri*	Yes		
	Glaucous-winged Gull	*Larus glaucescens*	Yes		
	Glaucous Gull	*Larus hyperboreus*	Yes		
	Caspian Tern	*Sterna caspia*	Yes		
	Common Tern	*Sterna hirundo*	Yes		
	Forster's Tern	*Sterna forsteri*	Yes		Yes
	Black Tern	*Chlidonias niger*			Yes
Non-native	Rock Dove	*Columba livia*			
	Band-tailed Pigeon	*Columba fasciata*		Yes	
	Mourning Dove	*Zenaida macroura*		Yes	
	Yellow-billed Cuckoo	*Coccyzus americanus*		Yes	
	Barn Owl	*Tyto alba*			
	Flammulated Owl	*Otus flammeolus*			
	Western Screech-owl	*Otus kennicottii*		Yes	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Great Horned Owl	*Bubo virginianus*			
	Snowy Owl	*Nyctea scandiaca*	Yes		
	Northern Pygmy-owl	*Glaucidium gnoma*			
	Burrowing Owl	*Athene cunicularia*			
	Barred Owl	*Strix varia*			
	Great Gray Owl	*Strix nebulosa*			
	Long-eared Owl	*Asio otus*		Yes	
	Short-eared Owl	*Asio flammeus*			Yes
	Boreal Owl	*Aegolius funereus*			
	Northern Saw-whet Owl	*Aegolius acadicus*			
	Common Nighthawk	*Chordeiles minor*			
	Common Poorwill	*Phalaenoptilus nuttallii*			
	Black Swift	*Cypseloides niger*			
	Vaux's Swift	*Chaetura vauxi*			
	White-throated Swift	*Aeronautes saxatalis*			
	Black-chinned Hummingbird	*Archilochus alexandri*			
	Calliope Hummingbird	*Stellula calliope*			
	Broad-tailed Hummingbird	*Selasphorus platycercus*			
	Rufous Hummingbird	*Selasphorus rufus*			
	Belted Kingfisher	*Ceryle alcyon*	Yes	Yes	
	Lewis's Woodpecker	*Melanerpes lewis*			
	Williamson's Sapsucker	*Sphyrapicus thyroideus*			
	Red-naped Sapsucker	*Sphyrapicus nuchalis*		Yes	
	Red-breasted Sapsucker	*Sphyrapicus ruber*			
	Downy Woodpecker	*Picoides pubescens*			
	Hairy Woodpecker	*Picoides villosus*			
	White-headed Woodpecker	*Picoides albolarvatus*			
	Three-toed Woodpecker	*Picoides tridactylus*			
	Black-backed Woodpecker	*Picoides arcticus*			
	Northern Flicker	*Colaptes auratus*			
	Pileated	*Dryocopus pileatus*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Woodpecker				
	Olive-sided Flycatcher	*Contopus cooperi*			
	Western Wood-pewee	*Contopus sordidulus*			
	Willow Flycatcher	*Empidonax traillii*	Yes	Yes	
	Least Flycatcher	*Empidonax minimus*			
	Hammond's Flycatcher	*Empidonax hammondii*			
	Gray Flycatcher	*Empidonax wrightii*			
	Dusky Flycatcher	*Empidonax oberholseri*			
	Pacific-slope Flycatcher	*Empidonax difficilis*			
	Cordilleran Flycatcher	*Empidonax occidentalis*		Yes	
	Say's Phoebe	*Sayornis saya*			
	Ash-throated Flycatcher	*Myiarchus cinerascens*			
	Western Kingbird	*Tyrannus verticalis*			
	Eastern Kingbird	*Tyrannus tyrannus*			
	Loggerhead Shrike	*Lanius ludovicianus*			
	Northern Shrike	*Lanius excubitor*			
	Cassin's Vireo	*Vireo cassinii*			
	Hutton's Vireo	*Vireo huttoni*			
	Warbling Vireo	*Vireo gilvus*		Yes	
	Red-eyed Vireo	*Vireo olivaceus*		Yes	
	Gray Jay	*Perisoreus canadensis*	Yes		
	Steller's Jay	*Cyanocitta stelleri*	Yes		
	Western Scrub-Jay	*Aphelocoma californica*			
	Pinyon Jay	*Gymnorhinus cyanocephalus*			
	Clark's Nutcracker	*Nucifraga columbiana*			
	Black-billed Magpie	*Pica pica*	Yes	Yes	
	American Crow	*Corvus brachyrhynchos*	Yes		
	Northwestern Crow	*Corvus caurinus*	Yes		
	Common Raven	*Corvus corax*	Yes		
	Horned Lark	*Eremophila alpestris*			
	Tree Swallow	*Tachycineta bicolor*	Yes	Yes	
	Violet-green	*Tachycineta*	Yes		

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Swallow	*thalassina*			
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Yes	Yes	
	Bank Swallow	*Riparia riparia*	Yes	Yes	
	Cliff Swallow	*Petrochelidon pyrrhonota*	Yes	Yes	
	Barn Swallow	*Hirundo rustica*	Yes	Yes	
	Black-capped Chickadee	*Poecile atricapillus*			
	Mountain Chickadee	*Poecile gambeli*			
	Chestnut-backed Chickadee	*Poecile rufescens*			
	Bushtit	*Psaltriparus minimus*			
	Red-breasted Nuthatch	*Sitta canadensis*			
	White-breasted Nuthatch	*Sitta carolinensis*			
	Pygmy Nuthatch	*Sitta pygmaea*		Yes	
	Brown Creeper	*Certhia americana*			
	Rock Wren	*Salpinctes obsoletus*			
	Canyon Wren	*Catherpes mexicanus*			
	Bewick's Wren	*Thryomanes bewickii*			
	House Wren	*Troglodytes aedon*			
	Winter Wren	*Troglodytes troglodytes*	Yes		
	Marsh Wren	*Cistothorus palustris*			Yes
	American Dipper	*Cinclus mexicanus*	Yes	Yes	
	Golden-crowned Kinglet	*Regulus satrapa*		Yes	
	Ruby-crowned Kinglet	*Regulus calendula*			
	Western Bluebird	*Sialia mexicana*			
	Mountain Bluebird	*Sialia currucoides*			
	Townsend's Solitaire	*Myadestes townsendi*			
	Veery	*Catharus fuscescens*		Yes	
	Swainson's Thrush	*Catharus ustulatus*			
	Hermit Thrush	*Catharus guttatus*			
	American Robin	*Turdus migratorius*	Yes		
	Varied Thrush	*Ixoreus naevius*	Yes		
	Gray Catbird	*Dumetella*		Yes	

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
		carolinensis			
	Northern Mockingbird	*Mimus polyglottos*			
	Sage Thrasher	*Oreoscoptes montanus*			
Non-native	European Starling	*Sturnus vulgaris*		Yes	
	American Pipit	*Anthus rubescens*			
	Bohemian Waxwing	*Bombycilla garrulus*			
	Cedar Waxwing	*Bombycilla cedrorum*		Yes	
	Orange-crowned Warbler	*Vermivora celata*			
	Nashville Warbler	*Vermivora ruficapilla*			
	Yellow Warbler	*Dendroica petechia*		Yes	
	Yellow-rumped Warbler	*Dendroica coronata*			
	Townsend's Warbler	*Dendroica townsendi*			
	American Redstart	*Setophaga ruticilla*		Yes	
	Northern Waterthrush	*Seiurus noveboracensis*		Yes	
	Macgillivray's Warbler	*Oporornis tolmiei*			
	Common Yellowthroat	*Geothlypis trichas*		Yes	Yes
	Wilson's Warbler	*Wilsonia pusilla*		Yes	
	Yellow-breasted Chat	*Icteria virens*		Yes	
	Western Tanager	*Piranga ludoviciana*			
	Green-tailed Towhee	*Pipilo chlorurus*			
	Spotted Towhee	*Pipilo maculatus*	Yes		
	American Tree Sparrow	*Spizella arborea*			
	Chipping Sparrow	*Spizella passerina*			
	Clay-colored Sparrow	*Spizella pallida*			
	Brewer's Sparrow	*Spizella breweri*			
	Vesper Sparrow	*Pooecetes gramineus*			
	Lark Sparrow	*Chondestes grammacus*			
	Sage Sparrow	*Amphispiza belli*			
	Savannah Sparrow	*Passerculus sandwichensis*			
	Grasshopper Sparrow	*Ammodramus savannarum*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Fox Sparrow	*Passerella iliaca*		Yes	
	Song Sparrow	*Melospiza melodia*	Yes		
	Lincoln's Sparrow	*Melospiza lincolnii*		Yes	Yes
	Swamp Sparrow	*Melospiza georgiana*			
	White-throated Sparrow	*Zonotrichia albicollis*			
	Harris's Sparrow	*Zonotrichia querula*			
	White-crowned Sparrow	*Zonotrichia leucophrys*			
	Golden-crowned Sparrow	*Zonotrichia atricapilla*			
	Dark-eyed Junco	*Junco hyemalis*			
	Lapland Longspur	*Calcarius lapponicus*			
	Snow Bunting	*Plectrophenax nivalis*			
	Black-headed Grosbeak	*Pheucticus melanocephalus*			
	Lazuli Bunting	*Passerina amoena*		Yes	
	Bobolink	*Dolichonyx oryzivorus*			
	Red-winged Blackbird	*Agelaius phoeniceus*			Yes
	Tricolored Blackbird	*Agelaius tricolor*			Yes
	Western Meadowlark	*Sturnella neglecta*			
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*			Yes
	Brewer's Blackbird	*Euphagus cyanocephalus*			
	Brown-headed Cowbird	*Molothrus ater*			
	Bullock's Oriole	*Icterus bullockii*		Yes	
	Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*			
	Black Rosy-finch	*Leucosticte atrata*			
	Pine Grosbeak	*Pinicola enucleator*			
	Purple Finch	*Carpodacus purpureus*		Yes	
	Cassin's Finch	*Carpodacus cassinii*			
	House Finch	*Carpodacus mexicanus*			
	Red Crossbill	*Loxia curvirostra*			
	White-winged Crossbill	*Loxia leucoptera*			
	Common Redpoll	*Carduelis flammea*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Pine Siskin	*Carduelis pinus*			
	Lesser Goldfinch	*Carduelis psaltria*		Yes	
	American Goldfinch	*Carduelis tristis*			
	Evening Grosbeak	*Coccothraustes vespertinus*			
Non-native	House Sparrow	*Passer domesticus*			
	Total Birds:	**280** **Total:**	**66**	**50**	**40**
Mammals					
Non-native	Virginia Opossum	*Didelphis virginiana*	Yes		
	Preble's Shrew	*Sorex preblei*			
	Vagrant Shrew	*Sorex vagrans*	Yes		
	Montane Shrew	*Sorex monticolus*	Yes		
	Water Shrew	*Sorex palustris*	Yes	Yes	
	Merriam's Shrew	*Sorex merriami*			
	Coast Mole	*Scapanus orarius*			
	California Myotis	*Myotis californicus*			
	Western Small-footed Myotis	*Myotis ciliolabrum*		Yes	
	Yuma Myotis	*Myotis yumanensis*		Yes	
	Little Brown Myotis	*Myotis lucifugus*			
	Long-legged Myotis	*Myotis volans*		Yes	
	Fringed Myotis	*Myotis thysanodes*			
	Long-eared Myotis	*Myotis evotis*			
	Silver-haired Bat	*Lasionycteris noctivagans*			
	Western Pipistrelle	*Pipistrellus hesperus*		Yes	
	Big Brown Bat	*Eptesicus fuscus*		Yes	
	Hoary Bat	*Lasiurus cinereus*			
	Townsend's Big-eared Bat	*Corynorhinus townsendii*			
	Pallid Bat	*Antrozous pallidus*		Yes	
	American Pika	*Ochotona princeps*			
Non-native	Eastern Cottontail	*Sylvilagus floridanus*			
	Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*			
	Snowshoe Hare	*Lepus americanus*		Yes	
	White-tailed Jackrabbit	*Lepus townsendii*			
	Black-tailed Jackrabbit	*Lepus californicus*			
	Least Chipmunk	*Tamias minimus*			
	Yellow-pine	*Tamias amoenus*			

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Chipmunk				
	Yellow-bellied Marmot	*Marmota flaviventris*			
	Merriam's Ground Squirrel	*Spermophilus canus*			
	Piute Ground Squirrel	*Spermophilus mollis*			
	Washington Ground Squirrel	*Spermophilus washingtoni*			
	Belding's Ground Squirrel	*Spermophilus beldingi*			
	Columbian Ground Squirrel	*Spermophilus columbianus*			
	Golden-mantled Ground Squirrel	*Spermophilus lateralis*			
Non-native	Eastern Fox Squirrel	*Sciurus niger*			
	Red Squirrel	*Tamiasciurus hudsonicus*			
	Northern Flying Squirrel	*Glaucomys sabrinus*	Yes		
	Northern Pocket Gopher	*Thomomys talpoides*			
	Great Basin Pocket Mouse	*Perognathus parvus*			
	Ord's Kangaroo Rat	*Dipodomys ordii*			
	American Beaver	*Castor canadensis*		Yes	Yes
	Western Harvest Mouse	*Reithrodontomys megalotis*		Yes	Yes
	Deer Mouse	*Peromyscus maniculatus*	Yes	Yes	Yes
	Northern Grasshopper Mouse	*Onychomys leucogaster*			
	Bushy-tailed Woodrat	*Neotoma cinerea*		Yes	
	Southern Red-backed Vole	*Clethrionomys gapperi*		Yes	
	Heather Vole	*Phenacomys intermedius*			
	Montane Vole	*Microtus montanus*			Yes
	Long-tailed Vole	*Microtus longicaudus*		Yes	Yes
	Water Vole	*Microtus richardsoni*		Yes	
	Sagebrush Vole	*Lemmiscus curtatus*			
	Muskrat	*Ondatra zibethicus*		Yes	Yes
Non-native	Norway Rat	*Rattus norvegicus*			

	Common Name	Scientific Name		Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
Non-native	House Mouse	*Mus musculus*				
	Western Jumping Mouse	*Zapus princeps*			Yes	
	Common Porcupine	*Erethizon dorsatum*				
	Coyote	*Canis latrans*		Yes		
	Red Fox	*Vulpes vulpes*		Yes		
	Black Bear	*Ursus americanus*		Yes		
	Grizzly Bear	*Ursus arctos*		Yes		
	Raccoon	*Procyon lotor*		Yes	Yes	
	American Marten	*Martes americana*		Yes		
	Ermine	*Mustela erminea*				
	Long-tailed Weasel	*Mustela frenata*		Yes		
	Mink	*Mustela vison*		Yes	Yes	
	American Badger	*Taxidea taxus*				
	Western Spotted Skunk	*Spilogale gracilis*				
	Striped Skunk	*Mephitis mephitis*		Yes		
	Northern River Otter	*Lutra canadensis*		Yes	Yes	Yes
	Mountain Lion	*Puma concolor*		Yes		
	Lynx	*Lynx canadensis*				
	Bobcat	*Lynx rufus*		Yes		
	Elk	*Cervus elaphus*				
	Mule Deer	*Odocoileus hemionus*				
	White-tailed Deer	*Odocoileus virginianus*				
	Pronghorn Antelope	*Antilocapra americana*				
	Mountain Goat	*Oreamnos americanus*				
	Bighorn Sheep	*Ovis canadensis*				
	Total Mammals:	**79**	**Total:**	**18**	**20**	**7**
Reptiles						
	Painted Turtle	*Chrysemys picta*				
	Long-nosed Leopard Lizard	*Gambelia wislizenii*				
	Short-horned Lizard	*Phrynosoma douglassii*				
	Sagebrush Lizard	*Sceloporus graciosus*				
	Western Fence Lizard	*Sceloporus occidentalis*				
	Side-blotched Lizard	*Uta stansburiana*				

	Common Name	Scientific Name		Salmonid Relationship	Closely Associated with Riparian	Closely Associated with Wetlands
	Western Skink	*Eumeces skiltonianus*				
	Rubber Boa	*Charina bottae*				
	Racer	*Coluber constrictor*				
	Ringneck Snake	*Diadophis punctatus*				
	Night Snake	*Hypsiglena torquata*				
	Striped Whipsnake	*Masticophis taeniatus*				
	Gopher Snake	*Pituophis catenifer*				
	Western Terrestrial Garter Snake	*Thamnophis elegans*		Yes		
	Common Garter Snake	*Thamnophis sirtalis*		Yes	Yes	Yes
	Western Rattlesnake	*Crotalus viridis*				
	Total Reptiles:	**16**	**Total:**	**2**	**1**	**1**
	Total Species:	**385**	**Total:**	**86**	**81**	**57**

Table B-2. Wildlife species occurrence by wildlife habitat type in the Walla Walla subbasin (NHI 2003).

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
American Badger	American Avocet	Tiger Salamander	American Badger	Great Blue Heron
American Beaver	American Badger	Long-toed Salamander	American Beaver	Tundra Swan
American Crow	American Crow	Great Basin Spadefoot	American Crow	American Wigeon
American Goldfinch	American Goldfinch	Western Toad	American Dipper	Blue-winged Teal
American Kestrel	American Kestrel	Woodhouse's Toad	American Goldfinch	Cinnamon Teal
American Marten	American Robin	Pacific Chorus (Tree) Frog	American Kestrel	Swainson's Hawk
American Robin	Bald Eagle	Columbia Spotted Frog	American Marten	Red-tailed Hawk
Ash-throated Flycatcher	Bank Swallow	Northern Leopard Frog	American Redstart	Gray Partridge
Bald Eagle	Barn Owl	Bullfrog	American Robin	Ring-necked Pheasant
Band-tailed Pigeon	Barn Swallow	Painted Turtle	American Tree Sparrow	Sandhill Crane
Bank Swallow	Barrow's Goldeneye	Short-horned Lizard	American Wigeon	Killdeer
Barn Swallow	Belding's Ground Squirrel	Sagebrush Lizard	Ash-throated Flycatcher	Solitary Sandpiper
Barred Owl	Bewick's Wren	Western Fence Lizard	Bald Eagle	Long-billed Curlew
Big Brown Bat	Big Brown Bat	Side-blotched Lizard	Bank Swallow	Long-billed Dowitcher
Black Bear	Black Bear	Western Skink	Barn Owl	Wilson's Snipe
Black Swift	Black-billed Magpie	Rubber Boa	Barn Swallow	Rock Dove
Black-backed Woodpecker	Black-chinned Hummingbird	Racer	Barred Owl	Mourning Dove
Black-billed Magpie	Black-necked Stilt	Night Snake	Belted Kingfisher	Barn Owl
Black-capped Chickadee	Black-tailed Jackrabbit	Gopher Snake	Big Brown Bat	Short-eared Owl
Black-chinned Hummingbird	Blue Grouse	Western Terrestrial Garter Snake	Black Bear	Loggerhead Shrike
Black-headed Grosbeak	Bobcat	Common Garter Snake	Black Swift	Northern Shrike
Blue Grouse	Brewer's Blackbird	Western Rattlesnake	Black-backed Woodpecker	Black-billed Magpie
Bobcat	Brewer's Sparrow	Turkey Vulture	Black-billed Magpie	American Crow
Brewer's Blackbird	Brown-headed Cowbird	Canada Goose	Black-capped Chickadee	Barn Swallow
Brewer's Sparrow	Burrowing Owl	Gadwall	Black-chinned	European Starling

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
			Hummingbird	
Brown Creeper	Bushy-tailed Woodrat	American Wigeon	Black-crowned Night-heron	American Pipit
Brown-headed Cowbird	California Myotis	Mallard	Black-headed Grosbeak	Vesper Sparrow
Bullfrog	Canada Goose	Blue-winged Teal	Blue Grouse	Savannah Sparrow
Bushtit	Canyon Wren	Cinnamon Teal	Bobcat	Grasshopper Sparrow
Bushy-tailed Woodrat	Chipping Sparrow	Northern Shoveler	Bobolink	Lazuli Bunting
California Myotis	Cliff Swallow	Northern Pintail	Bohemian Waxwing	Bobolink
California Quail	Columbia Spotted Frog	Green-winged Teal	Brewer's Blackbird	Western Meadowlark
Calliope Hummingbird	Columbian Ground Squirrel	Northern Harrier	Broad-tailed Hummingbird	Brewer's Blackbird
Canyon Wren	Common Garter Snake	Sharp-shinned Hawk	Brown Creeper	Brown-headed Cowbird
Cassin's Finch	Common Nighthawk	Cooper's Hawk	Brown-headed Cowbird	House Finch
Cassin's Vireo	Common Poorwill	Swainson's Hawk	Bufflehead	House Sparrow
Cedar Waxwing	Common Porcupine	Red-tailed Hawk	Bullock's Oriole	Virginia Opossum
Chipping Sparrow	Common Raven	Ferruginous Hawk	Bushtit	Big Brown Bat
Clark's Nutcracker	Cooper's Hawk	Rough-legged Hawk	Bushy-tailed Woodrat	Eastern Fox Squirrel
Cliff Swallow	Coyote	Golden Eagle	California Myotis	Northern Pocket Gopher
Coast Mole	Deer Mouse	American Kestrel	Calliope Hummingbird	Deer Mouse
Columbia Spotted Frog	Eastern Kingbird	Merlin	Canada Goose	Bushy-tailed Woodrat
Columbian Ground Squirrel	Ferruginous Hawk	Gyrfalcon	Canyon Wren	Montane Vole
Common Garter Snake	Fringed Myotis	Peregrine Falcon	Cassin's Finch	House Mouse
Common Nighthawk	Golden Eagle	Prairie Falcon	Cassin's Vireo	Raccoon
Common Poorwill	Golden-mantled Ground Squirrel	Chukar	Cattle Egret	White-tailed Deer (Eastside)
Common Porcupine	Gopher Snake	Gray Partridge	Cedar Waxwing	
Common Raven	Grasshopper Sparrow	Ring-necked Pheasant	Chipping Sparrow	
Cooper's Hawk	Gray Flycatcher	Sage Grouse	Cliff Swallow	
Coyote	Great Basin Pocket Mouse	Sharp-tailed Grouse	Coast Mole	
Dark-eyed Junco	Great Basin Spadefoot	Wild Turkey	Columbia Spotted Frog	
Deer Mouse	Great Horned Owl	Mountain Quail	Columbian	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
			Ground Squirrel	
Downy Woodpecker	Greater Yellowlegs	California Quail	Common Garter Snake	
Dusky Flycatcher	Green-tailed Towhee	Northern Bobwhite	Common Merganser	
Eastern Kingbird	Hoary Bat	Sandhill Crane	Common Nighthawk	
Ermine	Horned Lark	Killdeer	Common Porcupine	
European Starling	Killdeer	Black-necked Stilt	Common Raven	
Evening Grosbeak	Lark Sparrow	American Avocet	Common Redpoll	
Flammulated Owl	Least Chipmunk	Greater Yellowlegs	Common Yellowthroat	
Fox Sparrow	Lesser Yellowlegs	Lesser Yellowlegs	Cooper's Hawk	
Fringed Myotis	Little Brown Myotis	Solitary Sandpiper	Cordilleran Flycatcher	
Golden Eagle	Loggerhead Shrike	Spotted Sandpiper	Coyote	
Golden-crowned Kinglet	Long-billed Curlew	Upland Sandpiper	Dark-eyed Junco	
Golden-crowned Sparrow	Long-eared Myotis	Long-billed Curlew	Deer Mouse	
Golden-mantled Ground Squirrel	Long-eared Owl	Rock Dove	Double-crested Cormorant	
Gopher Snake	Long-legged Myotis	Mourning Dove	Downy Woodpecker	
Gray Flycatcher	Long-nosed Leopard Lizard	Barn Owl	Dusky Flycatcher	
Gray Jay	Long-tailed Vole	Great Horned Owl	Eastern Kingbird	
Great Basin Spadefoot	Long-tailed Weasel	Snowy Owl	Ermine	
Great Gray Owl	Long-toed Salamander	Burrowing Owl	Evening Grosbeak	
Great Horned Owl	Mallard	Long-eared Owl	Flammulated Owl	
Green-tailed Towhee	Merlin	Short-eared Owl	Fox Sparrow	
Grizzly Bear	Merriam's Ground Squirrel	Common Nighthawk	Fringed Myotis	
Hairy Woodpecker	Merriam's Shrew	Common Poorwill	Golden Eagle	
Hammond's Flycatcher	Mink	White-throated Swift	Golden-crowned Kinglet	
Hermit Thrush	Montane Vole	Lewis's Woodpecker	Golden-mantled Ground Squirrel	
Hoary Bat	Mountain Bluebird	Say's Phoebe	Gopher Snake	
House Finch	Mountain Quail	Western Kingbird	Gray Catbird	
House Wren	Mourning Dove	Eastern Kingbird	Gray Jay	
Killdeer	Mule Deer	Loggerhead Shrike	Great Basin Spadefoot	
Lark Sparrow	Nashville Warbler	Northern Shrike	Great Blue Heron	
Lazuli Bunting	Night Snake	Black-billed	Great Egret	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
		Magpie		
Least Chipmunk	Northern Flicker	American Crow	Great Horned Owl	
Least Flycatcher	Northern Goshawk	Common Raven	Greater Yellowlegs	
Lesser Goldfinch	Northern Grasshopper Mouse	Horned Lark	Green-tailed Towhee	
Lewis's Woodpecker	Northern Harrier	Northern Rough-winged Swallow	Green-winged Teal	
Little Brown Myotis	Northern Leopard Frog	Bank Swallow	Grizzly Bear	
Long-eared Myotis	Northern Pocket Gopher	Cliff Swallow	Hairy Woodpecker	
Long-eared Owl	Northern Rough-winged Swallow	Barn Swallow	Harlequin Duck	
Long-legged Myotis	Northern Shrike	Rock Wren	Heather Vole	
Long-tailed Vole	Nuttall's (Mountain) Cottontail	Canyon Wren	Hermit Thrush	
Long-tailed Weasel	Orange-crowned Warbler	Western Bluebird	Hoary Bat	
Long-toed Salamander	Ord's Kangaroo Rat	Mountain Bluebird	Hooded Merganser	
Macgillivray's Warbler	Osprey	Townsend's Solitaire	House Finch	
Merlin	Pacific Chorus (Tree) Frog	American Robin	House Wren	
Mink	Painted Turtle	Sage Thrasher	Killdeer	
Montane Vole	Pallid Bat	European Starling	Lazuli Bunting	
Mountain Bluebird	Peregrine Falcon	American Pipit	Least Chipmunk	
Mountain Chickadee	Piute Ground Squirrel	Green-tailed Towhee	Least Flycatcher	
Mountain Lion	Prairie Falcon	Chipping Sparrow	Lesser Goldfinch	
Mountain Quail	Preble's Shrew	Clay-colored Sparrow	Lesser Yellowlegs	
Mourning Dove	Pronghorn Antelope	Brewer's Sparrow	Lewis's Woodpecker	
Mule Deer	Racer	Vesper Sparrow	Lincoln's Sparrow	
Nashville Warbler	Red-tailed Hawk	Lark Sparrow	Little Brown Myotis	
Night Snake	Ringneck Snake	Sage Sparrow	Long-eared Myotis	
Northern Flicker	Rock Wren	Savannah Sparrow	Long-eared Owl	
Northern Flying Squirrel	Rocky Mountain Elk	Grasshopper Sparrow	Long-legged Myotis	
Northern Goshawk	Rough-legged Hawk	White-crowned Sparrow	Long-tailed Vole	
Northern Pocket Gopher	Rubber Boa	Lapland Longspur	Long-tailed Weasel	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
Northern Pygmy-owl	Sage Grouse	Snow Bunting	Long-toed Salamander	
Northern Rough-winged Swallow	Sage Sparrow	Bobolink	Macgillivray's Warbler	
Northern Saw-whet Owl	Sage Thrasher	Western Meadowlark	Mallard	
Olive-sided Flycatcher	Sagebrush Lizard	Brewer's Blackbird	Merlin	
Orange-crowned Warbler	Sagebrush Vole	Brown-headed Cowbird	Mink	
Osprey	Savannah Sparrow	American Goldfinch	Montane Shrew	
Pacific Chorus (Tree) Frog	Say's Phoebe	Preble's Shrew	Montane Vole	
Painted Turtle	Sharp-shinned Hawk	Vagrant Shrew	Mountain Bluebird	
Pallid Bat	Sharp-tailed Grouse	Merriam's Shrew	Mountain Chickadee	
Peregrine Falcon	Short-eared Owl	Coast Mole	Mountain Lion	
Pileated Woodpecker	Short-horned Lizard	California Myotis	Mountain Quail	
Pine Siskin	Side-blotched Lizard	Western Small-footed Myotis	Mourning Dove	
Pinyon Jay	Snow Bunting	Yuma Myotis	Mule Deer	
Prairie Falcon	Solitary Sandpiper	Little Brown Myotis	Muskrat	
Pronghorn Antelope	Spotted Sandpiper	Long-legged Myotis	Nashville Warbler	
Purple Finch	Striped Whipsnake	Fringed Myotis	Northern Flicker	
Pygmy Nuthatch	Swainson's Hawk	Long-eared Myotis	Northern Flying Squirrel	
Racer	Tiger Salamander	Silver-haired Bat	Northern Goshawk	
Red Crossbill	Townsend's Big-eared Bat	Western Pipistrelle	Northern Harrier	
Red Fox	Townsend's Solitaire	Big Brown Bat	Northern Leopard Frog	
Red Squirrel	Turkey Vulture	Hoary Bat	Northern Pocket Gopher	
Red-breasted Nuthatch	Vagrant Shrew	Townsend's Big-eared Bat	Northern Pygmy-owl	
Red-breasted Sapsucker	Vesper Sparrow	Pallid Bat	Northern River Otter	
Red-naped Sapsucker	Washington Ground Squirrel	Nuttall's (Mountain) Cottontail	Northern Rough-winged Swallow	
Red-tailed Hawk	Western Fence Lizard	White-tailed Jackrabbit	Northern Saw-whet Owl	
Ringneck Snake	Western Harvest Mouse	Black-tailed Jackrabbit	Northern Waterthrush	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
Ring-necked Pheasant	Western Kingbird	Yellow-bellied Marmot	Olive-sided Flycatcher	
Rock Wren	Western Meadowlark	Washington Ground Squirrel	Orange-crowned Warbler	
Rocky Mountain Elk	Western Pipistrelle	Belding's Ground Squirrel	Osprey	
Rough-legged Hawk	Western Rattlesnake	Columbian Ground Squirrel	Pacific Chorus (Tree) Frog	
Rubber Boa	Western Skink	Golden-mantled Ground Squirrel	Painted Turtle	
Ruby-crowned Kinglet	Western Small-footed Myotis	Northern Pocket Gopher	Pallid Bat	
Ruffed Grouse	Western Terrestrial Garter Snake	Great Basin Pocket Mouse	Peregrine Falcon	
Rufous Hummingbird	Western Toad	Ord's Kangaroo Rat	Pied-billed Grebe	
Sagebrush Lizard	White-crowned Sparrow	Western Harvest Mouse	Pileated Woodpecker	
Say's Phoebe	White-tailed Deer (Eastside)	Deer Mouse	Pine Siskin	
Sharp-shinned Hawk	White-tailed Jackrabbit	Northern Grasshopper Mouse	Prairie Falcon	
Short-horned Lizard	White-throated Swift	Montane Vole	Preble's Shrew	
Silver-haired Bat	Willet	Long-tailed Vole	Pronghorn Antelope	
Snowshoe Hare	Woodhouse's Toad	Sagebrush Vole	Pygmy Nuthatch	
Song Sparrow	Yellow-bellied Marmot	Western Jumping Mouse	Raccoon	
Spotted Towhee	Yuma Myotis	Coyote	Racer	
Steller's Jay		Black Bear	Red Crossbill	
Striped Skunk		Grizzly Bear	Red Fox	
Striped Whipsnake		Ermine	Red-breasted Nuthatch	
Tailed Frog		Long-tailed Weasel	Red-eyed Vireo	
Three-toed Woodpecker		Mink	Red-naped Sapsucker	
Tiger Salamander		American Badger	Red-tailed Hawk	
Townsend's Big-eared Bat		Bobcat	Red-winged Blackbird	
Townsend's Solitaire		Rocky Mountain Elk	Ring-necked Duck	
Townsend's Warbler		Mule Deer	Rocky Mountain Elk	
Tree Swallow		White-tailed Deer (Eastside)	Rough-legged Hawk	
Turkey Vulture		Pronghorn	Rubber Boa	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
		Antelope		
Vagrant Shrew		Rocky Mountain Bighorn Sheep	Ruby-crowned Kinglet	
Varied Thrush			Ruffed Grouse	
Vaux's Swift			Rufous Hummingbird	
Violet-green Swallow			Sandhill Crane	
Warbling Vireo			Savannah Sparrow	
Western Bluebird			Say's Phoebe	
Western Fence Lizard			Sharp-tailed Grouse	
Western Jumping Mouse			Silver-haired Bat	
Western Kingbird			Snowshoe Hare	
Western Pipistrelle			Solitary Sandpiper	
Western Rattlesnake			Song Sparrow	
Western Screech-owl			Southern Red-backed Vole	
Western Scrub-Jay			Spotted Sandpiper	
Western Skink			Spotted Towhee	
Western Small-footed Myotis			Steller's Jay	
Western Tanager			Striped Skunk	
Western Terrestrial Garter Snake			Swainson's Hawk	
Western Toad			Swainson's Thrush	
Western Wood-pewee			Tailed Frog	
White-breasted Nuthatch			Three-toed Woodpecker	
White-crowned Sparrow			Tiger Salamander	
White-headed Woodpecker			Townsend's Big-eared Bat	
White-tailed Deer (Eastside)			Townsend's Solitaire	
White-throated Swift			Townsend's Warbler	
Wild Turkey			Tree Swallow	
Williamson's Sapsucker			Turkey Vulture	
Willow Flycatcher			Vagrant Shrew	
Wilson's Warbler			Vaux's Swift	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
Yellow-bellied Marmot			Veery	
Yellow-pine Chipmunk			Violet-green Swallow	
Yellow-rumped Warbler			Warbling Vireo	
Yuma Myotis			Water Shrew	
			Water Vole	
			Western Bluebird	
			Western Harvest Mouse	
			Western Jumping Mouse	
			Western Pipistrelle	
			Western Rattlesnake	
			Western Screech-owl	
			Western Small-footed Myotis	
			Western Spotted Skunk	
			Western Tanager	
			Western Terrestrial Garter Snake	
			Western Toad	
			Western Wood-pewee	
			White-breasted Nuthatch	
			White-crowned Sparrow	
			White-headed Woodpecker	
			White-tailed Deer (Eastside)	
			White-tailed Jackrabbit	
			White-throated Swift	
			Williamson's Sapsucker	
			Willow Flycatcher	
			Wilson's Warbler	
			Winter Wren	
			Wood Duck	
			Woodhouse's Toad	

Ponderosa Pine	Shrubsteppe	Eastside (Interior) Grassland	Eastside (Interior) Riparian Wetland	Agriculture
			Yellow Warbler	
			Yellow-bellied Marmot	
			Yellow-billed Cuckoo	
			Yellow-breasted Chat	
			Yellow-pine Chipmunk	
			Yellow-rumped Warbler	
			Yuma Myotis	

Table B-3 Threatened and endangered species of the Walla Walla subbasin (NHI 2003).

Federal Species List	Status	
Common Name	**Oregon**	**Washington**
Oregon Spotted Frog	FC*	FC*
Columbia Spotted Frog	FC*	
Bald Eagle	FT	FT
Sage Grouse		FC*
Yellow-billed Cuckoo	FC*	FC*
Horned Lark	FC	FC
Washington Ground Squirrel	FC*	FC*
Gray Wolf		FE
Lynx	FT	FT
States Species List	**Status**	
Common Name	**Oregon**	**Washington**
Tiger Salamander	SS-US	
Tailed Frog	SS-V	
Western Toad	SS-V	SC
Woodhouse's Toad	SS-PN	
Oregon Spotted Frog	SS-C	SE
Columbia Spotted Frog	SS-US	SC
Northern Leopard Frog	SS-C	SE
Painted Turtle	SS-C	
Sagebrush Lizard	SS-V	
Striped Whipsnake		SC
Western Rattlesnake	SS-V	
Common Loon		SS
Horned Grebe	SS-PN	
Red-necked Grebe	SS-C	
Western Grebe		SC
American White Pelican	SS-V	SE
Harlequin Duck	SS-US	
Bufflehead	SS-US	
Barrow's Goldeneye	SS-US	
Bald Eagle	ST	ST
Northern Goshawk	SS-C	SC
Swainson's Hawk	SS-V	
Ferruginous Hawk	SS-C	ST
Golden Eagle		SC
Merlin		SC
Peregrine Falcon	SE	SS
Sage Grouse	SS-V	ST
Spruce Grouse	SS-US	
Sharp-tailed Grouse		ST
Mountain Quail	SS-US	
Sandhill Crane	SS-V	SE
Upland Sandpiper	SS-C	SE
Long-billed Curlew	SS-V	
Yellow-billed Cuckoo	SS-C	SC

Flammulated Owl	SS-C	SC
Northern Pygmy-owl	SS-C	
Burrowing Owl	SS-C	SC
Great Gray Owl	SS-V	
Boreal Owl	SS-US	
Common Nighthawk	SS-C	
Black Swift	SS-PN	
Vaux's Swift		SC
Lewis's Woodpecker	SS-C	SC
Williamson's Sapsucker	SS-US	
White-headed Woodpecker	SS-C	SC
Three-toed Woodpecker	SS-C	
Black-backed Woodpecker	SS-C	SC
Pileated Woodpecker	SS-V	SC
Olive-sided Flycatcher	SS-V	
Willow Flycatcher	SS-V/US	
Loggerhead Shrike	SS-V	SC
Horned Lark	SS-C	SC
Bank Swallow	SS-US	
White-breasted Nuthatch		SC
Pygmy Nuthatch	SS-V	
Western Bluebird	SS-V	
Sage Thrasher		SC
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	
Black Rosy-finch	SS-PN	
Merriam's Shrew		SC
Western Small-footed Myotis	SS-US	
Long-legged Myotis	SS-US	
Fringed Myotis	SS-V	
Long-eared Myotis	SS-US	
Silver-haired Bat	SS-US	
Townsend's Big-eared Bat	SS-C	SC
Pallid Bat	SS-V	
White-tailed Jackrabbit	SS-US	SC
Black-tailed Jackrabbit		SC
Washington Ground Squirrel	SE	SC
Northern Pocket Gopher		SC
Gray Wolf	SE	SE
American Marten	SS-V	
Fisher	SS-C	SE
Wolverine	ST	SC
Lynx		ST

Federal Status: FC = Federal Candidate; FT = Federal Threatened; FE = Federal Endangered State Status: SC = Species of Concern; SE = State Endangered; SS = Sensitive Species; ST = State Threatened

Table B-4. Partners in Flight priority and focal species of the Walla Walla subbasin (NHI 2003).

Common Name		
Northern Harrier	Western Wood-pewee	American Pipit
Swainson's Hawk	Willow Flycatcher	Orange-crowned Warbler
Ferruginous Hawk	Hammond's Flycatcher	Nashville Warbler
American Kestrel	Gray Flycatcher	Yellow Warbler
Sharp-tailed Grouse	Dusky Flycatcher	Yellow-rumped Warbler
Band-tailed Pigeon	Pacific-slope Flycatcher	Townsend's Warbler
Yellow-billed Cuckoo	Ash-throated Flycatcher	Macgillivray's Warbler
Flammulated Owl	Loggerhead Shrike	Wilson's Warbler
Burrowing Owl	Hutton's Vireo	Yellow-breasted Chat
Great Gray Owl	Warbling Vireo	Western Tanager
Short-eared Owl	Red-eyed Vireo	Green-tailed Towhee
Common Poorwill	Clark's Nutcracker	Chipping Sparrow
Black Swift	Horned Lark	Brewer's Sparrow
Vaux's Swift	Bank Swallow	Vesper Sparrow
White-throated Swift	Bushtit	Lark Sparrow
Calliope Hummingbird	White-breasted Nuthatch	Black-throated Sparrow
Rufous Hummingbird	Brown Creeper	Sage Sparrow
Lewis's Woodpecker	House Wren	Grasshopper Sparrow
Williamson's Sapsucker	Winter Wren	Fox Sparrow
Red-naped Sapsucker	American Dipper	Lincoln's Sparrow
Red-breasted Sapsucker	Western Bluebird	Black-headed Grosbeak
Downy Woodpecker	Townsend's Solitaire	Western Meadowlark
White-headed Woodpecker	Veery	Bullock's Oriole
Black-backed Woodpecker	Swainson's Thrush	Purple Finch
Pileated Woodpecker	Hermit Thrush	Red Crossbill
Olive-sided Flycatcher	Varied Thrush	Lesser Goldfinch

B-5

Rocky Mountain Bighorn Sheep

Species Account

Walla Walla Sub-basin

1.0 Introduction:

At one time, bighorn sheep roamed much of the western portion of north America. They existed in several subspecies and occupied from the Canadian Rockies of Alberta south to the mountain ranges of Mexico including portions of Oregon and Washington. In the mid-1800's they were quite numerous with an estimated population between 1.5 and 2 million (Seton 1953, Buechner 1960). As a result of the expansion of civilization without management protection, by 1900 they had been reduced to thousands and were extirpated from much of their former range (Oregon Department of Fish and Wildlife, 2003)

Rocky Mountain bighorn sheep were extirpated from Oregon in the mid-1940's. As a result of transplant efforts, populations have been re-established. Currently they only occupy a small portion of their historic range in Northeast Oregon.

2.0 Life History, Habitat Requirements, Key Environmental Correlates:

2.1 Life History:

Rocky Mountain bighorns are the most abundant and largest bodied bighorn in North America. Rocky Mountain bighorns have large bodies, thick coats and comparatively small ears. Mature Rocky Mountain rams also have heavy robust horns with obvious brooming, bases 13–16 inches in circumference, and 36–40 inches in length. Exceptionally large ram horns will exceed 45 inches in length with basal circumference larger than 17 inches and be more than full curl. Ewe horns are typically 8–10 inches long. Ages are determined by counting growth rings on the horns. (Oregon Department of Fish and Wildlife, 2003).

Bighorn sheep are relatively long lived animals. Those surviving their first year commonly live 10–12 years. Ewes tend to live longer than rams even in the absence of ram hunting. In Oregon, The oldest known ram age is 15 ½ years old while the oldest known ewe age is 19 ½ years old. (Oregon Department of Fish and Wildlife, 2003).

Rocky mountain bighorn sheep are gregarious. However, adult rams typically do not co-mingle with ewe-lamb groups except during the rut. Adult rams tend to congregate together into "bachelor groups" and occupy separate areas for much of the year. Immature rams often associate with either ram or ewe-lamb groups (Oregon Department of Fish and Wildlife, 2003).

2.1.1 Reproduction:

Rocky Mountain bighorns breed in the late fall with lambs born in May. There is little interaction between males and females until breeding season or rut occurs. Like most ungulates, Rocky Mountain bighorn sheep are polygamous and only a few dominant males participate in the rut. Adult rams establish dominance over each other by conducting head butting rituals. The peak of the rut occurs in November in Oregon, but can begin as early as late October and end as late as early December (Oregon Department of Fish and Wildlife, 2003).

Gestation is approximately 180 days and a single lamb is usually born. The lambing season spans April–May. Shortly before lambing, ewes become solitary and seek a secluded place in rugged terrain. After about one week, the ewe and lamb join other ewes and newborn lambs to re-form the ewe-lamb-sub-adult groups they will associate with for most of the year **(Oregon Department of Fish and Wildlife, 2003).**

Ewes usually become reproductively active at two years old. However, in Oregon's highest quality habitats, there is evidence that some yearling ewes may breed. They remain reproductively active throughout their life span but are in their prime from ages 3–10 (Oregon Department of Fish and Wildlife, 2003).

2.1.2 Home Range:

Their range extends from British Columbia and Alberta south to New Mexico and Arizona. Rocky Mountain bighorns are generally found in sub-alpine to alpine habitats.

Of all the subspecies of bighorn sheep endemic to the western portion of North America, only two were native to Oregon, Rocky Mountain, and California (Bailey 1936, Figure 2). The Rocky Mountain bighorns inhabited northeast Oregon from the John Day-Burnt River divide north to the Snake River and the Oregon-Washington state line in Umatilla and Wallowa Counties (Oregon Department of Fish and Wildlife, 2003).

California bighorns historically were and still are the most abundant in Oregon (Toweill and Geist 1999). Subspecies ranges are separated by the Blue and Umatilla mountains. The Walla Walla sub-basin is in the Umatilla portion of bighorn sheep range (Oregon Department of Fish and Wildlife 1992, 2003). As a result, Rocky Mountain bighorn sheep are the only subspecies known to historically exist in the Walla Walla sub-basin in Oregon.

2.1.3 Diet:

Grasses are the major item in bighorn diets throughout most of the year. However, forbs and shrubs are seasonally important depending on type and availability. Bighorn sheep generally are not competitors for forage with domestic cattle and other big game species because they typically occupy rugged habitats not used by other big game species. Domestic sheep can compete with bighorn sheep for forage because open range operations frequently include trailing through remote, rugged habitat (Oregon Department of Fish and Wildlife, 2003).

2.1.4 Movements:

Rocky Mountain bighorn sheep adapt to area specific conditions when forming migration patterns. Some populations such as the Lostine herd migrate from high elevation alpine meadows near 8,000 feet of elevation where they spend the summer months down to steep grassland slopes between 4,500 and 7,500 feet in elevation. Other populations living year-round in canyon habitats often move in response to changing forage conditions, but do not migrate between classic summer and winter ranges. Sheep occupying canyon habitats migrate less often between summer and winter ranges than sheep occupying alpine habitats (Oregon Department of Fish and Wildlife, 2003).

2.1.5 Mortality:

Bighorn sheep can be moderately long lived. The oldest recorded bighorn ram in Oregon was 15 ½ years old and the oldest ewe was 19 ½. Like most wild ungulates, Rocky Mountain bighorn sheep suffer a higher mortality rate amongst lambs than adults under normal conditions. Lambs can suffer loss from predation, disease, malnutrition, and accidents.

Once recruited to the adult age classes, bighorn sheep typically have low mortality rates until they reach old age. However, occasional disease outbreaks from mingling with domestic sheep can cause catastrophic die-offs resulting in large numbers of adult mortality in addition to juvenile losses. Mountain lion predation has been shown to be the second highest source of adult mortality in one population in Hells Canyon on the Oregon side of the Snake River (Oregon Department of Fish and Wildlife, 2003).

2.1.6 Harvest:

Hunting currently and historically results in the greatest intended human caused form of mortality for Rocky Mountain bighorn sheep. Early harvest in the late 19th century didn't conform to any management constraints and harvest was often detrimental to a population. Since sheep were re-introduced to Oregon, harvest has been strictly targeted on rams. Limited hunting of ewes remains a possible tool to limit population growth in areas where a bighorn population has grown to the limits of its available habitat. However, to date, the Oregon Department of Fish and Wildlife has used trapping and transplanting as the primary tool to limit populations to available habitat constraints (Oregon Department of Fish and Wildlife, 2003).

The first Rocky Mountain bighorn hunt was authorized in 1978 on Hurricane Divide. Since that time, 181 rams have been harvested from 7 areas (Table 1).

Table 1. Rocky Mountain bighorn sheep ram harvest in Oregon, 1978-2002.

Hunt	Unit	Rams Harvested	Years Hunted	Boone & Crockett Score Range	Boone & Crockett Score Average
Hurricane Divide	Snake River, Minam, Imnaha, Pine	66	20	111 5/8 – 203 5/8	163 0/8
Lower Imnaha	Snake River	78	18	122 6/8 – 184 6/8	162 7/8
Sheep Mtn.	Pine	8	7	157 1/8 – 183 7/8	170 1/8
Lookout Mtn.	Lookout	2	2	162 5/8 – 181 4/8	172 1/8
Bear Creek	Minam	5	4	120 0/8 – 164 5/8	142 3/8
Chesnimnus-Sled Springs[a]	Chesnimnus, Sled Springs	10	8	159 2/8 – 200 6/8	182 3/8
Wenaha	Wenaha	12	6	124 2/8 – 184 0/8	157 4/8
		181		111 5/8 – 203 5/8	164 3/8

[a] Eight auction or lottery tags and four draw tagholders hunted area. (Oregon Bighorn Sheep and Rocky Mountain Goat Plan, 2003)

2.2 Habitat Requirements:

2.2.1 Characteristics:

Bighorn sheep habitat typically is comprised of rugged habitat that is used by the sheep for security from predation. This habitat can be in the form of Canyons characterized by rim rocks with grass interspersed in the steep slopes between the rocky outcrops, alpine habitat which can be high elevation lush meadows or rocky security cover, or steep grass covered slopes as winter habitat (Oregon Department of Fish and Wildlife, 2003).

Rocky Mountain bighorn sheep occupying alpine habitat generally use it for summer range and migrate to lower elevation grassy slopes or canyon habitat to winter. Bighorns living in canyon habitat most often occupy that same habitat year-round. In many cases, canyon habitat grasses dry out during August and September. As a result, sheep in these areas may become stressed for nutrition during autumns with little rainfall (Oregon Department of Fish and Wildlife, 2003).

2.2.2 Threats:

Rocky Mountain bighorn sheep habitat has come under threat from noxious weeds in recent years. Across their range in Oregon bighorn habitat has suffered encroachment from yellow star-thistle, knapweed, leafy spurge, and other plants which reduce forage quality and vigor. In the Walla Walla subbasin, yellow star-thistle, knapweed, and common crupina are all noxious weed threats to the Rocky Mountain bighorn sheep range between the forks of the Walla Walla River in Oregon.

In addition, historical overgrazing of Rocky Mountain bighorn sheep habitat has reduced range quality and increased competition for resources. Poor water distribution and mineral deficiencies have also contributed to a lack of habitat quality (Oregon Department of Fish and Wildlife, 2003).

2.2.3 Enhancement:

In Oregon, habitat enhancement activities in Rocky Mountain bighorn sheep habitat have included 17 spring developments, 2 controlled burns treating 650 acres, and 2 seedings treating 85 acres (Oregon Department of Fish and Wildlife, 2003).

3.0 Population Distribution:

3.1 Population:

3.1.1 Historic:

In the mid-1800's when European settlers began to inhabit the western portion of North America, there were thought to be 1.5 to 2 million bighorn sheep of which, a portion were the Rocky Mountain subspecies (Seton 1953, Buechner 1960). Disease conflicts with domestic sheep and unmanaged harvest reduced the numbers to thousands by 1900 (Oregon Department of Fish and Wildlife, 2003).

3.1.2 Current:

In 1992 the population was estimated to be 460 animals (Table 2, Figure 2). In 2003 the Rocky Mountain bighorn population was estimated at 637 animals in 12 herds. Although the population has increased, several pasteurellosis related die-offs have reduced rates of population increase (Oregon Department of Fish and Wildlife, 2003).

3.2 Captive Breeding Programs, Transplants, Introductions:

Rocky Mountain bighorn sheep were extripated from Oregon in the mid-1940's. They were re-established exclusively with the use of transplant programs. Table 2 shows the transplants which have occurred to date (Oregon Department of Fish and Wildlife, 2003).

Table 2. Date, source, and origin of stock used for Rocky Mountain bighorn sheep transplant into Oregon, 1939–2002.

Date	Source	Origin	Release Site	County	#
1939	Montana	Not Known	Hart Mountain	Lake	23
4/71	Alberta, Canada	Jasper Park	Upr Hells Canyon	Wallowa	20
11/71	Alberta, Canada	Jasper Park	Lostine River	Wallowa	20
1/76	Lostine River	Jasper Park	Bear Creek	Wallowa	17
1/77	Lostine River	Jasper Park	Bear Creek	Wallowa	8
1/78	Lostine River	Jasper Park	Battle Creek	Wallowa	5
1/79	Lostine River	Jasper Park	Battle Creek	Wallowa	29
1/79	Salmon R., ID	Panther Cr.	Lwr. Imnaha	Wallowa	15
1/81	Lostine River	Jasper Park	Hass Ridge	Wallowa	10
1/83	Lostine River	Jasper Park	Wenaha Canyon	Wallowa	15
1/84	Sullivan L., WA	Waterton/T. Falls	Bear Creek	Wallowa	11
1/84	Salmon R., ID	Panther Creek	Hass Ridge	Wallowa	11
12/84	Salmon R., ID	Cove Creek	Wenaha WA	Wallowa	28
12/85	Salmon R., ID	Ebenezer	Minam River	Wallowa	12
1/90	Tarryall CO	Tarryall, CO	Sheep Mtn.	Baker	21
2/90	Cottonwood Cr., CO	Cottonwood Cr.	Sheep Mtn.	Baker	9
12/93	Wildhorse Is., MT	Sun River MT	Cherry Creek	Wallowa	9
12/93	Wildhorse Is., MT	Sun River MT	Fox Creek	Baker	12
2/94	Wildhorse Is., MT	Sun River MT	Downey Creek	Wallowa	14
2/94	Wildhorse Is., MT	Sun River MT	Fox Creek	Baker	12
2/95	Alberta, Canada	Cadomin	Joseph-Cottonwood Cr.	Wallowa	16
2/95	Alberta, Canada	Cadomin	Jim Cr.	Wallowa	22
2/95	Alberta, Canada	Cadomin	Sheep Mtn.	Baker	10
2/95	Lostine, Oregon	Waterton/Jasper	Sheep Mtn.	Baker	2
12/97	Spences Bridge, B.C.	Baniff N.P.	Muir Creek	Wallowa	13
1/98	Lostine, Oregon	Waterton/Jasper	McGraw	Wallowa	15
2/99	Alberta, Canada	Cadomin	Muir Creek	Wallowa	14
2/00	Alberta, Canada	Cadomin	Minam River	Wallowa	17
2/00	Alberta, Canada	Cadomin	Big Sheep Creek	Wallowa	19
12/01	Lostine, Oregon	Waterton/Baniff	Quartz Creek	Wallowa	15
	Total		Total		444

Originally, the impact of disease originating from domestic sheep was poorly understood and some of the early transplants were not successful. Once the relationship between disease and interaction of bighorn sheep with domestic sheep was understood, transplants were introduced in areas without domestic sheep nearby and success improved.

Currently there are 15 proposed transplant sites for Rocky Mountain bighorn sheep in Oregon (Table 3). One site in the Walla Walla Subbasin, the south fork of the Walla Walla River, is listed as a third priority site due to concerns over interaction with domestic sheep (Oregon Department of Fish and Wildlife, 2003, 1992). If domestic sheep were no longer a concern, the site would undoubtedly rise to a first priority site.

Table 3. Proposed transplant sites for Rocky Mountain bighorn sheep in Oregon. All Wallowa-Whitman National Forest sites are cleared.

Transplant Priority	Site Name	District	County	New or Supplement	Comments
1	Sluice/Rush Creek	Wallowa	Wallowa	New	
1	Sand/Yreka Creek	Wallowa	Wallowa	New	
1	Hat Point Plateau	Wallowa	Wallowa	Supplement	Summer Range Release
1	Minam	Wallowa	Wallowa	New	Predation, Non-Migratory
1	Deep Creek/Teaser Ridge	Wallowa	Wallowa	New	Domestic Goats, Private Land
1	Lone Pine	Wallowa	Wallowa	Supplement	
1	Quartz Cr/Two Corral	Wallowa	Wallowa	Supplement	
2	Big Sheep Creek	Wallowa	Wallowa	New	Domestic Sheep
3	Mid-Joseph Creek	Wallowa	Wallowa	Supplement	Domestic Sheep
3	Sheep Creek (G. Rhonde)	Union	Union	New	Domestic Sheep
3	Deadhorse Ridge	Wallowa	Wallowa	New	Domestic Sheep
3	Spring Creek	Wallowa	Wallowa	New	Domestic Sheep
3	S. Fork Walla Walla	Umatilla	Umatilla	New	Domestic Sheep
3	Mud Creek	Wallowa	Wallowa	New	Domestic Sheep
3	Jim Creek	Wallowa	Wallowa	New	Domestic Sheep, Disease

3.2 Distribution – Historic and Current:

Rocky Mountain bighorn sheep were once widely distributed in the mountains of northeast Oregon north of the John Day/Burnt River divide. Now they only occupy a small percentage of their former habitat (Figure 1) (Oregon Department of Fish and Wildlife 2003).

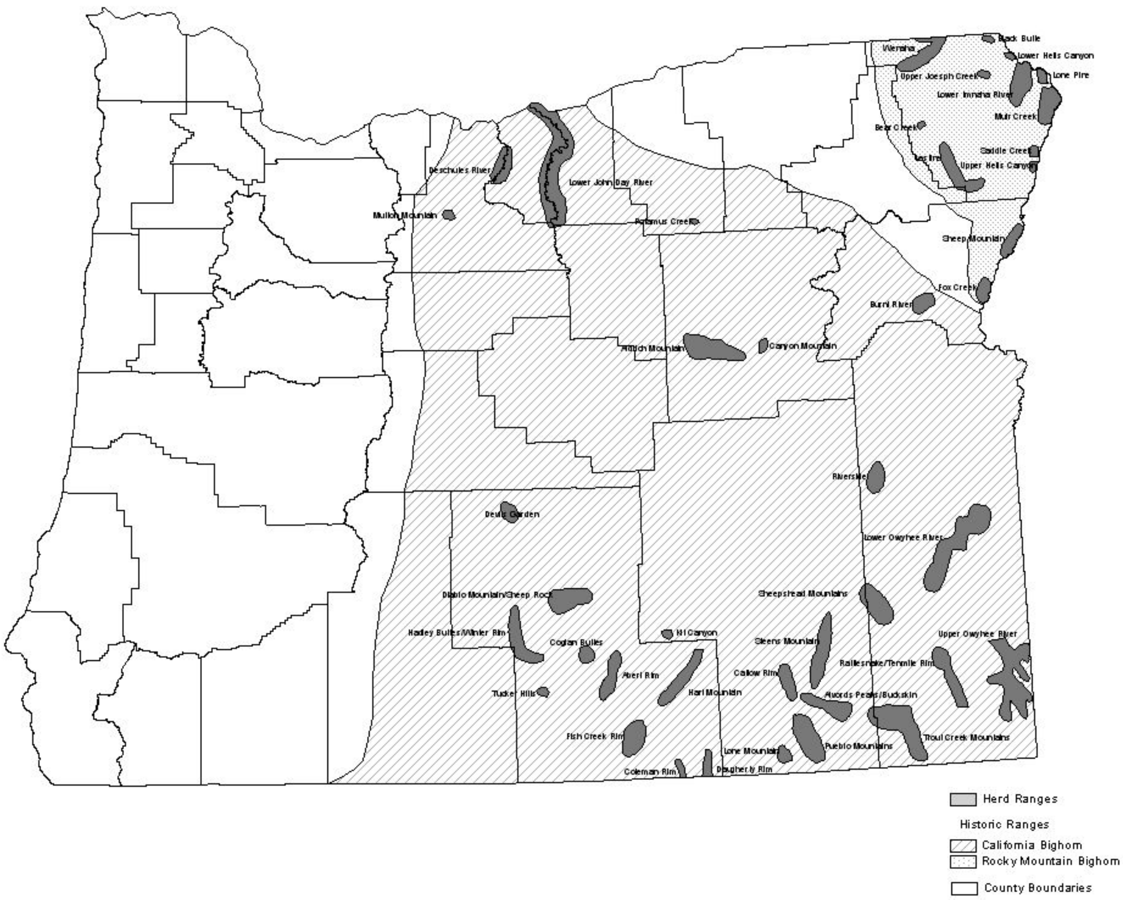

Figure 1. Historic and current distribution of Rocky Mountain and California bighorn sheep in Oregon (Adapted from Williams and Schommer 2001)(Oregon Department of Fish and Wildlife, 2003).

The current distribution of Rocky Mountain bighorn sheep is the result of transplants, which targeted areas with suitable habitat that lacked conflicts with domestic sheep. The last population estimate in 2003 was 637 Rocky Mountain bighorns in 12 herds (Oregon Department of Fish and Wildlife 2003).

4.0 Status and Abundance Trends:

4.1 Status:

Currently the Rocky Mountain bighorn sheep is classified in the state of Oregon as a game mammal and is under the administrative management of the Oregon Department of fish and wildlife.

4.2 Trend:

From the time of extirpation in the mid-1940's to present, the Rocky Mountain bighorn sheep has improved in population until the present day as the result of transplants conducted by the Oregon Department of Fish and Wildlife. However, population growth has been hampered by repeated disease outbreaks as the result of contact with domestic sheep (Oregon Department of Fish and Wildlife 2003).

5.0 Factors Affecting Population Status

5.1 Key Factors Inhibiting Populations and Ecological Processes

5.1.1 Historical:

During the time when Rocky Mountain bighorn sheep were declining across their range, there was little or no wildlife management activity surrounding bighorn sheep. As a result, the relationship between diseases carried by domestic sheep and declines in bighorn sheep populations was not understood. However, it is generally accepted that the expansion of civilization to the western portion of North America and the domestic livestock that accompanied that settlement was a major factor in the decline and localized extirpation of Rocky Mountain bighorn sheep. In addition, unregulated harvest on bighorn sheep probably played a secondary role in the loss of Rocky Mountain bighorn sheep in many areas.

5.1.2 Current:

Currently, three key factors threaten the successful re-establishment of a population of Rocky Mountain bighorn sheep in the Walla Walla subbasin of Oregon. They are: 1) the continuing threat of disease transmission from domestic sheep and goats both in the high elevation areas of the subbasin and in the privately owned river bottom farmsteads that are oriented below the bighorn sheep habitat. 2) a large portion of the core bighorn sheep habitat not being in protected status and vulnerable to land management changes negative to bighorn sheep. 3) the continued threat of noxious weed invasion on core Rocky Mountain bighorn sheep habitat in the Walla Walla subbasin.

5.1.2.1 Disease:

Disease transmission from domestic sheep and goats has proven to be the largest threat to wild bighorn sheep populations in Oregon. The 2003 Oregon Bighorn Sheep and Rocky Mountain Goat Plans provide an explanation of the hazards of disease transmission in bighorn sheep. The following is quoted directly from that document:

Bighorn sheep are a big game species where disease is a management priority. Bighorns are susceptible to several diseases and parasites that have caused both acute and chronic herd reductions. Although most other big game species are susceptible to various diseases and parasites, they generally are not impacted to the level observed in bighorns.

When bighorn sheep encounter domestic sheep, bighorns usually die of pneumonia within 3-7 days of contact (Foryet et al. 1994, Martin et al. 1996, Schomer and Woolever 2001). Because exposed bighorns do not die immediately, infected individuals may return to their herd and infect other individuals, which can cause 70–100% of the herd to die. For this reason, the Oregon Department of Fish and Wildlife will not release bighorns in locations where with a known potential to contact domestic sheep (Oregon Department of Fish and Wildlife, 2003).

The amount of separation necessary to protect bighorn sheep from interaction with domestic sheep is variable based on each location's specific circumstances. After a pasteurella dieoff in 1993 in an Aldrich Mountain California bighorn herd, trailing practices of a domestic sheep band were modified to provide 5 miles of separation in the spring and 20 miles of separation in the fall. This approach has protected that population of bighorns from any recurrence of pasteurella (Oregon Department of Fish and Wildlife, 2003). In Hells Canyon a 25 mile separation between Rocky Mountain bighorn sheep and domestic sheep has proven ineffective at insulating bighorns from pasteurella transmission (Schommer and Woolever, 2001).

Currently, the high elevation areas of the Walla Walla sub-basin of Oregon on both private and public land have domestic sheep grazing that occurs on a frequent basis. In addition, domestic sheep are kept sporadically in small quantities in the river bottoms of the Walla Walla River system which introduce a source of disease into the area. The Wenaha Rocky Mountain bighorn sheep herd occasionally is the source of individual dispersal of Rocky Mountain bighorn sheep to the Walla Walla sub-basin of Oregon (personal communication Mark Kirsch, ODFW, 2004). These individual bighorn sheep could encounter domestic sheep and become infected with pasteurellosis. At some point, there is a high probability they would return to their source herd. As a result, despite the fact, there is suitable habitat for Rocky Mountain bighorn sheep in the Walla Walla sub-basin, the Oregon Department of Fish and Wildlife pursues removal of these sheep when they are discovered in the sub-basin.

With the exception of lungworm and scabies, most diseases negatively effecting bighorns commonly occur in domestic sheep and disease prevalence in bighorns generally increases with contact between bighorns domestic sheep. Following is a brief description of Pasteurellosis, which is primarily responsible for negatively effecting bighorn sheep.

Pasteurellosis

Pasteurellosis refers to pneumonia, septicemia, and other infections caused by bacteria of the genus *Pasteurella*, and has proven devastating to bighorn sheep. Prior to 2000, bacteria causing pasteurellosis were all classified as *Pasteurella* spp. In 2000 *Pasteurella haemolytica*, which has been implicated as causing many bighorn die-offs, was reclassified as *Mannhaemia haemolytica.* Although there are now two genera of bacteria involved in bighorn pneumonia outbreaks, the disease is still commonly referred to as Pasteruellosis.

Pasteurellosis has played a significant role in bighorn population declines throughout western North America (Miller 2000). Occurrence of epidemics followed settlement and establishment of domestic sheep grazing, and may reflect the introduction of novel pathogens causing bacterial pneumonia into naïve bighorn populations (Miller 2000). Disease, along with habitat degradation and unregulated hunting, resulted in extirpation of wild sheep from Oregon. In modern times, pasteurellosis outbreaks have occurred in 1972, 1983–84, 1986–87, 1995–96 and 1999 in some Oregon Rocky Mountain bighorn herds, and 1991 in the Aldrich Mountain California bighorn herd. Contact with domestic sheep or goats are the most likely source for these outbreaks. Ongoing research in Hells Canyon indicates pasteurellosis continues to be the leading cause of mortality in Oregon's Rocky Mountain bighorns.

Pneumonia outbreaks occur almost annually somewhere in the U.S. or Canadian bighorn range. Outbreaks range in severity from 100% mortality to only a few animals dying. Poor lamb survival generally follows. Studies in Hells Canyon indicate lambs contract pneumonia and the disease can spread through entire lamb groups. In all probability, lambs contract the disease from their mothers. Long term monitoring of the Lostine herd indicates surviving bighorns recover and eventually lamb survival increases.

Field treatment of pasteurellosis with antibiotics has had some success but prevention needs to be emphasized. The most effective prevention is separation between bighorns and domestic sheep or goats (Oregon Department of Fish and Wildlife, 2003).

5.1.2.2 Land in Protected Status:

As much as 75 percent of the bighorn sheep habitat in the Walla Walla subbasin is privately owned and not in protected status. As a result, any transplant of Rocky Mountain bighorn sheep into the Walla Walla subbasin would be constantly under threat of land sale or land management changes that could be detrimental to bighorn sheep. As a result, the Oregon Department of Fish and Wildlife will attempt no relocation of Rocky Mountain bighorn sheep to the Walla Walla subbasin until the habitat has come under protected status.

5.1.2.3 Noxious Weeds:

Noxious weeds continue to be a threat to the upland areas of the Walla Walla subbasin. Currently the bighorn sheep habitat in the Walla Walla subbasin is in good condition with populations of native bunch grass distributed throughout the habitat area, yellow-star thistle infestations to the north and west and common crupina to the south threaten to degrade the habitat (personal communication Mark Kirsch, ODFW, 2004). The Oregon Department has conducted several projects to control or eradicate yellow star-thistle and common crupina in the Walla Walla subbasin of Oregon a list of the projects is as follows in Table 4:

Table 4. Noxious weed control projects conducted by the Oregon Department of Fish and Wildlife

Year	Type of Project	Noxious Weed	Location	Acres Treated
1996	Chemical Application	yellow star-thistle	NF Walla Walla R.	425
1996	Chemical Application	yellow star-thistle	Cottonwood Creek	200
1996	Chemical Application	yellow star-thistle	SF Cottonwood Creek	150
1996	Chemical Application	yellow star-thistle	Cottonwood Creek	250
1996	Chemical Application	common crupina	Dry Creek	4,000
1997	Chemical Application	yellow star-thistle	Cup Gulch/NF Walla Walla	450
1997	Chemical Application	yellow star-thistle	Saddle Mountain	100
1997	Chemical Application	yellow star-thistle	Saddle Mountain	250
1997	Chemical Application	yellow star-thistle	NF Walla Walla	25
1997	Chemical Application	yellow star-thistle	Saddle Mountain	250
1997	Chemical Application	yellow star-thistle	NF Walla Walla	70
1997	Chemical Application	yellow star-thistle	Cup Gulch	15
1997	Chemical Application	common crupina	Dry Creek	4,000
1998	Chemical Application	yellow star-thistle	Cottonwood Creek	150
1998	Chemical Application	common crupina	Dry Creek	4,000
1999	Chemical Application	common crupina	Dry Creek	2,000
2000	Chemical Application	yellow star-thistle	Cup Gulch	57
2000	Chemical Application	yellow star-thistle	Cottonwood Creek	150
2000	Chemical Application	yellow star-thistle	Cottonwood Creek	600
TOTAL ACRES				17,142

Even if moved to protected status, bighorn sheep habitat in the Walla Walla subbasin would need to be monitored for incidence of noxious weeds and treated before infestations became large.

6.0 Citations

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ALKALI BEES

The following discussion is from Baird, et al (1991):
The alkali bee (*Nomia melanderi*) is a solitary ground nesting bee native to western North America used for pollination of alfalfa. As its name suggests, it can be found nesting in alkali soil. It prefers to nest in bare soil that remains moist but not wet, and dry on top. This occurs naturally in areas where a layer of hard pan exists in alkali soils. The alkali salts seal the top of the soil, holding in the moisture.

The following discussion is from Greer (1999):
Western scientists and farms attract this wild bee by building nests that simulate natural in-ground nests in alkaline soil. Although alkali bees are solitary, individuals nest near each other. Adults are black with metallic-colored bluish, greenish, or yellowish bands circling their abdomen. The larvae overwinter in their cells, then pupate and emerge from the soil in late spring or early summer, depending on temperature and moisture of the soil. They rarely use their stingers.

The alkali bee is an excellent pollinator of alfalfa and onion seed, and can also pollinate onions, clover, mint and celery (Baird et al. 1991; Greer 1999). They next underground in the Touchet area. Limiting factors include flooding in the Walla Walla Valley that can destroy their nests (Pierce 2002).

REFERENCES

Baird, C.R., D.F. Mayer, and R.M. Bitner. 1991. Pollinators. In Alfalfa Seed Production and Pest Management. Western Regional Extension Publication 12.

Greer, L. 1999. Alternative Pollinators: Native Bees. Appropriate Techology Transfer for Rural Areas Horticultural Note.

Pierce, S. 2002. Alfalfa Seed Growing and Harvesting Practices in Walla Walla County, Washington. Whitman College. Downloaded March 23, 2004 from http://www.whitman.edu/environmental_studies/WWRB/agriculture/alfalfa.html

WDFW PLANS APPLICABLE TO SUB-BASINS

Status report: A status report includes a review of information relevant to the species' status in Washington and addresses factors affecting its status including, but not limited to: historic, current, and future population trends, natural history including ecological relationships, historic and current habitat trends, population demographics and their relationship to long-term sustainability, known and potential threats to populations, and historic and current species management activities.
Bald eagle, 2001
Burrowing owl, draft 2004
Common loon, 2000
Fisher, 1998
Lynx, 1993; 1999
Mountain quail, 1993
Northern leopard frog, 1999
Oregon spotted frog, 1997
Peregrine falcon, 2002
Sharp-tailed grouse, 1998
Streaked horned lark, draft 2004
Washington ground squirrel, draft 2004

Recovery/management plans: Recovery/management plans summarize the historic and current distribution and abundance of a species in Washington and describe factors affecting the population and its habitat. It prescribes strategies to recover the species, such as protecting the population, evaluating and managing habitat, and initiating research and education programs. Target population objectives and other criteria for reclassification are identified and an implementation schedule is presented.

Bald eagle, 1990, federal 1986
Bighorn sheep, 1995
Black bear, 1997
Cougar, 1997
Deer, 1997
Elk, 1997
Ferruginous hawk, 1996
Fisher, draft 2004
Furbearers, 1987-93
Gray wolf, federal
Grizzly bear, federal 1993
Lynx, 1993; 2001
Moose, 1997
Mountain quail, 1993
Oregon spotted frog, 1998
Sharp-tailed grouse, 1995
Waterfowl, 1997
Upland birds, 1997

Management recommendations (PHS): Each species account provides information on the species' geographic distribution and the rationale for its inclusion on the PHS list. The habitat requirements and limiting factors for each species are discussed, and management recommendations addressing the issues in these sections are based on the best available science. Each species document includes a bibliography of the literature used for its development, and each has a key points section that summarizes the habitat requirements and management recommendations for the species.

Game Management Plan: The game management plan guides the Washington Department of Fish and Wildlife's management of hunted wildlife through June 2009. The plan focuses on the scientific management of game populations, harvest management, and other factors affecting game populations. The overall goals of the plan are to protect, sustain, and manage hunted wildlife, provide stable, regulated recreational hunting opportunity to all citizens, to protect and enhance wildlife habitat, and to minimize adverse impact to residents, other wildlife and the environment. The plan outlines management strategies for the following species or groups of species:

Volume III – Amphibians and Reptiles, 1997
Columbia spotted frogNorthern leopard frog
Oregon spotted frog
Striped whipsnake

Volume IV – Birds, 2003
American white pelican
Bald eagle
Black-backed woodpecker
Blue grouse
Burrowing owl
Cavity-nesting ducks
Chukar
Common loon
Flammulated owl
Golden eagle
Great blue heron
Harlequin duck
Lewis' woodpecker
Loggerhead shrike
Mountain quail
Northern goshawk
Peregrine falcon
Pileated woodpecker
Prairie falcon
Ring-necked pheasant
Sage sparrow
Sage thrasher
Sharp-tailed grouse
Shorebirds
Vaux's swift
Wild turkey
White-headed woodpecker

<u>Volume V – Mammals</u>
(currently in development)

Management Recommendations for
<u>Washington's Priority Habitats and Species, May 1991</u>

Bighorn sheep
Elk
Fisher
Gray wolf
Grizzly bear
Lynx
Marten
Merriam's turkey
Moose
Osprey
Pygmy shrew
Rocky Mountain mule deer
Townsend's big-eared bat
Western bluebird
White-tailed deer
Yellow-billed cuckoo
Elk
Deer
Bighorn Sheep
Moose
Black Bear
Cougar
Waterfowl
Migratory Birds (e.g., Mourning Dove)
Wild Turkey
Mountain Quail
Forest Grouse
Upland Game Birds
Small game (e.g., rabbits)
Furbearers (e.g., beaver)
Unclassified Species (e.g. coyote)

Bighorn Sheep Plan: The Washington State management plan for bighorn sheep describes the geographical range, natural history, habitat requirements and status, population dynamics and status, and management activities and implementation for 16 herds statewide. The plan identifies goals and objections for managing bighorn sheep and addresses specific issues related to monitoring, recreation, enforcement, reintroductions, research, and disease. The plan was adopted in 1995 and fits within the umbrella of the Game Management Plan for 2003-2009.

Black Bear Plan: The Washington State management plan for black bear describes the geographical range, life history, habitat, population dynamics, and management direction for bears. The plan identifies goals and objections for managing black bear and addresses specific issues related to nuisance activity, recreation, enforcement, habitat protection, and education. The plan was adopted in 1997 and fits within the umbrella of the Game Management Plan for 2003-2009.

Elk Herd Plans: Washington state elk herd plans summarize historic and current distribution and abundance. The Department recognizes ten, distinct elk herds in the state. Five of the ten elk herd management plans have been completed. The plans address the major factors affecting abundance and persistence. Population management objectives, spending priorities, and management strategies are spelled out. Priorities for habitat enhancement are identified.

Blue Mountains Elk Herd Plan, February 2001

Interagency waterfowl management plans: Washington Department of Fish and Wildlife (WDFW) is a member of the Pacific Flyway Council, an organization of 11 western states that develops management recommendations for migratory waterfowl. Management plans developed by the Council include population objectives, harvest strategies, habitat recommendations, and basic biological information. The Council also participates in the development of nationwide management plans for waterfowl. The following is a list of interagency plans that deal with Washington's waterfowl resources:

Canada Geese
Western Tundra

Pacific Coast Band-tailed Pigeons

Mourning Doves

Related Plans
North American Waterfowl Management Plan
National Mourning Dove Plan

Joint Venture habitat plans: WDFW is an active participant in two joint ventures under the North American Waterfowl Management Plan, the Pacific Coast Joint Venture and the Intermountain West Joint Venture. The joint ventures include representatives of agencies from all levels of government and nonprofit organizations, who are interested in conservation and enhancement of habitat for migratory birds and related fish and wildlife resources. The joint ventures have developed strategic plans to guide conservation efforts of all the partners:

Pacific Coast Joint Venture Strategic Plan
Intermountain West Joint Venture Strategic Plan