3.2.4 Terrestrial Focal Species Population Delineation and Characterization

3.2.4.1 Population Data

Because of the importance of habitat in focal species selection, information on populations of the ten terrestrial focal species is arranged by habitat type. More detailed descriptions of each habitat type follow in Section 3.2.4.2. In addition, focal species accounts, which include information on life history, large scale distribution and trends, habitat relationships, and appropriate citations to primary literature, are found in Appendix C. However, it should be noted that most of the information presented in the species accounts found in Appendix C are general descriptions of the species throughout their range. Unfortunately, focal species data specific to the Umatilla/Willow subbasin are extremely limited. The following section includes a brief description of the species, and, if known, information on its present distribution and status in the Umatilla/Willow subbasin. More comprehensive information on the relationship of focal species with their habitat, including a description of key environmental correlates, are found in Section 3.4.2.

MIXED CONIFER FOREST FOCAL SPECIES

Pileated Woodpecker (*Dryocopus pileatus*)[1]

The Pileated Woodpecker, the largest woodpecker in the United States, is an excellent excavator and uses its strong chisel-shaped bill to construct nests and roost cavities and to find insects in wood. Because of its dependence on decaying large-diameter trees for nesting, roosting, and foraging, it is closely associated with mature stands of forest. Because of its habitat needs, it is primarily associated with intermediate elevations; habitats at higher and lower elevations tend to lack trees large enough for nesting, roosting, and foraging.

In the Umatilla/Willow subbasin, the Pileated Woodpecker is an uncommon permanent resident in the Blue Mountains (Figure 86). Little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. However, the conversion of stands dominated by grand fir to an earlier seral stage dominated by ponderosa pine likely reduces the amount of suitable habitat for the Pileated Woodpecker in northeastern Oregon. Although Breeding Bird Survey data for 1966-1991 show no significant change for the Pileated Woodpecker in the western United States, it is listed as a vulnerable sensitive species in Oregon (Table 20) and appears on the Oregon PIF list (Table 26).

[1] Information presented in this section is largely derived from Bull 2003 and the focal species accounts presented in Appendix C.

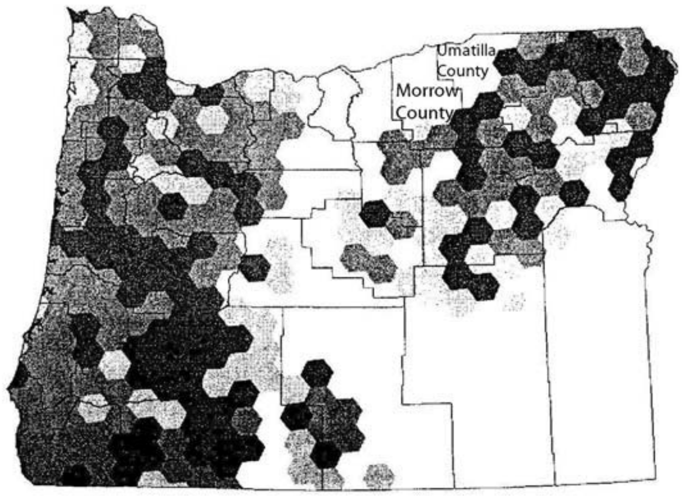

Figure 86. Map of Oregon breeding distribution during 1995-1999 for the Pileated Woodpecker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

PONDEROSA PINE FOCAL SPECIES

White-headed Woodpecker *(Picoides albolarvatus)*[2]

The White-headed Woodpecker occurs primarily in open ponderosa pine or mixed-conifer forests dominated by ponderosa pine (Bull et al. 1986, Dixon 1995a,b, Frenzel 2000), and is the only woodpecker that relies heavily on the seeds of ponderosa pine for food. In Oregon, White-headed Woodpecker population density was found to increase with increasing volumes of old-growth ponderosa pine and large-diameter ponderosa pines in both contiguous and fragmented sites (Dixon 1995 a,b). Individuals usually excavate nest cavities in snags, but have also been found to use stumps, leaning logs, and the dead tops of live trees (Milne and Hejl 1989, Frederick and Moore 1991, Dixon 1995a,b)

In the Umatilla/Willow subbasin, the White-headed Woodpecker is an uncommon permanent resident in the Blue Mountains (Figure 87), and suitable habitat in the area is believed to be limited. Although the White-headed Woodpecker has occasionally been observed in the mid to upper elevations of the subbasin since 1985 (personal communication: Charles Gobar, USFS, January 2001), little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Although its overall range in Oregon appears to be similar to historic patterns (Gabrielson and Jewett 1940), the woodpecker's distribution is believed to have become more patchy

[2] Information presented in this section is largely derived from Marshall 2003 and the focal species accounts presented in Appendix C.

because of habitat deterioration associated with timber harvest and fire suppression. Studies in other areas of Oregon (the Deschutes and Winema National Forests), which are believed to have some of the best remaining habitat for this bird in Oregon, have shown that population recruitment was insufficient to offset mortality (Frenzel 2000). Thus, populations in the Umatilla/Willow subbasin are believed to be facing serious threats; an assertion supported by the conclusion made by Gilligan et al. (1994) that severely degraded habitats in the Blue Mountains have resulted in this bird being "now quite scarce." The White-headed Woodpecker is listed as a critical sensitive species in Oregon (Table 20) and appears on the Oregon PIF list (Table 26).

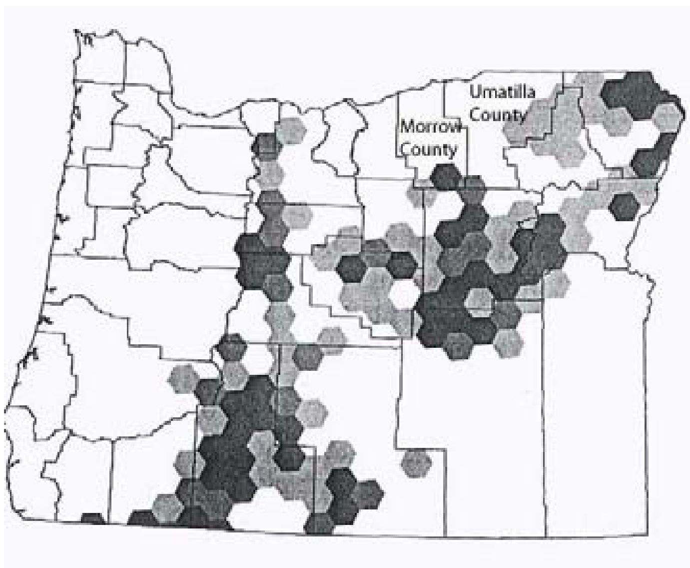

Figure 87. Map of Oregon breeding distribution during 1995-1999 for the White-headed Woodpecker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

UPLAND ASPEN FOREST FOCAL SPECIES

Red-naped Sapsucker (*Sphyrapicus nuchalis*)[3]

Red-naped Sapsuckers are strongly associated with aspen stands east of the Cascades, where they feed on sap, cambium, and soft parts beneath a tree's bark. Foraging activity is often evident by rows of neat holes drilled in the bark of trees. Red-naped sapsuckers build nesting cavities in aspen, and prefer trees that have heartwood decay (Kilham 1971a). Because of their nesting and foraging activity, Red-naped sapsuckers are considered a double keystone species because the nest cavities are used by secondary cavity-nesters and its sap wells provide food for a variety of other animals, from insects to other birds to squirrels (Daily et al. 1993).

[3] Information presented in this section is largely derived from Simmons 2003 and the focal species accounts presented in Appendix C.

The Red-naped Sapsucker is a common summer resident throughout forested mountains east of the Cascades and it migrates in spring and fall through the mountains and forested lower elevations. Although numerous confirmed breeding observations have been made in the Umatilla/Willow subbasin (Figure 88), little information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Although Breeding Bird Survey data for Oregon showed a non-significant 0.5% increase per year from 1966-2000 (Sauer et al. 2000), long-term widespread degradation of aspen and other riparian forest through intensive livestock grazing and fire suppression are believed to pose a significant threat to the species because of its dependence on large aspen trees and snags for nesting. A lack of tree regeneration and the resulting loss of large trees are expected to lead to significant declines in Red-naped Sapsucker populations (Dobkin et al. 1995). The Red-naped Sapsucker appears on the Oregon PIF list (Table 26).

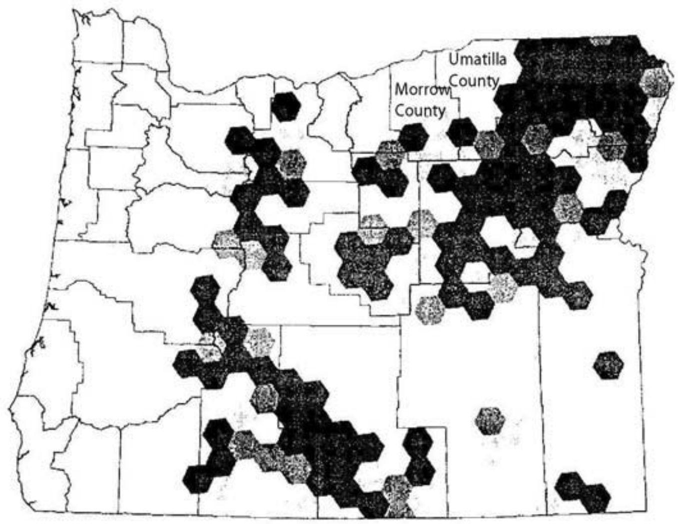

Figure 88. Map of Oregon breeding distribution during 1995-1999 for the Red-naped Sapsucker. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

WESTERN JUNIPER WOODLAND FOCAL SPECIES

Ferruginous Hawk (*Buteo regalis*)[4]

The Ferruginous Hawk is Oregon's largest hawk and is associated with open habitats of shrub-steppe and the bunchgrass prairies along the northern foothills of the Blue Mountains. Because of their sensitivity to human disturbance, they tend to reside in remote areas, and prefer areas where their principal prey – grounds squirrels, rabbits, and hares – are common.

[4] Information presented in this section is largely derived from Janes 2003 and the focal species accounts presented in Appendix C.

Although the Ferruginous Hawk is an uncommon to rare resident in open landscapes east of the Cascades, it is relatively common in the Umatilla/Willow subbasin (Figure 89). Quantitative information about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin is limited, although there is evidence that nesting activity in the lower subbasin has declined in the last 60 years; the number of nests that presently occurs in the low elevation habitat portion of the subbasin is only a fraction of the 28 nests found in 1940 (Gabrielson and Jewett 1940) in northern Morrow and Umatilla Counties (personal communication: R. Morgan, ODFW, February 2001). This decline is believed to be related to the loss of high quality habitat through agricultural conversion. The Ferruginous Hawk is also extremely sensitive to human disturbance and will readily abandon nests if disturbed (Olendorff and Stoddard 1974, White and Thurow 1985). This problem is exacerbated by the tendency of the Ferruginous Hawk to nest in short trees. Although foothill grasslands and shrub-steppe continue to harbor Ferruginous Hawks in the Umatilla/Willow subbasin, their stability is unknown. The Ferruginous Hawk is listed as a critical sensitive species and a PIF species in Oregon.

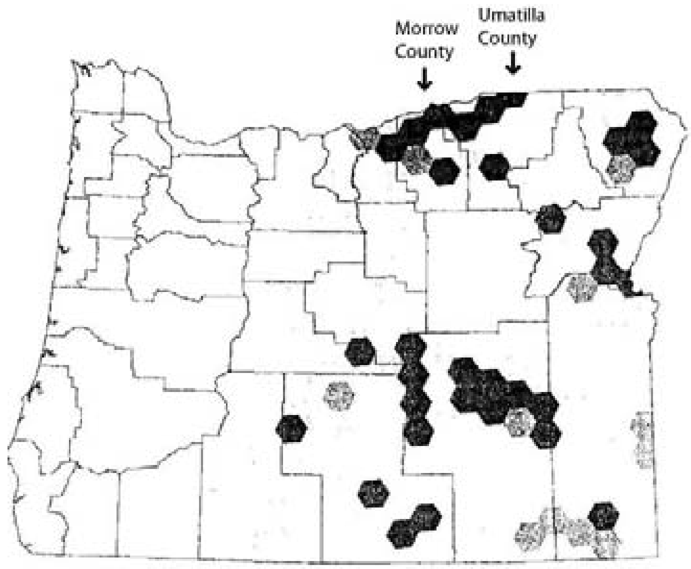

Figure 89. Map of Oregon breeding distribution during 1995-1999 for the Ferruginous Hawk. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

SHRUB-STEPPE FOCAL SPECIES

Sage Sparrow (*Amphispiza belli*)[5]

Sage Sparrows are highly dependent on shrub-steppe habitat; in Oregon, they are most commonly associated with big sagebrush communities, some of which may include a mix of western juniper and other shrubs.

As seen in Figure 90, although Sage Sparrows are most common in southeast and central Oregon, breeding individuals have also been observed in the Umatilla/Willow subbasin. Once abundant in northern Morrow and Umatilla Counties (Gabrielson and Jewett 1940), this bird currently only breeds on a few small remaining habitat tracts – the Umatilla Army Depot and the Boardman Bombing Range. Although Breeding Bird Survey data reveal no significant population trends in Oregon as a whole in the past 30 years, agricultural conversion, livestock grazing, the spread of exotic weeds, and the practice of replacing sagebrush habitat with non-native grasslands, such as crested wheatgrass, have resulted in local populations declines (Wiens and Roteneberry 1985). The extent of shrub-steppe habitat under public ownership has slowed but not stopped the destruction of their requisite habitat (see Section 3.2.4.2). One of the only areas supporting nesting Sage Sparrows in the Umatilla/Willow subbasin, the Boardman Bombing Range, was negatively affected by a large fire (and the post-fire cheatgrass invasion) at the facility in 1988, which eliminated approximately 60% of the known sage sparrow habitat at that location. The Sage Sparrow is listed as a critical sensitive species and a PIF species in Oregon.

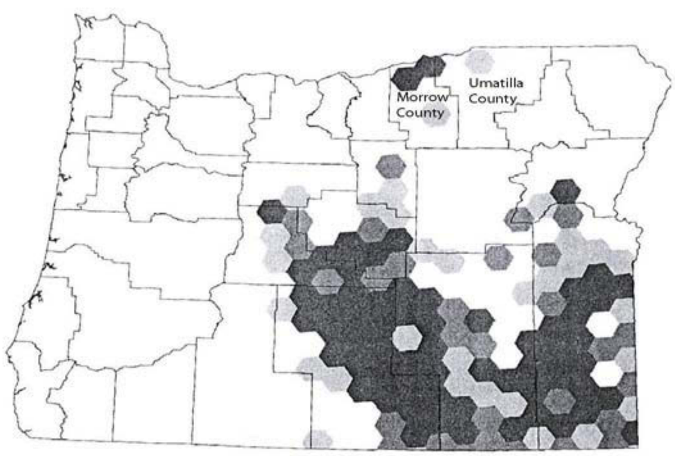

Figure 90. Map of Oregon breeding distribution during 1995-1999 for the Sage Sparrow. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

[5] Information presented in this section is largely derived from Miller 2003 and the focal species accounts presented in Appendix C.

INTERIOR GRASSLAND FOCAL SPECIES

Grasshopper Sparrow (*Ammodramus savannarum perpallidus*)[6]
In Oregon, Grasshopper Sparrows are restricted to grasslands, where they occur in native bunchgrass remnants (Janes 1983). Grasshopper Sparrows sing from elevated perches, a critical habitat feature. In Morrow County, they use the flowering stalks of the large velvet lupine as perches (Janes 1983). However, Grasshopper Sparrows are rarely encountered in habitats with abundant woody shrubs, possibly because of competition with Brewer's Sparrows. Individuals construct a domed nest on the ground, which is concealed under vegetation (Vickery 1996).

The Grasshopper Sparrow is a widespread but very local breeder and rare migrant. As seen in Figure 91, the Grasshopper Sparrow occurs throughout the Umatilla/Willow subbasin, and is especially common in scattered patches along the unforested northern slopes of the Blue Mountains (Janes 1983, Evanich 1992a, Sullivan 1992e). A study in very limited habitats in Morrow County found that densities varied from 1.1 individuals per 100 acres in the Boardman area to 8.2 individuals per 100 acres in the Heppner area (Janes 1983). Holmes and Janes (1983) showed the species was most abundant in the foothill grassland areas of the subbasin and preferred north-facing slopes with undisturbed bunchgrass and lupine (*Lupinus leucophilus*). The status of the species in Oregon is unclear, partially because historic data on the bird is limited because of the difficulty of detection and highly variable annual abundances. However, the conversion of native bunchgrass prairies to dryland wheat and other crops is believed to have negatively impacted the species, and continues to threaten populations in Northeastern Oregon. Many existing pairs persist in bunchgrass remnants between cultivated fields or in marginal habitats with soils that are too shallow to plow. Overgrazing also appears to negatively affect habitat suitability for Grasshopper Sparrows. The species is a state sensitive species (vulnerable/peripheral or naturally rare) and occurs on the Oregon PIF list.

[6] Information presented in this section is largely derived from Janes 2003 and the focal species accounts presented in Appendix C.
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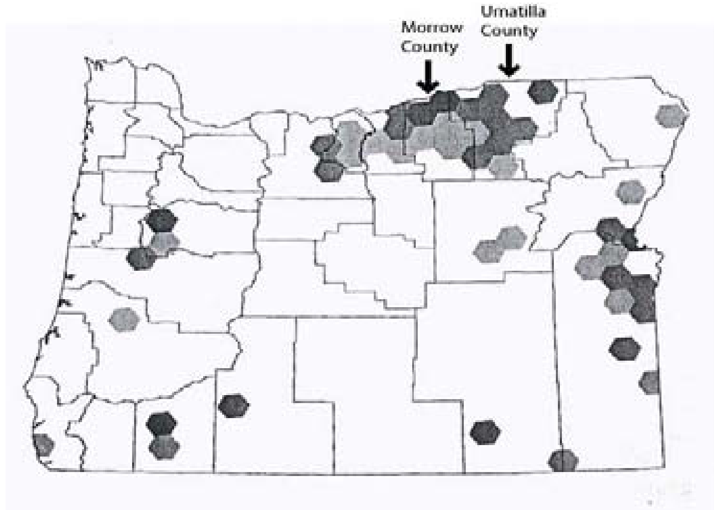

Figure 91. Map of Oregon breeding distribution during 1995-1999 for the Grasshopper Sparrow. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

HERBACEOUS WETLAND FOCAL SPECIES

Columbia Spotted Frog (*Rana luteiventris*)
The Columbia spotted frog is rarely found far from water. It occupies a variety of still water habitats and can also be found in streams and creeks (Hallock and McAllister 2002). Columbia spotted frogs are closely associated with clear, slow-moving or ponded surface waters, with little shade (Reaser 1997). Aquatic sites used by this species may have a variety of vegetation types, from grasslands to forests (Csuti 1997).

Columbia spotted frogs are thought to be widely distributed in eastern Oregon, but local populations appear to be isolated from each other. Most (81%) of the 16 sites known to be inhabited by Columbia spotted frogs in eastern Oregon support fewer than 10 adult frogs, with the exception of a single population of Columbia spotted frogs in the Dry Creek drainage of Malheur County that has hundreds of adults (Munger et al. 1996). Monitoring of Columbia spotted frogs in Wallowa County of northeastern Oregon, which began in 1998, suggests the existence of relatively stable, small local populations (< 5 adults) (Pearl 2000). All known local populations of the species in eastern Oregon appear to be functionally isolated. The current status and distribution of the Columbia spotted frog in the Umatilla/Willow subbasin is undetermined. However, the frog occurs sporadically throughout the Blue Mountains and has occasionally been observed in the middle and lower elevations of the subbasin since 1995. Abundance of the Columbia spotted frog are believed to have decreased dramatically since historical times due to draining, destruction, and degradation of wetlands and the introduction of the bullfrog, although no quantitative data exists to demonstrate this assertion. The Columbia spotted frog is a federal candidate species and an Oregon sensitive species with undetermined status.

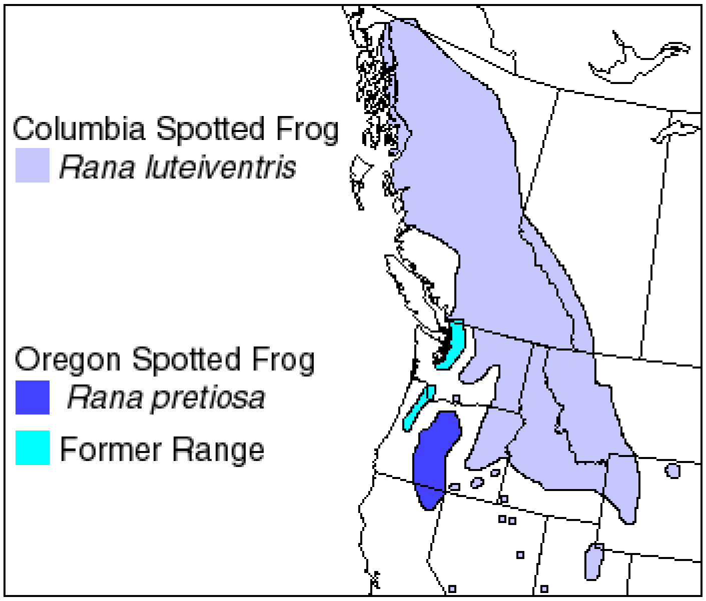

Figure 92. Distribution of the Oregon spotted frog in the Northwest (from Green et al. 1997).

RIPARIAN WETLAND FOCAL SPECIES

Great Blue Heron (*Ardea herodias*)[7]

The Great Blue Heron, the largest heron in North America, is one of the most widespread and familiar waterbirds in Oregon. Great Blue Herons are commonly associated with shallow areas of marshes, lakes, streams, and oceans, where they feed on fish, amphibians, and aquatic invertebrates. Nest colonies occur in a variety of trees, including black cotton wood, red alder, ponderosa pine, and Douglas-fir.

As shown in Figure 93, breeding Great Blue Herons occur in the Umatilla/Willow subbasin. However, little quantitative information exists about their abundance, fine scale distribution, or status in the subbasin. In Oregon as a whole, population size and range may be static, but nesting and foraging habitat has been reduced due to urban development and tree harvesting. The Great Blue Heron is defined as a critically linked species, a HEP species, and a salmon-associated species (see Section 3.2.1).

[7] Information presented in this section is largely derived from Thomas 2003 and the focal species accounts presented in Appendix C.

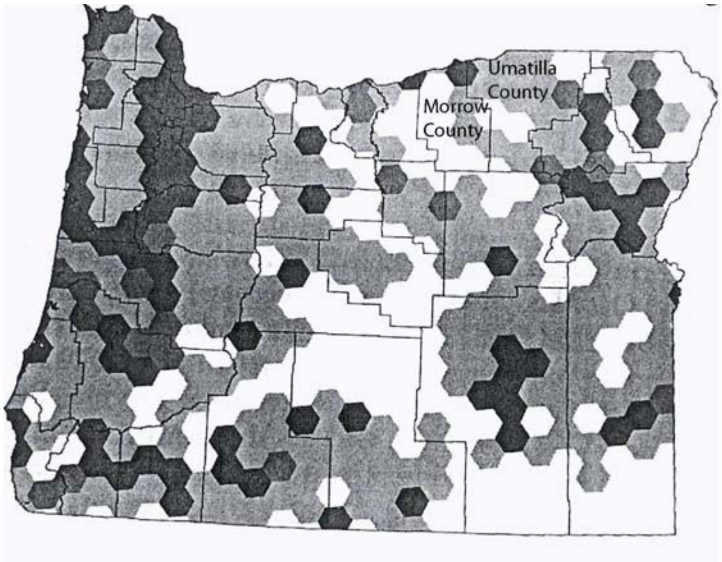

Figure 93. Map of Oregon breeding distribution during 1995-1999 for the Great Blue Heron. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

Yellow Warbler (*Dendroica petechia*)[8]

Yellow Warblers prefer to nest among riparian woodland and thickets, particularly those dominated by willow or cottonwood (Fix 1990a, Gilligan et al. 1994, Sanders and Edge 1988). Cup shaped nests are built in bushes, saplings, or trees within 6.5 feet of the ground (Gabrielson and Jewett 1940, Taylor and Littlefield 1986).

The Yellow Warbler is a common to abundant breeder in the Umatilla/Willow subbasin in the Blue Mountains and along watercourses. However, little quantitative information is available about its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. In Oregon, Breeding Bird Survey data from 1966-2000 shows a consistent loss of 1.7% each year. This decline is believed to be the result of riparian habitat destruction and degradation. Livestock grazing and the development of farms and pastures have benefited the Brown-headed Cowbird, whose brood parasitism can have an adverse effect on the Yellow Warbler. Yellow Warblers are HEP species and occur on the Oregon PIF list.

[8] Information presented in this section is largely derived from Scheuering 2003 and the focal species accounts presented in Appendix C.

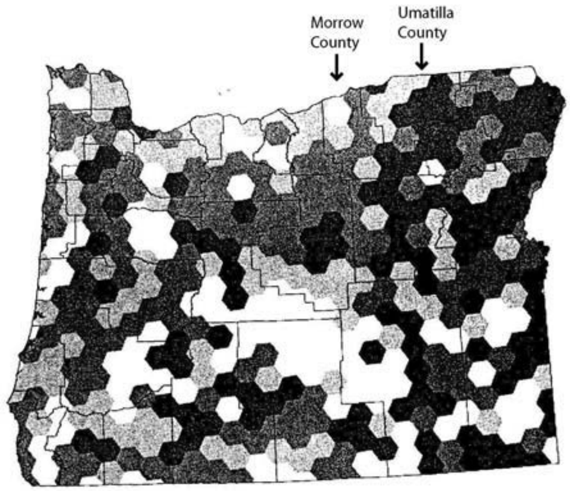

Figure 94. Map of Oregon breeding distribution during 1995-1999 for the Yellow Warbler. Darkly shaded hexagons indicate confirmed breeding observations, intermediately shaded hexagons indicate probable breeding observations, and lightly shaded hexagons indicate possible breeding observations. Map adapted from Marshall et al. 2003.

American Beaver (*Castor canadensis*)[9]

The American beaver (*Castor canadensis*) is a large, highly specialized aquatic rodent found in the immediate vicinity of aquatic habitats. In Oregon, the American beaver can be found in suitable habitats throughout the state (Verts and Carraway 1998), and is almost always associated with riparian or lacustrine habitats bordered by a zone of trees, especially cottonwood and aspen (*Populus*), willow (*Salix*), alder (*Alnus*), and maple (*Acer*) (Verts and Carraway 1998). Small streams with a constant flow of water that meander through relatively flat terrain in fertile valleys and are subject to being dammed seem especially productive of beavers (Hill 1982).

Beaver distribution occurs from the Columbia River to mid-elevation forested regions throughout the Umatilla/Willow subbasin drainage (personal communication: M. Kirsch, ODFW, January 2001). Although American beaver are active in riparian wetlands of the Umatilla/Willow subbasin, there are no quantitative data on its abundance, fine scale distribution, or status in the Umatilla/Willow subbasin. Historically, beaver populations in the area were more expansive until populations were reduced by unregulated trapping, as they were throughout much of the western United States. Currently, the American beaver is a managed game species.

[9] Information derived for this section is derived from the focal species information presented in Appendix C.

3.2.4.2 Distribution and Condition of Habitat Types Associated with Focal Species
Terrestrial wildlife planners took advantage of a new wildlife database, the Interactive Biodiversity Information System (IBIS), to provide information and maps on the historic and current distribution of focal habitats, ownership and protection status for each habitat, and functional redundancy analyses.

The following description describes the process used by the NWHI to develop IBIS maps of current and historical distributions of focal habitats and some of the limitations and assumptions associated with that process (personal communication, Tom O'Neil, NWHI, April 2004):

> Current Conditions:
>
> NWHI developed a map depicting the current distribution of the 32 wildlife habitats types, described by the Species Habitat Project for the Columbia River basin in the United States. US Geological Survey, Biological Resource Division (USGS/BRD), compiled this map from existing vegetation maps that were created for each state as part of the National Gap Analysis Program. Each state's map is based on interpreting vegetation cover data from satellite imagery. Vegetation maps from all or parts of seven states (Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming) in the Columbia River Basin were used by NWHI to develop the wildlife habitat types map depicting current conditions.
>
> The primary purpose for developing the vegetation maps for the National Gap Analysis Program was for USGS/BRD to conduct statewide biodiversity assessments. Hence, the resolution of their vegetation maps reflects a statewide, regional, or coarse resolution for planning. That is, their maps can serve as an initial basis for large-scale mapping or database investigations but they are more accurately interpreted at the statewide or province scales, and only for some of the largest subbasins.
>
> Hence, the current wildlife-habitat type map provides only an initial depiction of the amounts of wildlife habitats that may exist within watersheds, but is not of sufficient resolution for depicting the site-specific location of habitats within each watershed. The minimum mapping unit for the subbasin-wide map is 250 acres, whereas a more appropriate scale for within watershed assessments would be 10-75 acres depending on land ownership and habitat patch sizes. Thus, wildlife habitats that occur in patch sizes less than 250 acres, e.g. linear riparian habitat, are likely underrepresented in the current map.
>
> Further, there has been no formal validation of the subbasin-wide current wildlife habitat map. Because maps are only a representation of reality and cannot depict all the detail represented in nature, some generalization is unavoidable. Remotely sensed maps developed from photo interpretation or satellite imagery also contain some errors. Conducting an accuracy assessment allows the user to know at a glance what the overall reliability is, so that when decisions are made the accuracy of the map can be taken into account. Because of the size of the mapping area, time frame, and costs, no formal accuracy assessment was done.

However, the National Biodiversity Gap Analysis Program had a goal of 80 percent overall accuracy for each state's vegetation map, and NWHI accepted their stated validity of their map products.

Finally, because there is a desire to move towards subbasin information, which would entail maps produced at finer resolutions than presented in this report, accuracy assessments may be less critical or a lower priority for the current array of map products than for later map products produced at the subbasin scale. We do recognize the importance of conducting accuracy assessments and that they would be critical to the utility and acceptance of subbasin-scale maps as a tool for resource managers. In general, accuracy assessments would entail determining the classification error in maps by using an *a priori* target level of thematic map accuracy (for subbasin mapping we would propose a per class accuracy of 75 percent and overall map accuracy of 80 percent) and designing the empirical assessment (number of sampling points, etc.) based on statistical sampling procedures.

<u>Historic Conditions</u>
NWHI developed an historic map by combining products from two previous works: Interior Columbia Basin Ecosystem Management Project (ICBEMP; USDA Forest Service 1997), and the Oregon Biodiversity Project (Defenders of Wildlife 1998). These two mapping efforts used very different methods. The ICBEMP historic data were mostly derived from a model, whereas at least using surveyors' notes from the 1850 land survey created a portion of the Oregon Biodiversity Project map.

NWHI combined these efforts to create a wildlife habitat map that depicts historic (potential) conditions of the Columbia River Basin in the U.S. The result is a historic map that is a theoretical construct with a coarse (1-km square pixel size) level of resolution designed to give a regional perspective. This map can provide only initial approximations of the presence and distribution of wildlife habitat types within specific subbasins and watersheds because of the need for more detailed information at these levels. Specifically, wildlife-habitat types that are typically small or linear in size or shape (like riparian or herbaceous wetlands) would be under-represented in the historic condition map.

Because of the limitations with the historic map, no validation of this map was done. We are unaware of any previously collected detailed information for all the subbasins and watersheds throughout the specific geographic areas of basin addressed in this project. Further, because there are no recognized historical data sets that would give such a basin perspective, validation would be difficult. Hence, the historic map best depicts gross generalizations of gains or loses of specific wildlife habitat types. Additionally, it can give a user an idea of what potential may have existed within provinces and within larger subbasins.

As discussed above, IBIS identifies 32 different habitat types as occurring in Oregon and Washington. Historically (c. 1850) the Umatilla/Willow subbasin had 13 habitat types (Table 36; Figure 95). According to IBIS, as of 1999 the subbasin still has 13 habitat types, although three habitat types (montane mixed conifer forest, alpine grasslands and shrublands, and desert playa and salt scrub) have been lost and three habitat types (agriculture, pasture, and mixed environs; urban and mixed environs; and montane coniferous wetlands) have been gained (Table 36; Figure 95).

IBIS habitat data that were believed to be inaccurate were either replaced or supplemented with additional sources of data, if available. For example, although IBIS indicates that shrub-steppe habitat has increased substantially since 1850 (Table 36; Figure 95), this increase is believed by the planning team to be primarily due to the increase of rabbit brush in agricultural lands in CRP. As discussed below, more detailed information on shrub-steppe habitat in the lower Umatilla/Willow subbasin is available; these data indicate that the acreages of high quality shrub-steppe in the Umatilla/Willow subbasin have declined significantly (Kagan et al. 1999). Habitat types in which data are believed to be inaccurate or questionable are highlighted in Table 36.

Another caveat that should be noted is that IBIS data reflect presence and absence of habitat only, and do not provide information about habitat quality.

Table 36. Historic acreage and percent cover, current acreage and percent cover, and percent change from historic to current conditions generated by IBIS 2004. Habitat types are listed in order of historic prevalence. Habitat types in which data are believed to be inaccurate or questionable are highlighted.

Habitat Type	Historic Acreage (c. 1850)	Historic Percent Cover	Current Acreage (1999)	Current Percent Cover	Percent Change[2]
Interior Grasslands	2,030,959	78%	528,269	20%	-74%
Shrub-Steppe	273,546	10.5%	628,795	24%	+130%
Ponderosa Pine Forest	143,321	5.5%	162,257	6%	+13%
Interior Mixed Conifer Forest	83,275	3%	167,299	6%	+100%
Open Water	32,371	1%	18,201	< 1%	-44%
Herbaceous Wetlands[1]	18,286	1%	4,670	< 1%	-75%
Montane Mixed Conifer Forest	247	< 1%	0	0%	-100%
Lodgepole Pine Forest	247	< 1%	33	< 1%	-87%
Upland Aspen Forest	1,236	< 1%	46	0%	-96%
Alpine Grasslands and Shrublands	741	< 1%	0	0%	-100%
Western Juniper Woodlands	2,741	< 1%	36,495	1%	+1,377%
Desert Playa and Salt Scrub	8,154	< 1%	0	0%	-100%
Interior Riparian Wetlands[1]	247	< 1%	2,541	< 1%	+928%
Agriculture, Pasture, and Mixed Environs	0	0%	1,023,421	39%	--
Urban and Mixed Environs	0	0%	18,523	1%	--
Montane Coniferous Wetlands[1]	0	0%	482	< 1%	--

[1] IBIS notes that the acreages of these habitats are only general approximations; they are likely underrepresented because of scale issues and available mapping information.
[2] Percent change cannot be calculated for habitats that had no historical acreage.

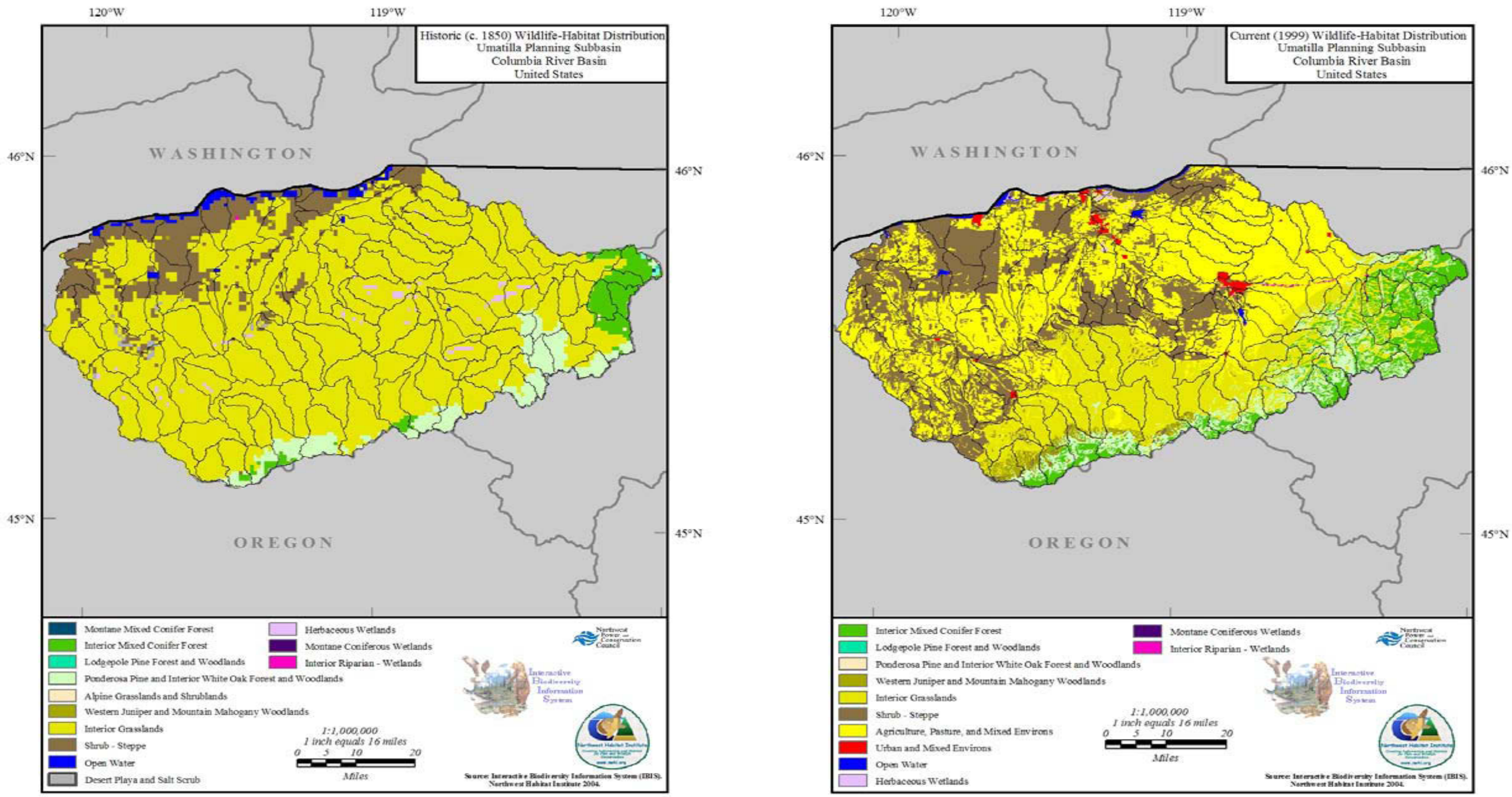

Figure 95. Historic (c. 1850) and current distribution (1999) of habitat types found in the Umatilla/Willow subbasin (IBIS 2004).

IBIS also generates information and maps on protected status (Figure 96; Table 38) and land ownership (Figure 97; Table 39). When data were believed to be inaccurate, alternative sources were used to replace or supplement IBIS data. The definitions of protected status used by IBIS are consistent with four categories described in the USGS Gap Analysis Program Handbook (Table 37; personal communication: C. Langhoff, NWHI, April 2004). Protection and ownership patterns for the eight focal habitat types are discussed in more detail below.

Table 37. Definitions used for gap analyses generated by IBIS. Definitions are from the Gap Analysis Program Handbook (http://www.gap.uidaho.edu/handbook/Stewardship/) and are derived from Scott et al. 1993, Edwards et al. 1994, and Crist et al. 1996.

Protected Status	**Definition**
High	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 disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Medium	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 uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Low	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
None	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

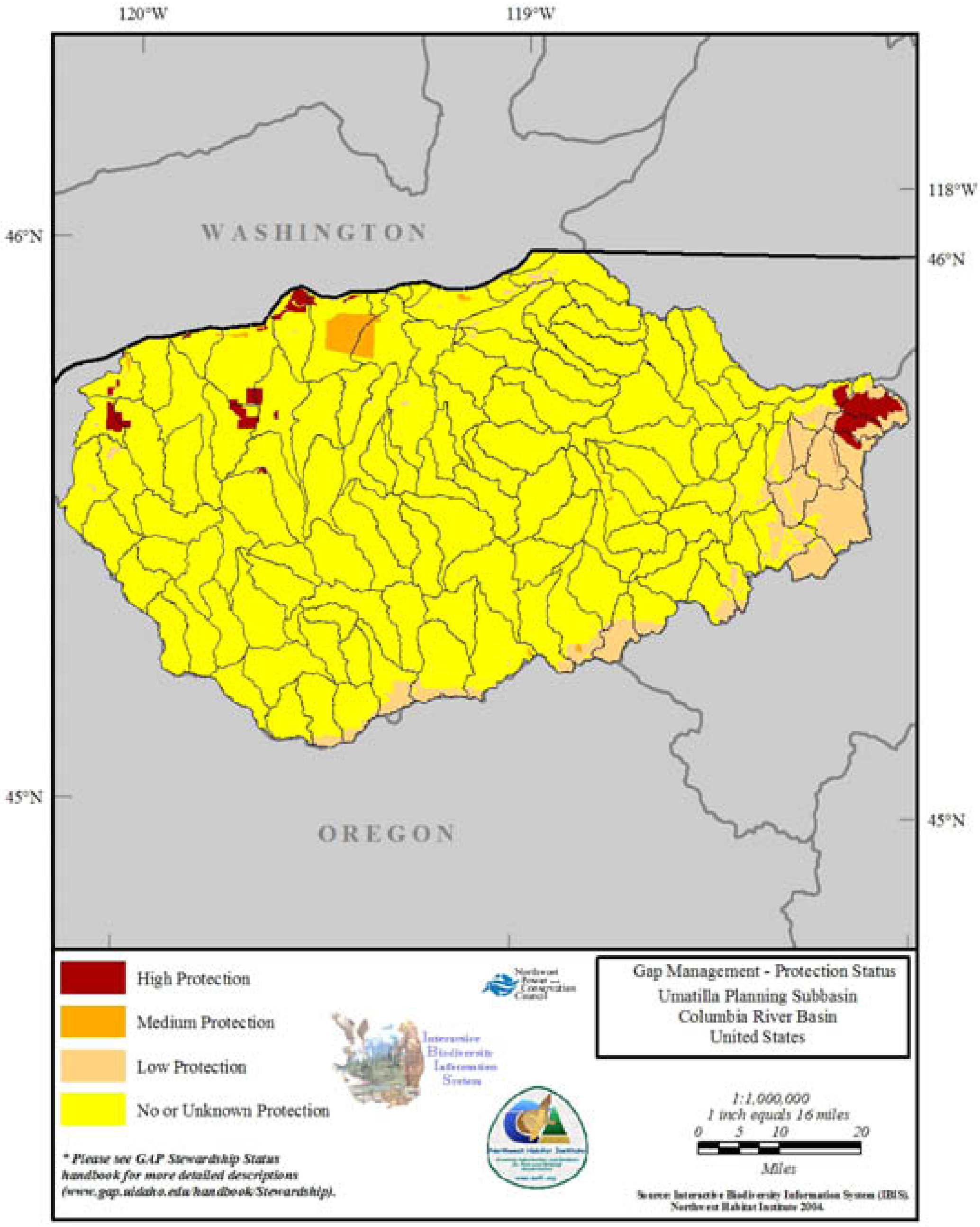

Figure 96. Protection status of habitat found in the Umatilla/Willow subbasin (IBIS 2004).

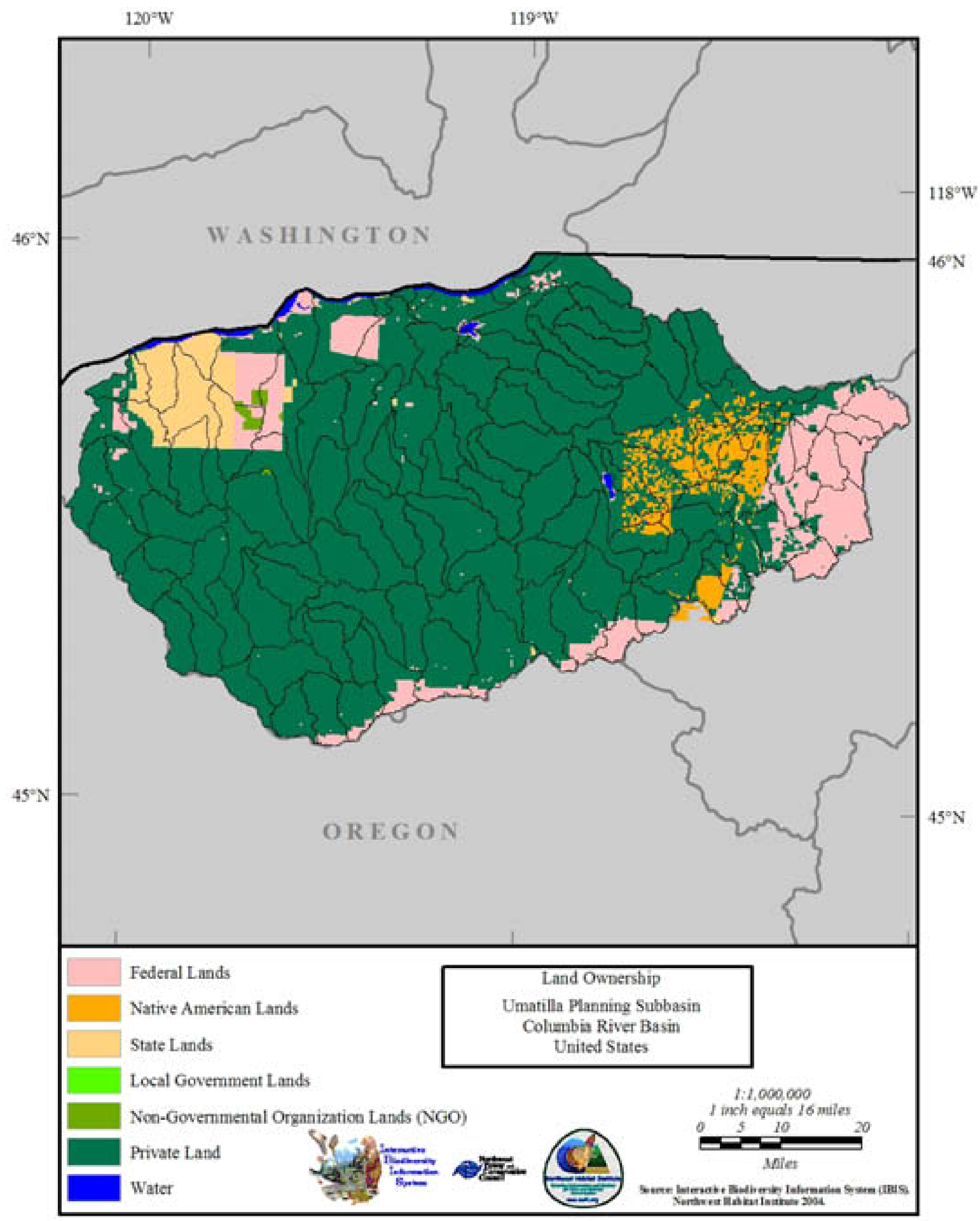

Figure 97. Ownership status of habitat found in the Umatilla/Willow subbasin (IBIS 2004).

Table 38. Estimated area of each habitat type under four different protection levels. Sources of data are denoted with superscripts.

Habitat Type:	**High Protection**	**Medium Protection**	**Low Protection**	**No Protection**
Mixed Conifer Forest[1]	12,788 acres (8%)	543 acres (<1%)	98,825 acres (59%)	55,143 acres (33%)
Ponderosa Pine[1]	3,504 acres (2%)	135 acres (<1%)	43,058 acres (27%)	115,559 acres (71%)
Western Juniper[1]	0 acres (0%)	18 acres (<1%)	525 acres (1%)	35,952 acres (99%)
Shrub-Steppe[2]				
Big Sage/Bluebunch Wheatgrass	49 (<1%)	124 (<1%)	9,200 (32%)	19,109 (67%)
Big Sagebrush Steppe	59 (<1%)	294 (<1%)	9,234 (21%)	33,499 (78%)
Bitterbrush	2,535 (6%)	8,609 (20%)	8,638 (20%)	23,670 (54%)
Rigid Sage/Sandberg Bluegrass	0 (0%)	5,468 (4%)	16,904 (14%)	102,467 (82%)
Interior Grassland[1]	3,964 acres (<1%)	0 acres (0%)	37,603 acres (7%)	486,702 acres (92%)
Herbaceous Wetlands[1]	657 acres (14%)	12 acres (<1%)	140 acres (3%)	3,861 acres (83%)
Riparian Wetlands[1,2,3,4]	(0%)	(2%)	(0-4%)	(94-98%)

1 IBIS 2004
2 Kagan et al. 2000
3 National Wetlands Inventory data
4 Adamus et al. 2002

Table 39. Land ownership of focal habitat types in the Umatilla/Willow subbasin. Sources of data are denoted with superscripts.

Habitat Type:	Federal Land	Native American Lands	State Lands	NGO Lands	Private Lands
Mixed Conifer Forest[1]	111,535 acres (67%)	11,661 acres (7%)	1,039 acres (<1%)	0 acres (0%)	43,065 acres (26%)
Ponderosa Pine[1]	45,648 (28%)	16,425 acres (10%)	825 acres (<1%)	0 acres (0%)	99,359 acres (61%)
Western Juniper[1]	525 (1%)	0 acres (0%)	18 acres (<1%)	0 acres (0%)	35,952 acres (99%)
Shrub-Steppe[2]					
Big Sagebrush Steppe	2,899 (7%)	272 (<1%)	57 (<1%)	6,733 (16%)	33,231 (77%)
Bitterbrush	13,751 (31%)	1,117 (3%)	0 (0%)	5,555 (13%)	23,529 (53%)
Rigid Sage/Sandberg Bluegrass	22,370 (18%)	502 (<1%)	25 (<1%)	0 (0%)	101,940 (82%)
Interior Grassland[1]	41,224 acres (8%)	54,430 acres (10%)	225 acres (<1%)	0 acres (0%)	432,390 acres (82%)
Herbaceous Wetlands[1]	768 acres (18%)	118 acres (3%)	260 acres (6%)	0 acres (0%)	3,229 acres (74%)
Riparian Wetlands[1,2,3,4]	(2-7%)	(1-64%)	(0-3%)	(0%)	(26-97%)

1 IBIS 2004
2 Kagan et al. 2000
3 National Wetlands Inventory data
4 Adamus et al. 2002

The following section describes the historic and current habitat distribution and protection and ownership status for each of the eight focal habitat types in the Umatilla/Willow subbasin. Detailed information about each of the focal habitat types, including descriptions of geographic range, vegetation, natural disturbance regimes, anthropogenic effects, and status and trends can be found in Appendix D. A discussion of limiting factors for each habitat is found in Section 3.5.2

INTERIOR MIXED CONIFER FOREST

As shown in Table 36 and Figure 98, the area of mixed conifer forest in the Umatilla/Willow subbasin has apparently doubled since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current mixed conifer forest of the subbasin are available through assessment databases, such as IBIS. However, the maps shown in Figure 98 accurately depict the problem of fragmentation in this habitat.

As seen in Tables 38 and 39 and Figures 96, 97, and 98 most (>90%) of the mixed conifer habitat in Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned.

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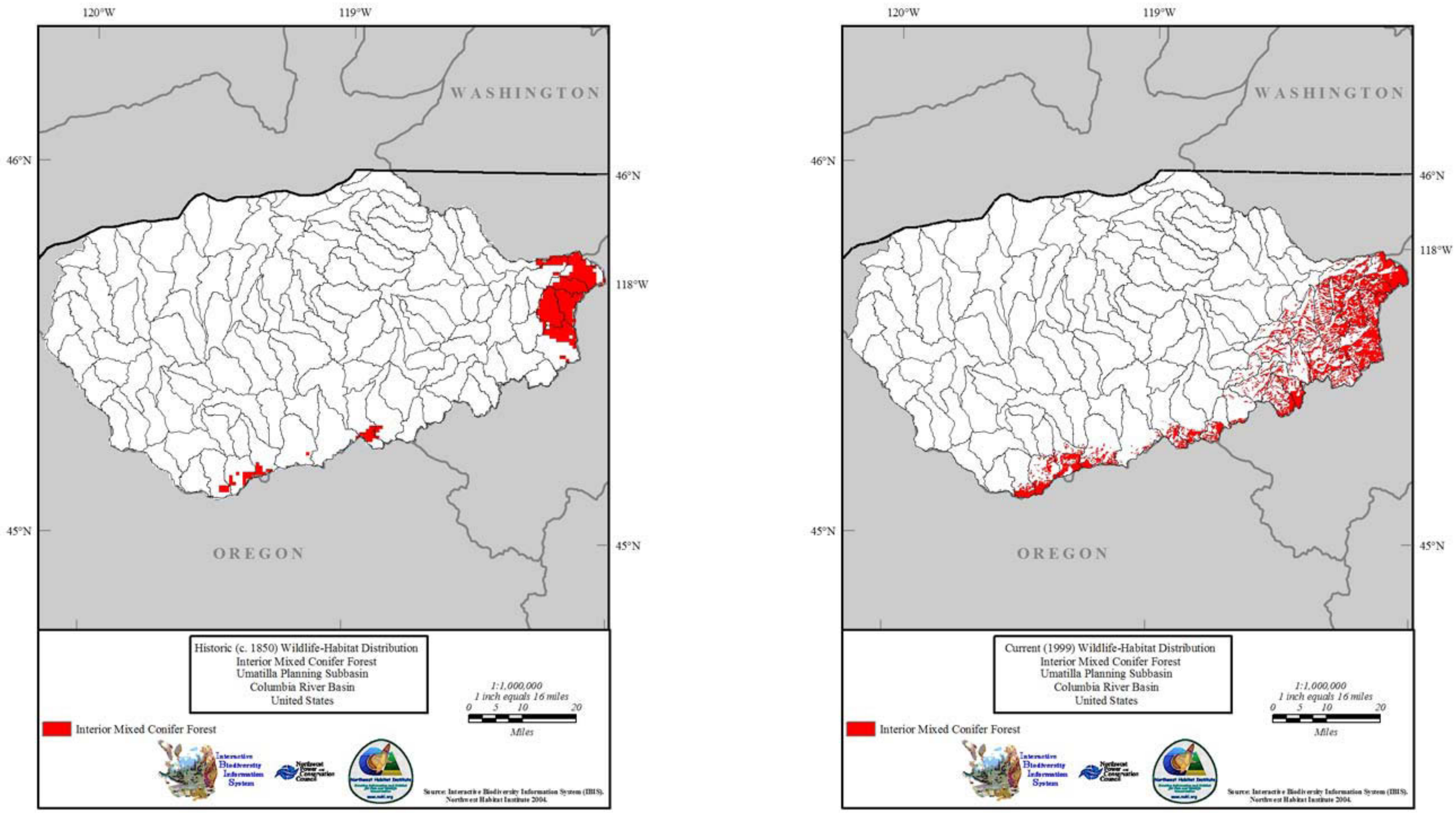

Figure 98. Historic (c. 1850) and current distribution (1999) of interior mixed conifer forest in the Umatilla/Willow subbasin (IBIS 2004).

PONDEROSA PINE FORESTS

As shown in Table 36 and Figure 99, the area of ponderosa pine forest in the Umatilla/Willow subbasin has apparently increased by over 10% since historic times (c. 1850). However, planners believe that the quality of this habitat has declined, although no quantitative data on habitat quality (e.g., structure, species or seral diversity) of historic or current ponderosa pine forest of the subbasin are available through assessment databases, such as IBIS. However, the maps shown in Figure 99 accurately depict the problem of fragmentation in this habitat.

As seen in Tables 38 and 39 and Figures 96, 97, and 99 most (98%) of the ponderosa pine habitat in Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned.

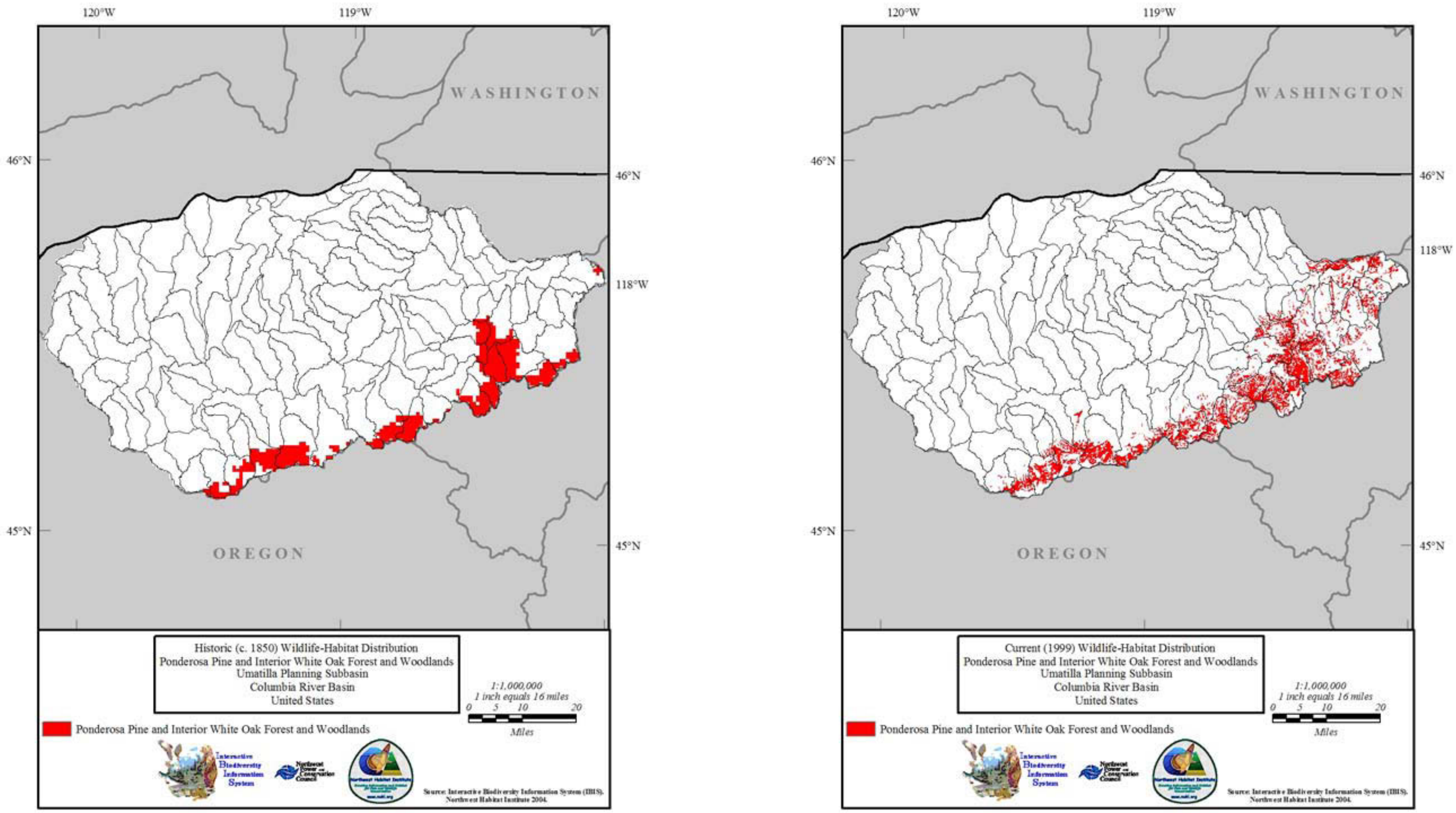

Figure 99. Historic (c. 1850) and current distribution (1999) of Ponderosa pine forests in the Umatilla/Willow subbasin (IBIS 2004).

QUAKING ASPEN FOREST

As shown in Table 36, the area of quaking aspen forest in the Umatilla/Willow subbasin has apparently decreased by 96% since historic times (c. 1850). The historical distribution of quaking aspen generated by IBIS is depicted in Figure 100; a map of current aspen distribution is not shown because of the limited habitat remaining. A recent study by CTUIR scientists provides additional data on both the potential historic distribution of aspen and its present distribution in a portion of the subbasin (Figures 101 and 102; Schumacher and O'Daniel 2004). Using a combination of field data and several spatial and statistical techniques, they determined that the current acreage in the study area was approximately 32 acres and the potential historical distribution in the study area was estimated at 60 acres. By combining IBIS and CTUIR data, the present acreage of quaking aspen in the subbasin is probably at least 80 acres. Although no quantitative data on habitat quality of historic or current quaking aspen forest of the subbasin are available through assessment databases, such as IBIS, subbasin planners believe that much of the remaining habitat is degraded.

No data are available from IBIS or other sources on the ownership or protected status of the limited amount of quaking aspen habitat in the subbasin; subbasin planners believe that most of it is on CTUIR or federal lands with an uncertain protected status.

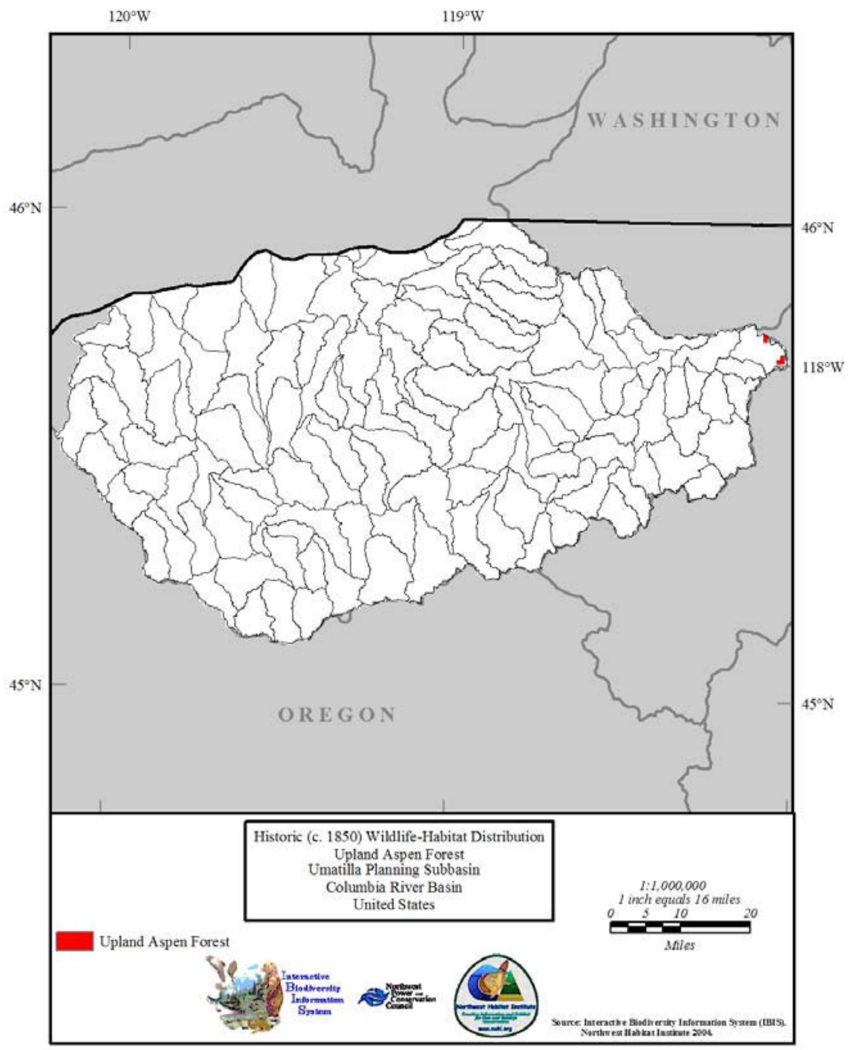

Figure 100. Historic (c. 1850) and current distribution (1999) of upland aspen forest in the Umatilla/Willow subbasin (IBIS 2004).

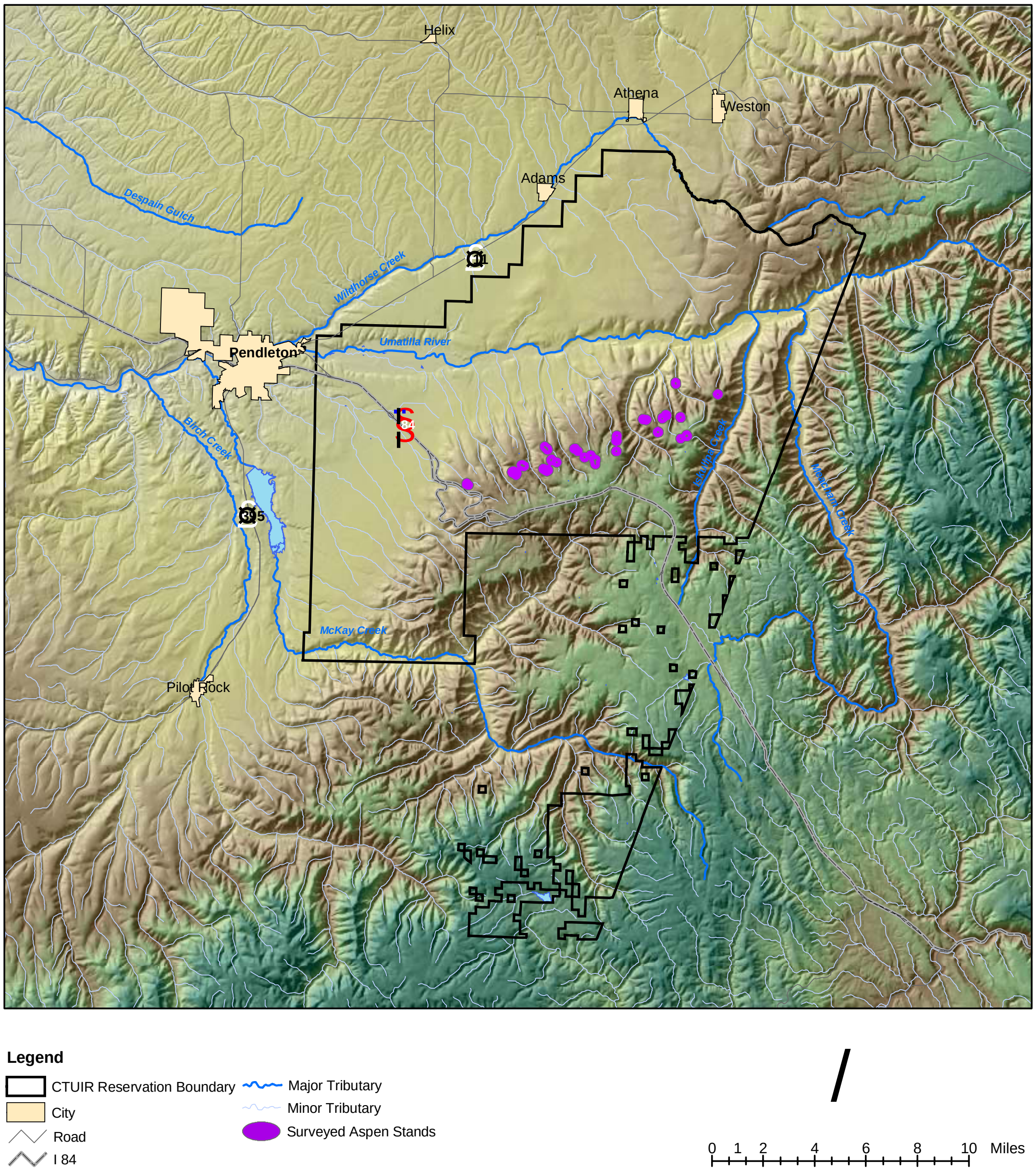

Figure 101. Surveyed aspen stands on the Umatilla Indian Reservation (map from Schumacher and O' Daniel 2004)

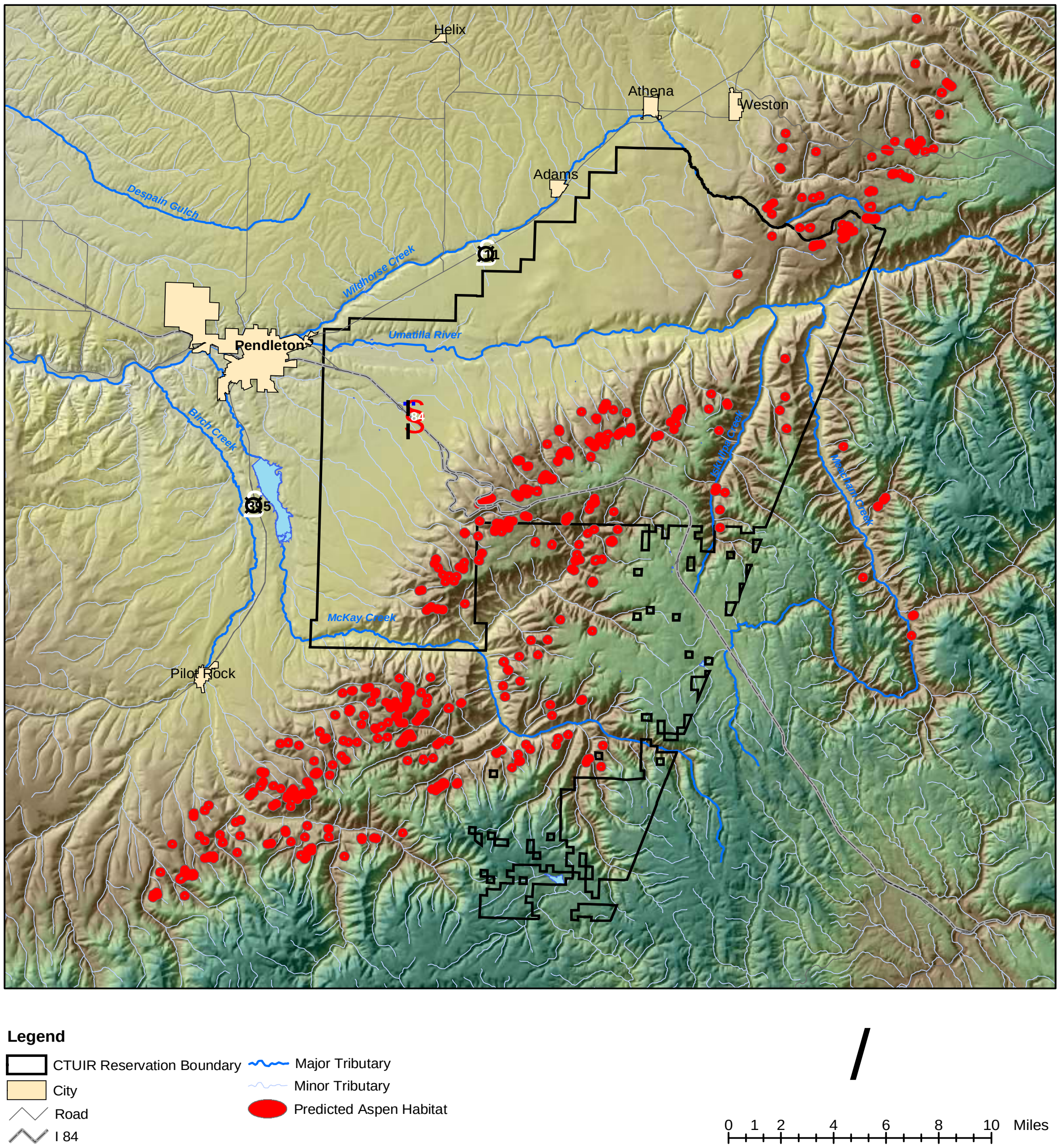

Figure 102. Predicted aspen habitat in the Umatilla Indian Reservation (map from Schumacher and O'Daniel 2004)

WESTERN JUNIPER WOODLANDS

As indicated in Table 36 and Figure 103, the area of western juniper woodland habitat in the Umatilla/Willow subbasin is estimated to have increased by over 1,000% since historic times (c. 1850) according to IBIS. However, planners believe the current acreage is overestimated. Juniper woodlands are found in two general areas of the subbasin: 1) on the foothills of the Blue Mountains in a mid-elevation transitional zone between ponderosa pine and grasslands/shrub-steppe habitats, and 2) as isolated trees or patches at lower elevations in shrub-steppe habitat. Unlike neighboring subbasins, such as the John Day subbasin, the invasion of juniper found in transitional zones into grasslands of the Umatilla/Willow subbasin is not a serious problem. Although the current distribution of mid-elevation transitional zone juniper woodland in the Umatilla/Willow subbasin compared to historical conditions is unclear, it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe are believed to be decreasing markedly, although the amount of that decline has not been well quantified because of the inability of past studies to map current juniper habitat using satellite imagery (Kagan et al. 2000). Juniper has always occurred sparsely in the western portions of the Umatilla Basin, and is still present in patches in many of the areas in which it was first seen by European settlers (Kagan et al. 2000). In these areas irrigated agriculture has been estimated to have resulted in the clearing of half to two-thirds of these stands, although important stands remain on the Boardman Bombing Range and in some canyons to the west.

As seen in Tables 38 and 39, and Figures 97, 98, and 103 virtually all of the western juniper habitat in Umatilla/Willow subbasin is under no or low protected status and most (99%) is privately owned.

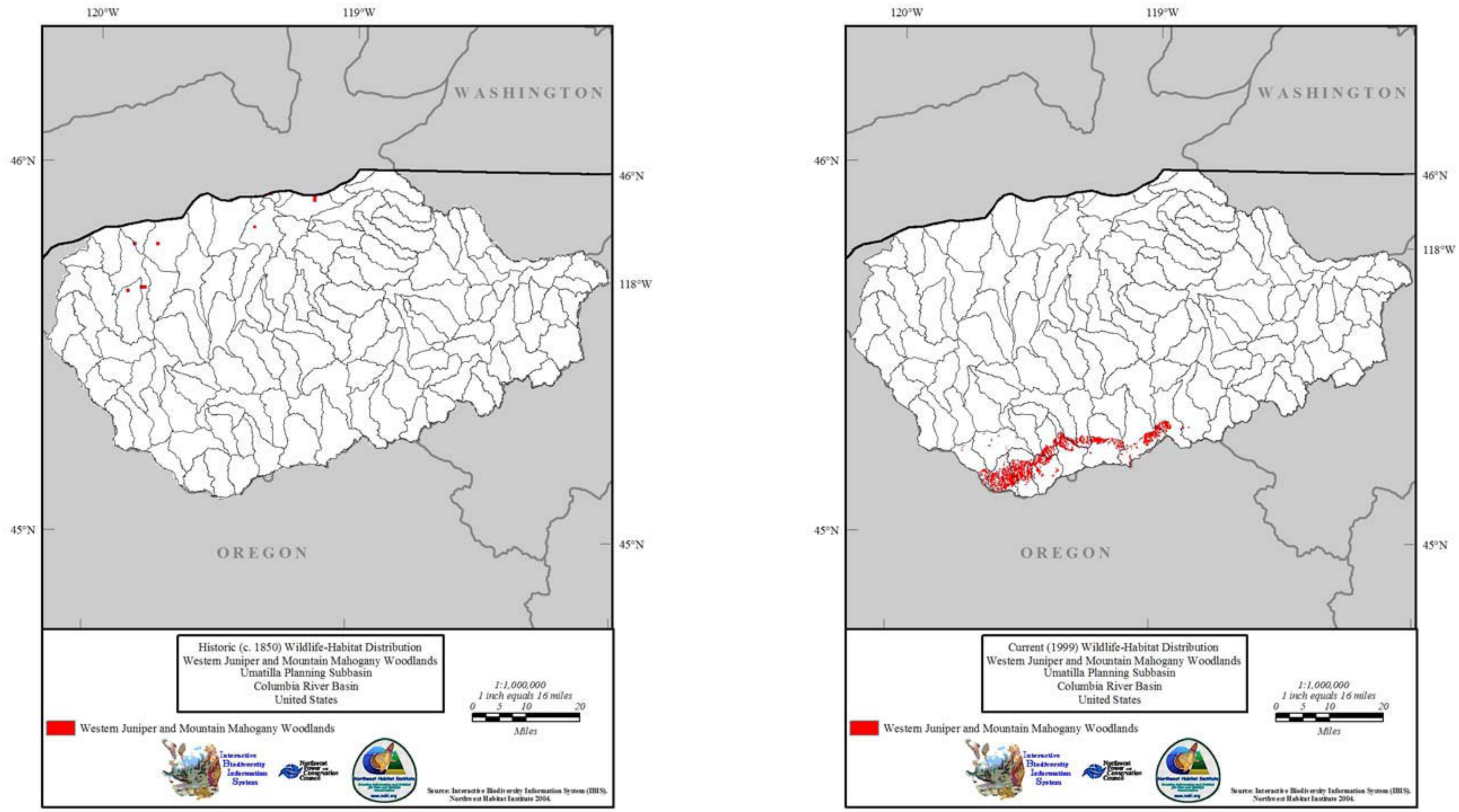

Figure 103. Historic (c. 1850) and current distribution (1999) of western juniper and mountain mahogany woodlands in the Umatilla/Willow subbasin (IBIS 2004).

SHRUB-STEPPE

Shrub-steppe habitat in the Umatilla/Willow subbasin is found both at low-elevations, where it occurs primarily on silt and sand loam soils of the lower subbasin, and at higher-elevations, where it is primarily associated with the foothills of the Blue Mountains. Figure 105 shows the historic and current distribution of shrub-steppe habitat in the Umatilla/Willow subbasin according to the IBIS database; this habitat type shows a dramatic increase (>100%) in the subbasin (Table 36). However, subbasin planners believe that large portions of the area depicted in Figure 105 is rabbitbrush associated with abandoned wheat fields that have been enrolled in CRP.

A more detailed and thorough study of shrub-steppe habitat was conducted by Kagan and colleagues (2000), who estimated historical and current distribution of specific types of shrub-steppe communities in a study area that included the majorioty of the Umatilla/Willow subbasin. They estimate that big sagebrush steppe has declined by 86% (Table 40), with most of this habitat loss occurring in the northern part of the subbasin on deeper loess soils, which are now farmed. Bitterbrush shrub-steppe, located primarily in the sandy areas of the northern part of the subbasin, has also experienced significant losses, with only 45% of the original habitat remaining (Kagen et al. 20000). The amount of higher-elevation shrub-steppe (rigid sage/sandberg bluegrass shrub-steppe) is believed not to have changed significantly since historic times and is currently estimated to be approximately 124,480 acres. The quality of both low and higher elevation shrub-steppe habitats is believed to have declined, although no quantitative data on habitat quality of historic or current shrub-steppe habitat of the subbasin are available.

Table 40. Estimated area (in acres) of historic (c. 1850) and current shrub-steppe habitat in the Umatilla/Willow subbasin.

Type of Shrub-Steppe	Historic Acreage	Current Acreage	Change in Acreage
Low Elevation Shrub-Steppe			
Big Sage/Bluebunch Wheatgrass	*	28,481	*
Big Sagebrush Steppe	302,951	43,085	-259,866 acres (-86%)
Bitterbrush	97,137	43,463	-53,674 acres (-55%)

* Not available

Protection and ownership status of shrub-steppe is shown in Tables 38 and 39. Kagan and colleagues identified five critical areas that not only contain a large portion of the existing low-elevation shrub-steppe habitat in the subbasin (up to 50%), but also the largest and highest quality remnants of low-elevation shrub-steppe. These areas are also significant because many of them have large portions of land that are owned or controlled by the federal government and TNC, which explains to some extent the patterns of ownership and protection status in low-elevation shrub-steppe evident in Tables 38 and 39. Each area is briefly described in Table 41.

Table 41. Description of five critical areas of shrub-steppe habitat in the Umatilla/Willow subbasin (from Kagen et al. 2000).

Critical Area	**General Description**
Horne Butte-Willow Creek	This area consists of BLM and adjacent private lands and includes high quality sagebrush habitat in the Willow Creek canyon. Its close proximity to the Boardman Bombing Range provides an important opportunity to restablish connectivity.
Boardman Bombing Range	The Boardman Bombing Range contains some of the best remaining examples of big sagebrush and bitterbrush habitat in Oregon. It includes the largest protected area in the lower Umatilla Basin – the Boardman Research Natural Area. The Nature Conservancy manages 4,750 acres on the Boardman Bombing Range.
Boeing Lease Lands	The property referred to as the Boeing Lease Lands is a 93,000 acre block of land owned by the state of Oregon, which was leased to the Boeing Company in 1963. No longer leased by Boeing, the area contains a small but very high quality bitterbrush remnant which may be the best example of this habitat in the world. The site also provides a connection between large blocks of habitat at the Boardman Bombing Range and habitat at Horne-Butte Willow Creek. The Nature Conservancy took over management of 22,642 acres of the former Boeing lease lands in 2001 and has begun developing long-term management and restoration plans for the property.
Umatilla Army Depot	The Umatilla Army Depot includes the largest remnants of Columbia Basin bitterbrush habitat.
Juniper Canyon	This is a small area, but represents the only remaining un-farmed area in the north-central portion of the Umatilla/Willow subbasin. It also contains unusual western Juniper and shrub habitats.

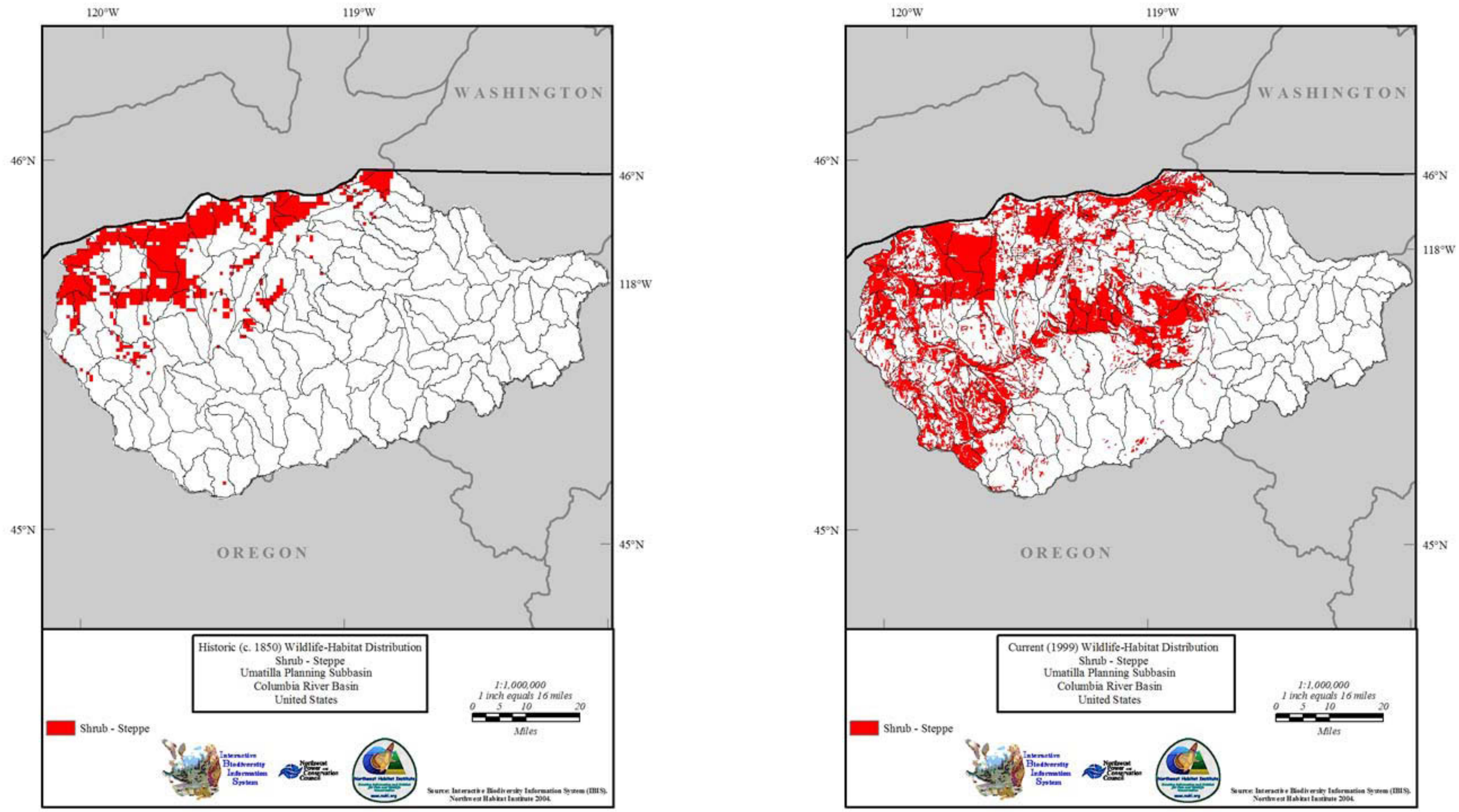

Figure 104. Historic (c. 1850) and current distribution (1999) of shrub-steppe habitat in the Umatilla/Willow subbasin (IBIS 2004).

EASTSIDE INTERIOR GRASSLANDS

As indicated in Table 36 and Figure 105, interior grasslands in the Umatilla/Willow subbasin are estimated to have declined by 74% since historic times (c. 1850). In addition, subbasin planners believe that the quality of remaining grassland habitat has also decreased, although no quantitative data on habitat quality of historic or current interior grasslands of the subbasin are available through assessment databases.

As seen in Tables 38 and 39 and Figures 96, 97, and 105, the vast majority (99%) of grassland habitat in the Umatilla/Willow subbasin is under no or low protected status and most (82%) is privately owned.

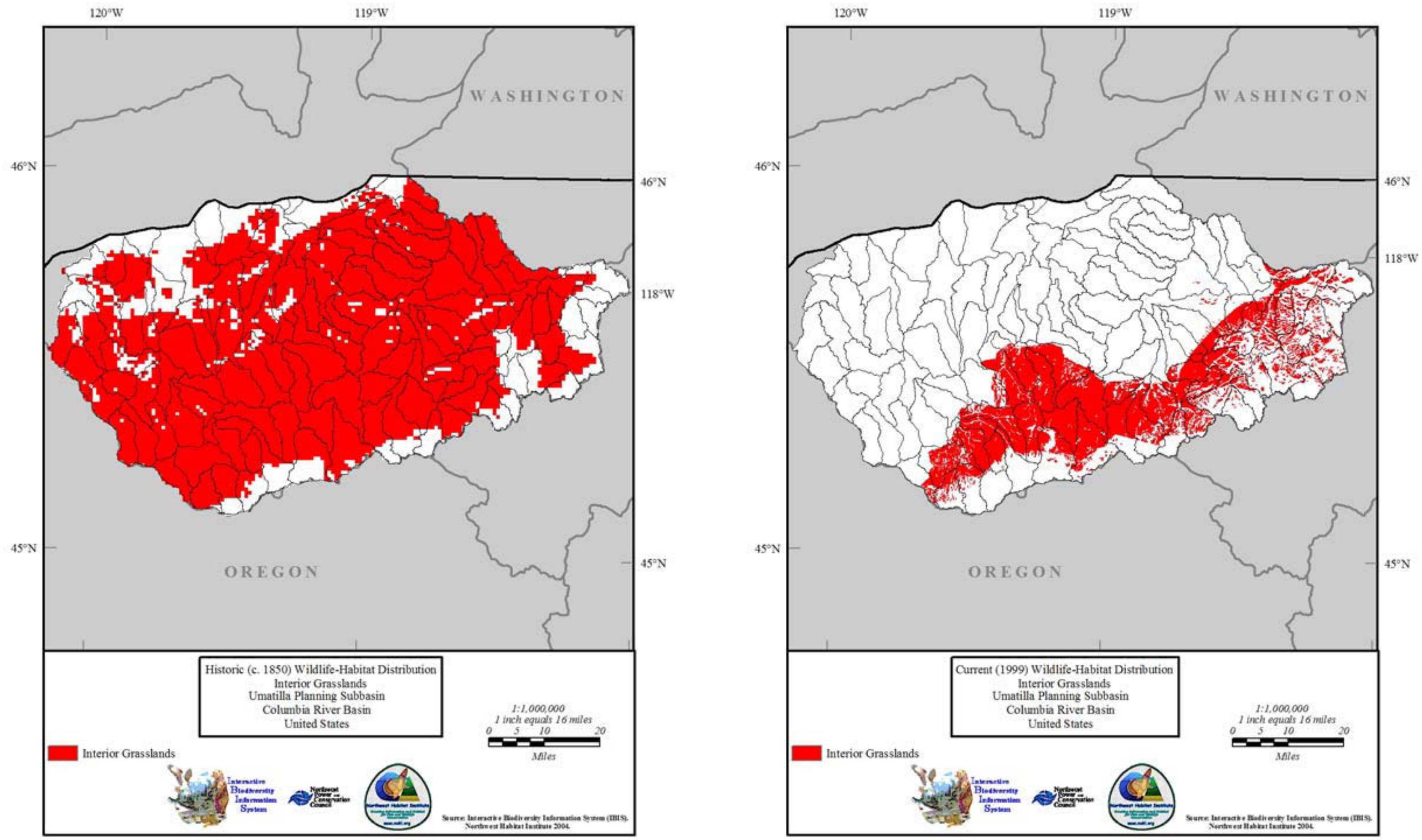

Figure 105. Historic (c. 1850) and current distribution (1999) of eastside interior grasslands found in the Umatilla/Willow subbasin (IBIS 2004).

HERBACEOUS WETLANDS

As indicated in Table 36 and Figure 106, the area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850). Although data produced by IBIS is consistent with National Wetlands Inventory (NWI) data, a study conducted in the subbasin suggests that NWI maps may be inaccurate. According to Adamus and colleagues (2002) NWI maps are limited because they rely on aerial photos from July 1981 that have fairly coarse resolution. Also wetlands depicted on NWI do not necessarily meet federal land state jurisdictional criteria for wetlands. Regardless of the exact amount of herbaceous wetland in the subbasin, planners believe that the quality of that habitat has deteriorated, although no quantitative data on habitat quality of historic or current herbaceous wetland habitat of the subbasin are available.

As seen in Tables 38 and 39 and Figures 96, 97, and 106, most (86%) of the herbaceous wetland habitat in Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned.

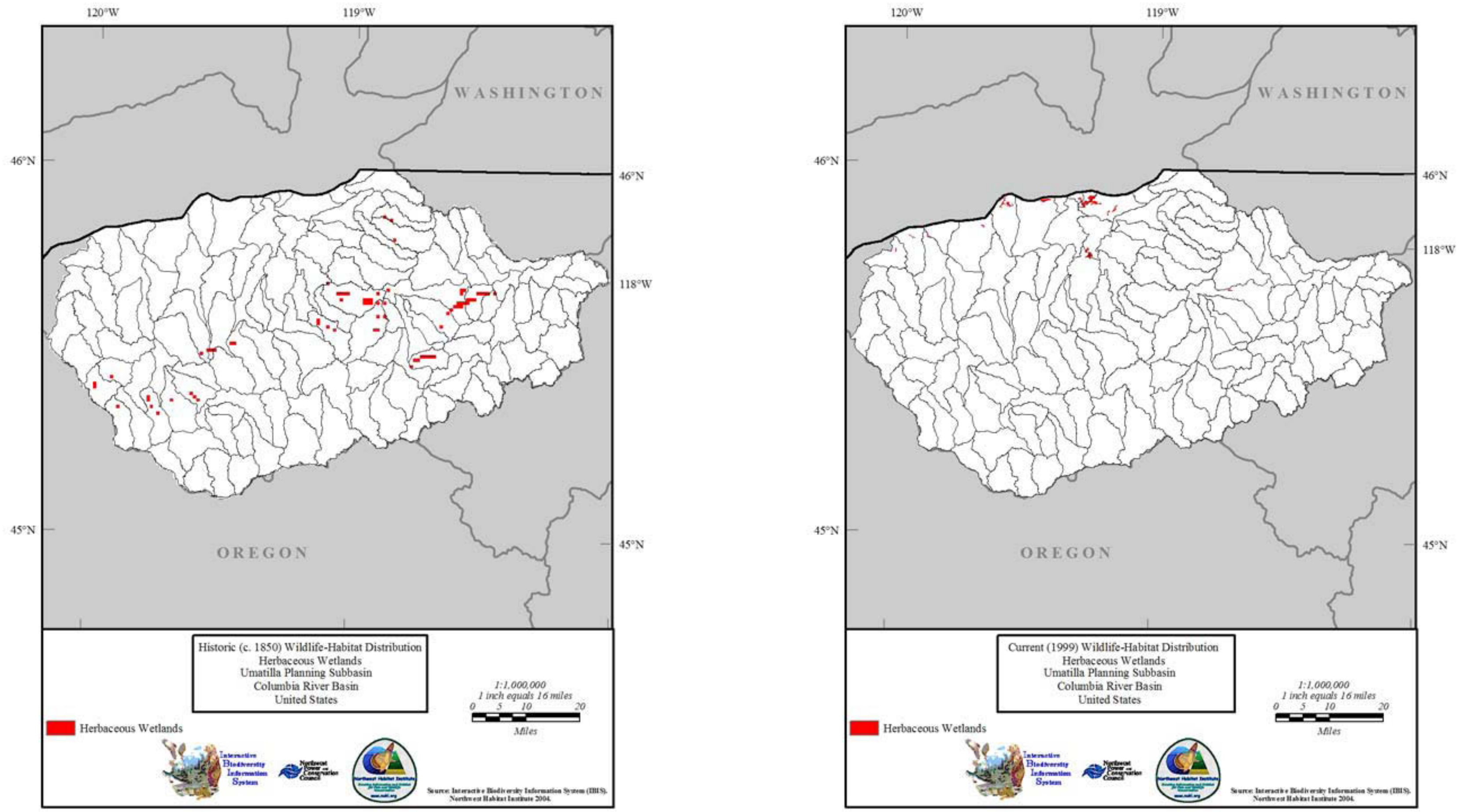

Figure 106. Historic (c. 1850) and current distribution (1999) of herbaceous wetlands in the Umatilla/Willow subbasin (IBIS 2004).

INTERIOR RIPARIAN WETLANDS

The amount of riparian wetland presently occurring in the Umatilla/Willow subbasin is uncertain. Data produced by IBIS suggesting that riparian wetlands have increased by over 900% are not accurate. However, the problem with IBIS data probably relates to underestimating the historical distribution of riparian wetlands. The current acreage of riparian wetlands estimated by IBIS (2,541 acres) is fairly consistent with estimates from other sources. For example, data from NWI estimate riparian wetland acreage in the Umatilla/Willow subbasin to be 1,137 acres, and Kagan et al. (2000) estimated riparian wetland acreage at 11,020 acres, although their study area included some areas outside the boundaries of the Umatilla/Willow subbasin. Regardless of the amount currently existing in the subbasin, the loss of riparian wetlands in the subbasin is estimated to have been severe. According to Kagan and colleagues (2000), riparian areas have shown a loss of 87%, which they believe to be an underestimate because the historical estimates were determined using information recorded by GLO surveyors, who only reported the largest riparian bottomland areas. Many thousands of acres dominated by willows with scattered alder and cottonwood were not reported, and therefore they suggest true losses probably exceeded 95%.

Several studies support the conclusion of subbasin planners that the quality of remaining riparian wetland habitats are poor (e.g., Watershed Professionals and Duck Creek Associates 2003, Wooster and DeBano 2003), although no quantitative data on historic riparian wetland habitat of the subbasin are available.

3.3 Out-of-Subbasin Effects

3.3.1 Aquatic

During the outmigration of smolts, ocean residency of growing subadults, and the spawning return of adults, salmon and steelhead encounter a variety of “out-of-subbasin” effects that negatively impact their populations. These effects include poor habitat in the Columbia River, the Columbia River estuary, and the ocean resulting from anthropogenic influences; dam passage, and harvest in both the Columbia River and the ocean. These effects are summarized briefly below.

The development of the federal hydropower system on the Columbia River has dramatically changed the habitat of the river from a free-flowing lotic system to a series of slow-flowing reservoirs. This change in flow as well as the need to navigate around dams has increased the passage time through the Columbia River of both outmigrating smolts and returning adults (NRC 1996). This increase in travel time has been identified as “…a key obstacle to survival of juvenile salmon and steelhead” (NRC 1996, pg. 243). With increased time spent in the reservoirs of the Columbia River comes an increase in mortality resulting from a variety of factors, including disease and predation (Raymond 1979, Rieman et al. 1991).

For salmon and steelhead of the Umatilla/Willow subbasin travel through the Columbia River also involves passing three hydroelectric dams (John Day, The Dalles, Bonneville). Dam passage is another source of significant mortality for both outmigrating juveniles and adults. Current estimates suggest that mortality at each facility is 4-5% (NRC 1996).

Before reaching the ocean, outmigrating juveniles pass through the Columbia River estuary. Estuaries are important environments for outmigrating juvenile salmon and steelhead. They provide abundant food resources and protected habitat (salt marshes and eelgrass beds) in which juveniles of some species (e.g., Chinook) grow considerably before entering the ocean (Steelquist 1992). Hydropower development has greatly affected the Columbia River estuary. By altering the Columbia River hydrograph less sediment is delivered to the estuary, the residence time of freshwater has increased resulting in reduced salinity, and there has been an increase in detritus in the estuary (NRC 1996). These changes have resulted in a loss of invertebrate productivity (the main food source for juvenile salmon) and a loss of protected habitat, which may result in increased mortality from predators (NRC 1996).

Upon reaching the ocean, salmon and steelhead populations are influenced by conditions found there. These conditions are greatly influenced by a recurring climatic pattern called the Pacific Decadal Oscillation (PDO) (Taylor and Southards 2003). TOAST (2004) summarized the impacts of the PDO on Columbia River salmon and steelhead as follows:

> The Pacific Decadal Oscillation is a pan-Pacific, recurring pattern of ocean-atmospheric variability that alternates between climate regimes every 20-30 years (Hare et al. 1999). The PDO affects water temperatures off the coast of Oregon and Washington and has cold (negative) and warm (positive) phases (Hare et al. 1999). A positive PDO phase brings warmer water to the eastern North Pacific, reducing upwelling of nutrient-rich cooler water off the coast of North America and decreasing juvenile salmon survival (Hare et al. 1999). The negative phase of the PDO has the opposite effect, tending to increase salmon survival.
>
> Climatic changes are manifested in both returns and harvest. Mantua et al. (1997) found evidence of an inverse relationship between harvests in Alaska and off the coast of Oregon and Washington. The negative phase of the PDO resulted in larger harvests of Columbia River stocks and lower harvests of Alaskan stocks. In the positive phase, warmer water resulted in lower harvests (and runs) in the Columbia River, but higher harvests in Alaska. Phase reversals occurred around 1925, 1947, 1977, and possibly 1999. The periods from 1925-1947 and from 1977-1999 were periods of low returns to the Columbia River, while periods from 1947-1977 and the current period are periods of high returns.

Finally, Umatilla/Willow subbasin salmon and steelhead populations are also influenced by out-of-subbasin harvest, both in the Columbia River and in the ocean. This harvest is summarized in a report by WDFW and ODFW (2002).

The total impact on an anadromous fish population of all of these out-of-subbasin effects can be aggregated into a single value, the smolt-to-adult survival or SAS. The SAS is calculated by dividing the total number of adults that return for a given brood year by the estimate of the number of smolts that left the subbasin for that brood year. In the Umatilla/Willow subbasin these data are available for hatchery and naturally produced summer steelhead and spring Chinook and for hatchery reared fall Chinook (Table 42).

Table 42. Estimates of out-of-subbasin effects on anadromous salmonid populations in the Umatilla/Willow subbasin. This estimate is the percentage of smolts that return as adults (SAS) for hatchery production and natural production. Data from Chess et al. (2003).

Brood Year	Steelhead		Spring Chinook		Fall Chinook
	Hatchery SAS	Natural SAS	Hatchery SAS	Natural SAS	Hatchery SAS
1991	0.110 %		0.117 %		
1992	0.413 %		0.306 %		
1993	0.543 %		0.376 %		
1994	0.928 %		0.003 %		
1995	0.374 %		1.009 %		
1996	0.302 %	5.2 %	0.400 %	3.2 %	0.020 %
1997	0.281 %	2.7 %		1.6%	0.004 %
Average	**0.422 %**	**3.95 %**	**0.369 %**	**2.4 %**	**0.012 %**

These estimates reveal that a very large proportion of these populations are lost resulting from out-of-subbasin impacts. In addition, while the data for naturally produced fish is limited, it appears that their out-of-subbasin survival is much higher than hatchery produced fish. Measurements of the survival of hatchery and naturally produced outmigrating smolts released from Three Mile Falls Dam (RM 3.7) and an ODFW trap to the John Day Dam on the Columbia River indicate that even after that brief period out of the subbasin, hatchery produced fish (of both steelhead and Chinook) are already surviving at a lower rate than naturally produced fish (Table 43) (Ackerman et al. 2003).

Table 43. Survival rate of hatchery and natural steelhead and Chinook smolts from near the mouth of the Umatilla River to the John Day Dam. Data from Ackerman et al. 2003.

Migration Year	Rear Type	Number Released	Estimated Survivors to John Day Dam	Estimated Survival Rate
		Steelhead		
1999	Natural	1830	1427	0.780
	Hatchery	1508	1102	0.731
2001	Natural	281	99	0.354
	Hatchery	329	77	0.235
		Chinook		
1999	Natural	653	560	0.858
	Hatchery	1104	404	0.366

It is unclear why the survival of hatchery reared fish is so much lower than that of naturally produced fish. Several factors are most likely responsible for this including high levels of stress in hatchery fish, inappropriate behavior resulting from hatchery rearing and predation. For example, tern predation on outmigrating smolts in the Columbia River estuary has recently received attention because of the large number of terns that have colonized Rice island, a man-made island formed from dredge spoil. Work by Collis et al. (2001) revealed that hatchery reared steelhead and Chinook were more vulnerable than naturally produced fish of both species to tern predation in the estuary. The authors attribute this to differences in the behavior of hatchery and wild fish -- hatchery fish spend more time near the water surface where terns forage, and this behavior most likely results from the manner in which they were fed in hatcheries (with floating food pellets).

The estimates of out-of-subbasin survival in Table 42 illuminate the need to improve out-of-subbasin conditions to enhance adult returns to the subbasin. However, within-subbasin survival is obviously also an important issue. Within-subbasin survival has been estimated for hatchery spring Chinook outmigrating smolts and for adults from passage at TMFD to spawning (Table 44).

By comparing Table 42 and 44, it is obvious that out-of-subbasin survival for spring Chinook is much lower than survival within the subbasin. This is not surprising given the fact that the Umatilla/Willow subbasin represents only a tiny fraction of the total habitat used by spring Chinook throughout their life cycle and the very brief period of time that the spring Chinook, for which we have within-subbasin survival estimates, spend in the subbasin (particularly given that the juvenile survival estimate is for hatchery releases smolts that immediately start to outmigrate once they are released). However, these estimates of within-subbasin survival also reveal that there is much room for improvement for survival within the subbasin. In addition, these estimates of within-subbasin survival reveal an important data gap: accurate estimates of the survival of naturally produced fish from the egg stage to outmigrating smolts. This is a critical time at which within-subbasin survival might be very low given the poor habitat conditions and high water temperatures characteristic throughout much of the subbasin.

Table 44. Estimates of within-subbasin survival for spring Chinook. Data for smolt survival from Chess et al. (2003) and data for adult survival from Kissner (2003).

Year	Hatchery Smolt Survival[a]	Adult Surival to Spawning[b]
1991	Not Calculated	23.6%
1992	Not Calculated	29.3%
1993	Not Caclulated	42.9%
1994	Not Calculated	52.3%
1995	Not Caclulated	41.0%
1996	34%	32.5%
1997	Not Applicable[c]	35.9%
1998	104%	43.0%
1999	81%	45.3%
2000	95%	43.1%
2001	18%	28.1%
2002	Not Available	32.0%
Average	**66.4%**	**37.4%**

a Smolts were released in the Umatilla River mainstem at RM 79.5 and collected at RM 3.7 in 1996 and RM 1.2 in 1998-2001. Survival was calculated by dividing the estimated number of hatchery smolts passing the trap location by the known number of hatchery smolts released at RM 79.5. Data from Chess et al. (2003).
b The percent of the adults surviving to spawning was calculated as the percent of total adult carcasses found that had spawned. Estimates are for natural and hatchery fish combined. Data from Kissner (2003).
c In 1997 ODFW changed their smolt trapping methodology from the use of an irrigation canal bypass trap to the use of rotary screw traps. However, a reasonable estimation of the proportion of smolts captured using rotary screw traps was not developed until 1998. Therefore, the outmigrating smolt numbers for 1997 are considered inaccurate and were not used to calculate smolt survival.

3.3.2 Terrestrial

As with aquatic species, out-of-subbasin effects will be of concern for migratory species or species with large home ranges that may span two or more subbasins. Only five of the Umatilla/Willow subbasin's focal species are known to migrate: the Great Blue Heron, the Yellow Warbler, the Red-naped Sapsucker, the Sage Sparrow, and the Grasshopper Sparrow. Very little is known about the magnitude of out-of-subbasin effects for any of these species, although some generalizations can be made. Habitat destruction and degradation along the migratory route, as well as in the wintering location, may negatively impact some species. However, subbasin planners believe that focal species populations in the subbasin are primarily limited by factors operating within the subbasin rather than factors operating outside of the subbasin, at least to the point that habitat improvements undertaken within the subbasin are predicted to result in increases in focal species populations.

Ashley and Stoval (2004) describe some of the factors that may negatively affect the five migratory species outside of the subbasin (Ashley and Stoval, 2004)

Great Blue Heron
Great Blue Heron may be affected by poor water quality within their winter range. Poor water quality can negatively affect the species by 1) reducing the amount of large fish and invertebrate species available in wetland areas, and 2) introducing toxic chemicals into the food chain, where they accumulate in the tissues of prey and may eventually cause reproductive failure in the herons.

Yellow Warbler
Poor riparian habitat and increased pesticide use are two negative effects Yellow Warblers may encounter as they migrate. Increased pesticide use in the metropolitan areas, especially with the outbreak of mosquito born viruses like West Nile Virus, may impact food availability.

Red-naped Sapsucker
Migrating Red-naped Sapsuckers may have an increased probability of hybridizing with Red-breasted Sapsuckers and Yellow-bellied Sapsuckers where distributions overlap.

Sage Sparrow and Grasshopper Sparrow
Both species are especially vulnerable to loss and fragmentation of shrub steppe habitat throughout their respective travel corridors.