3.6 Synthesis and Interpretation

3.6.1 Aquatic Focal Species Synthesis and Interpretation

3.6.1.1 Restoration Scenarios and Working Hypotheses

Based on the EDT results, the aquatic working group determined that the important limiting factors could be addressed through habitat restoration and implementation of Phase III of the Umatilla Basin Project. Implementation of Phase III will involve increased instream flows in the mainstem from Thornhollow (RM 73.5) to the mouth and will impact GAs 1, 2, 9, 11, 25, and 28. Each of these actions should result in lower water temperatures, increased passage survival, and increased habitat quantity. Habitat restoration (based on specific habitat objectives and strategies that are outlined in the Management Plan) should also address sediment loads and habitat complexity. From this, three restoration scenarios were examined with EDT:

1) Habitat restoration of the top priority geographic areas singly plus the implementation of Phase III of the Umatilla Basin Project.
2) Habitat restoration of the top 19 geographic areas plus implementation of Phase III.
3) Habitat restoration of the top 19 geographic areas with no implementation of Phase III.

The impact of each of these scenarios on the anadromous focal species was determined through EDT. EDT output provides a working hypothesis on the impact that each scenario has on the productivity and abundance of steelhead and salmon.

Working Hypotheses

Steelhead – EDT estimate of current abundance = 2,650 adults and productivity = 4.9

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in no impact on productivity and an increase in returning adult abundance by approximately 2% (adult abundance = 2,705).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 43% (a value of 7.0) and an increase in returning adult abundance by approximately 36% (an abundance of 3,610 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 37% (a value of 6.7) and an increase in returning adult abundance by approximately 30% (an abundance of 3,443 adults).

These results are shown graphically in figures 149 and 150.

Figure 149. EDT estimate of current abundance and results showing the impacts on abundance of adult steelhead under the three restoration scenarios.

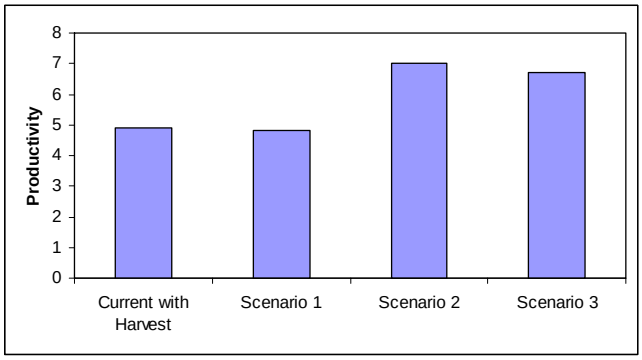

Figure 150. EDT estimate of current productivity and results showing the impacts on productivity of the steelhead population under the three restoration scenarios.

Spring Chinook – EDT estimate of current abundance = 440 adults and productivity= 2.3

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 42% (a value of 3.4) and an increase in returning adult abundance by approximately 152% (adult abundance = 1,108).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 100% (a value of 4.6) and an increase in returning adult abundance by approximately 287% (an abundance of 1,702 adults).

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 83% (a value of 4.2) and an increase in abundance of returning adults by approximately 127% (an abundance of 998 adults).

These results are shown graphically in figures 151 and 152.

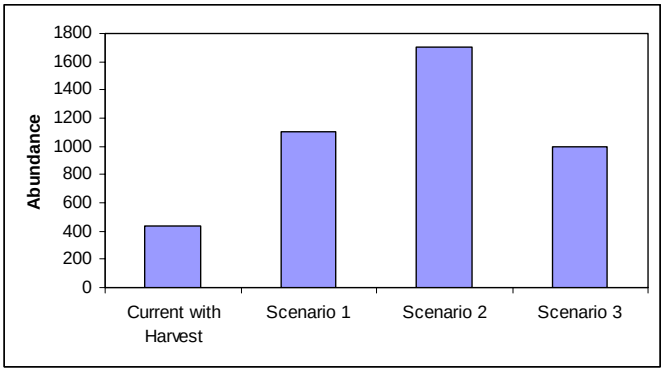

Figure 151. EDT estimate of current abundance and results showing the impacts on abundance of adult spring Chinook under the three restoration scenarios.

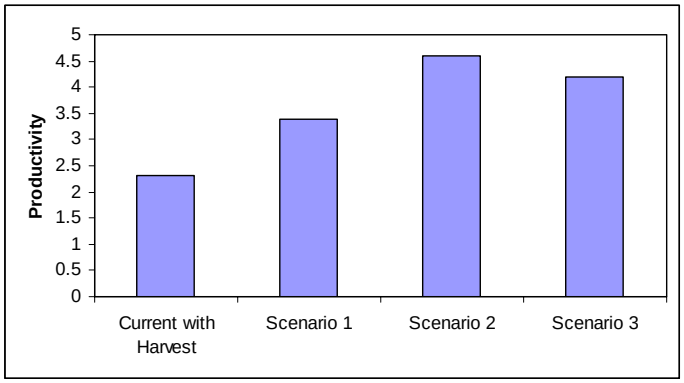

Figure 152. EDT estimate of current productivity and results showing the impacts on productivity of the spring Chinook population under the three restoration scenarios.

Fall Chinook – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 200% (a value of 1.2) and an increase in returning adult abundance to approximately 1,457 fish.

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 350% (a value of 1.8) and an increase in returning adult abundance to approximately 4,192 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 275% (a value of 1.5) and an increase in abundance of returning adults to approximately 3,005 fish.

These results are shown graphically in figures 153 and 154.

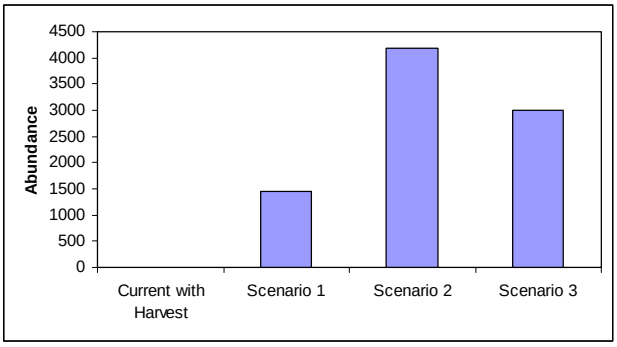

Figure 153. EDT estimate of current abundance and results showing the impacts on abundance of adult fall Chinook under the three restoration scenarios.

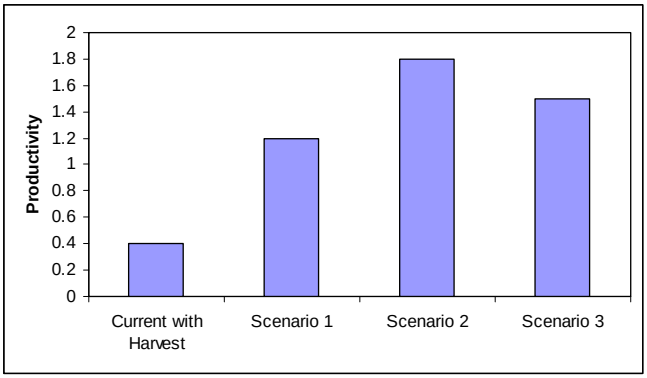

Figure 154. EDT estimate of current productivity and results showing the impacts on productivity of the fall Chinook population under the three restoration scenarios.

Coho – EDT estimate of current abundance = 0 adults and productivity = 0.4

1) Restoration of the top priority geographic area (the area ranked 1) plus the implementation of Phase III will result in an increase in productivity by 25% (a value of 0.5); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

2) Restoration of the top 19 priority geographic areas plus implementation of Phase III will result in an increase of productivity by 150% (a value of 1.0) and an increase in returning adult abundance to approximately 69 fish.

3) Restoration of the top 19 priority geographic areas with no Phase III will result in an increase in productivity by 125% (a value of 0.9); however, the number of adult returns will continue to be so small as to be negligible (i.e., recognized as 0 by EDT).

These results are shown graphically in figures 155 and 156.

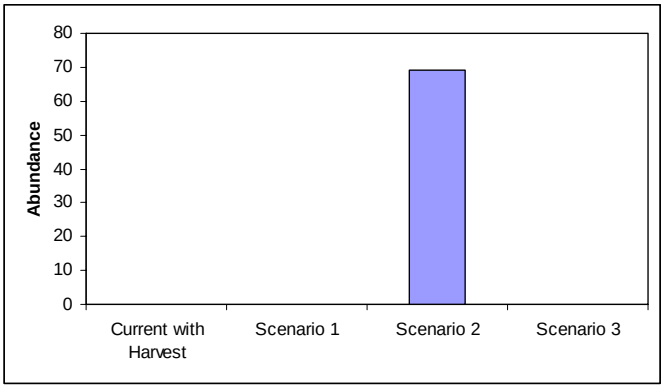

Figure 155. EDT estimate of current abundance and results showing the impacts on abundance of adult coho under the three restoration scenarios.

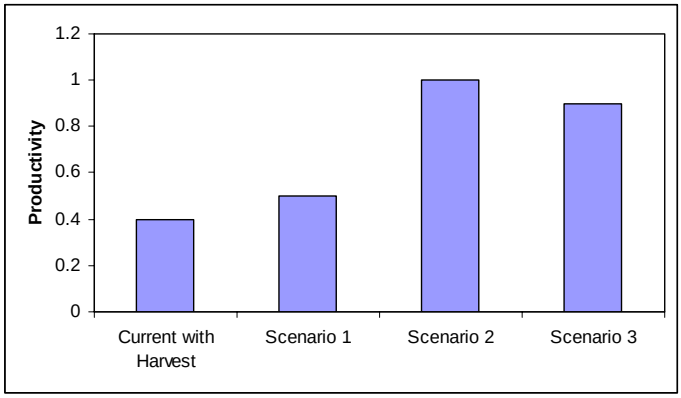

Figure 156. EDT estimate of current productivity and results showing the impacts on productivity of the coho population under the three restoration scenarios.

Not surprisingly, these results suggest that the greatest amount of action (restoring all 19 geographic areas and implementing Phase III) has the greatest impact on steelhead and salmon productivity and abundance. However, the relative benefit of different actions varies among the species. For example, implementation of Phase III has a relatively small impact on steelhead, while restoring all 19 areas has a large impact. In contrast, implementing Phase III and restoring only the most important geographic area has a greater impact on spring Chinook than restoring all 19 areas and not implementing Phase III. A future challenge will be to examine the economic cost effectiveness, cultural, social, and political ramifications of each restoration scenario. However, the aquatic working group has adopted as adult abundance objectives those abundances found under restoration scenario 2, restoration of all priority areas and implementation of Phase III, and therefore efforts will be made to restore as many priority areas as possible and to

support the development and implementation of Phase III (see Management Plan, Section 5).

The QHA model does not present quantitative measures of the benefits accrued from restoration. However, it does prioritize areas for restoration and protection and ranks limiting factors. Qualitative working hypotheses, based on the results of QHA, for bull trout and redband trout are presented below.

Bull Trout
Restoration of the top priority areas designed to address channel complexity, high water temperatures, and channel form will result in increases in bull trout abundance.

Redband Trout
Restoration of the top priority areas designed to address channel form, riparian condition, and fine sediment will result in increases in redband trout abundance.

The aquatic working group has developed a set of working hypotheses (and objectives and strategies) for each of the priority restoration areas. These hypotheses are outlined in the Management Plan, Section 5, and were not shown here for the sake of brevity.

3.6.1.2 Desired Future Conditions and Properly Functioning Conditions

The general desired future condition is to develop steelhead and salmon populations to levels that provide for tribal and sports harvest and enough spawning escapement to enhance natural production. This is in line with the vision for the subbasin (see Management Plan, Section 5) of supporting "sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin." The restoration scenarios and objectives and strategies outlined in the Management Plan will move us towards this vision.

EDT provides an estimate of the abundances of steelhead and salmon under "properly functioning conditions" (PFC). PFC is a concept developed by the BLM and further refined for salmonids by NMFS to apply ratings of environmental attributes of systems given the current economic, political, and social constraints. An analysis of PFC for the Umatilla/Willow subbasin was conducted by Mobrand Biometrics and their report and results are given here.

Analysis of Properly Functioning Conditions in the Umatilla River
Mobrand Biometrics
May 18, 2004

Description of PFC Conditions in EDT

Properly functioning conditions (PFC) is a concept created originally by the Bureau of Land Management (BLM) to assess the natural habitat-forming

processes of riparian and wetland areas (Pritchard and others 1993). When these processes are working properly, it can be assumed that environmental conditions are suitable to support productive populations of native anadromous and resident fish species. The notion of Properly Functioning Conditions for salmonid systems has also been advanced by the National Marine Fisheries Service (1996) in connection with recovery of species listed under the Endangered Species Act.

The PFC concept has been translated into a set of EDT Level 2 attribute ratings—ratings that define a PFC environmental condition relevant to anadromous salmonids within Pacific Northwest streams. Following an assessment of current and template conditions, EDT was used to assess population performance for a third condition, PFC. The PFC scenario is not necessarily advocated by any management agency and has not been analyzed for feasibility. Instead, it is used to illustrate species performance under a set of conditions likely to be conducive to healthy fish populations.

PFC does not imply pristine or template conditions. There are many examples of healthy populations occupying degraded habitat (Hanford Reach Chinook, for example). With this in mind, PFC ratings were applied to all reaches regardless of current habitat rating (e.g., if riparian function is 100% for the current condition, the PFC condition would still apply the 70% functional rating).

Also, PFC is not intended to imply a standard against which all streams are compared. PFC cannot be "better" than historic conditions for a stream reach (e.g., if percent fine sediment in historic reconstruction was 15%, the PFC rating for sediment must be greater than or equal to 15%).

We used Properly Functioning habitat conditions outlined by the National Marine Fisheries Service (1996) to help define the EDT PFC Level 2 rating. The NMFS document includes a Matrix of Pathways and Indicators (MPI) that relates closely to EDT attributes. An inter-agency team organized by Washington Department of Fish and Wildlife and the Northwest Indian Fisheries Commission was responsible for translating the NMFS definitions into EDT Level 2 attributes. EDT attribute ratings and their relationship to the NMFS definition of PFC are presented in Table 51. However, NMFS has not, at this time, endorsed the EDT PFC definition in connection with recovery of listed fish populations. The MPI addressed only a subset of the attributes used in EDT. All attributes used in EDT were assigned a PFC condition by the inter-agency team.

Table 51 also includes those attributes that were not defined by NMFS but were assigned a PFC rating by the technical team. Our guidance for these attributes was an understanding of the intent of the NMFS definition of properly functioning gleaned largely from attributes described in the MPI.

The composition of habitat types (pool, riffle, glide, etc) was not clearly defined in the MPI for PFC. The MPI provided pool frequency by channel width (number of pools per mile). However, this description did not adequately consider differences in gradient and channel confinement between stream reaches. Furthermore, the pristine composition of habitat types is not consistent with the overall PFC definition. Simply applying the template assumptions to PFC is not appropriate.

The EDT definition of habitat types under PFC assumes 80% of the template or 80% of current (whatever is greater) pool type habitat (primary pools, backwater pools and pool tailouts, and beaver ponds) within the reach. The composition of non-pool habitat (riffles and glides) is calculated, using the template composition of these habitat types for the reach. This assumes that the template characterization for riffle and glide habitat (largely based on an assessment of channel gradient and confinement for the reach) would correctly represent the natural composition (i.e., derived through natural habitat-forming processes) for these habitat types.

Table 51. Correspondence of Properly Functioning Condition as designated by NMFS (1996) and PFC as used in the EDT model.

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Hydrologic Characteristics		
1) Annual Variation in High Flow	a) Change in Peak/Base Flow: Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
2) Annual Variation in Low Flow		Consistent with natural runoff pattern or hydro project following WDFW ramping rate criteria (Rating 2).
3) Diel Variation in Flow		Consistent with undisturbed watershed of similar size, geology, and geography (Rating 1).
4) Intra-Annual Variation in High Flow	b) Increase in Drainage Network: Zero or minimum increases in drainage network density due to roads.	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
5) Natural Hydrologic Regime	Not described	Attribute describes basic geomorphology and hydrology of basin
6) Regulated Hydrologic Regime	Not described	Flow not modified by hydro project (Rating 0)
Stream Corridor Structure		
7) Channel Length	Not described	EDT analysis assumed historic (template) channel length, gradient and widths; this assumption consistent with assumptions for channel hydromodifications (none)
8) Gradient		
9) Channel Minimum Width		
10) Channel Maximum Width		
11) Hydromodifications	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Stream channel is fully connected to the floodplain although very minor structures may exist that do not result in flow restriction or constriction (Rating 0).
12) Natural Channel Confinement	Not described; attribute describes basic geomorphology of reach	No difference historic and current ratings in EDT
13) Habitat Types	a) Pool Frequency: Width 5' 184 pools/mile Width 10' 96 pools/mile Width 15' 70 pools/mile Width 20' 56 pools/mile Width 50' 26 pools/mile Width 75' 23 pools/mile Width 100' 18 pools/mile b) Pool Quality: Pools > 1 meter depth (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment	Assumed to be consistent with 80% of historic (template) pool frequency; EDT criteria developed to acknowledge reach-specific differences in pool frequency.
14) Habitat Type – Off Channel	Backwaters with cover, and low-energy off-channel areas (ponds, oxbows, etc.)	Assumed full connection of historic (template) off-channel habitats.
15) Migration Obstructions	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	Obstructions removed or designed to allow full passage of juveniles and adults (Rating 0)

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
16) Water withdrawals	Not described	Very minor withdrawals (entrainment probability considered to be very low)
17) Bed Scour	Although not described, bank stability - >90% of banks not actively eroding - implies a stable stream bed.	Average depth of scour >2 cm and < 10 cm (Rating 1)
18) Icing	Not described	Riparian function is high, assumed no degradation of channel stability due to icing – assume historic (template) condition
19) Riparian Function	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers include known refugia for sensitive aquatic species (>80% intact); and/or grazing impacts; percent similarity of riparian vegetation to the potential natural community composition > 50%.	> 70%-90% of functional attributes present (overbank flows, vegetated streambanks, groundwater interactions typically present) (modeled 70% - Rating 1.6).
20) Wood Debris	>80 pieces/mile (diameter > 2"; length > 50') and adequate sources of woody debris recruitment in riparian areas.	Complex array of large wood pieces but fewer cross channel bars and fewer pieces of sound large wood due to reduced recruitment; influences of large wood and jams are a prevalent influence on channel morphology where channel gradient and flow allow such influences. (Rating 1).
21) Embeddedness	Dominant substrate is cobble or gravel, or embeddedness < 20%	>10% and <25% covered by fine sediment (Rating 1)
22) Fine Sediment (< 0.85 mm) and Turbidity	Fines: < 12%, turbidity low	Fines: 6%-11% (modeled 11% fines - Rating 1.5). Turbidity low, infrequent episodes, short duration, low concentrations (<50 mg/l) (Rating 0.5)
Water Quality		
23) Alkalinity and Dissolved Oxygen	Not described	Assumed historic (template) conditions
24) Pollutants (Metals, misc. pollutants)	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches	No toxicity expected due to dissolved heavy metals to salmonids under prolonged exposure (1 month exposure assumed) (Rating 0.5).
25) Nutrient enrichment		Very small amount suspected through land use activities (Rating 1.5)
26) Temperature – Daily Maximum	10-14 C	10-16 C on warmest day (Rating 1)
27) Temperature – Daily Minimum	Not described	Assumed historic (template) conditions
28) Temperature – Spatial Variation	Not described	Assumed historic (template) conditions

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Biological Community		
28) Biological community (benthic community richness, introduced species, predator risk, and fish community richness)	Not Described	Assumed historic (template) conditions
29) Fish Pathogens	Not Described	a) No fish stocking within last decade; or b) no sockeye population in basin; or c) no viral epizootics in kokanee populations at the subbasin level (Rating 1).
30) Salmon Carcasses	Not Described	Very abundant -- an average number of carcasses per total miles of main channel habitat >400 and < 800 (Rating 1.5).
22) Hatchery Outplants	Not Described	No more than two instances of fish releases in the past decade in the drainage (Rating 1.5).

Application of PFC conditions to the Umatilla River

The PFC conditions in Table 157 were applied to the Umatilla River and analyzed with EDT for the four defined populations. As described above, PFC conditions are generally an improvement over current conditions but always less than the template condition. Application of the PFC restored a substantial portion of the estimated potential of the four populations in the Umatilla River. PFC produced 89 percent of the potential for summer steelhead (Figure 157), 70 percent of the potential for coho (Figure 158), 83 percent of the potential for spring Chinook (Figure 159) and 88 percent of the potential for fall Chinook (Figure 160). PFC produced a Diversity Index similar to the template except for coho for which PFC resulted in about 50 percent of the template Diversity Index.

Figure 157. Estimated potential of the Umatilla River for summer steelhead under three scenarios.

Umatilla Summer Steelhead

Scenario	Diversity index	Productivity	Abundance
Current without harvest	40%	5.0	2,815
PFC Scenario	98%	10.0	8,293
Reference potential	99%	14.3	9,317

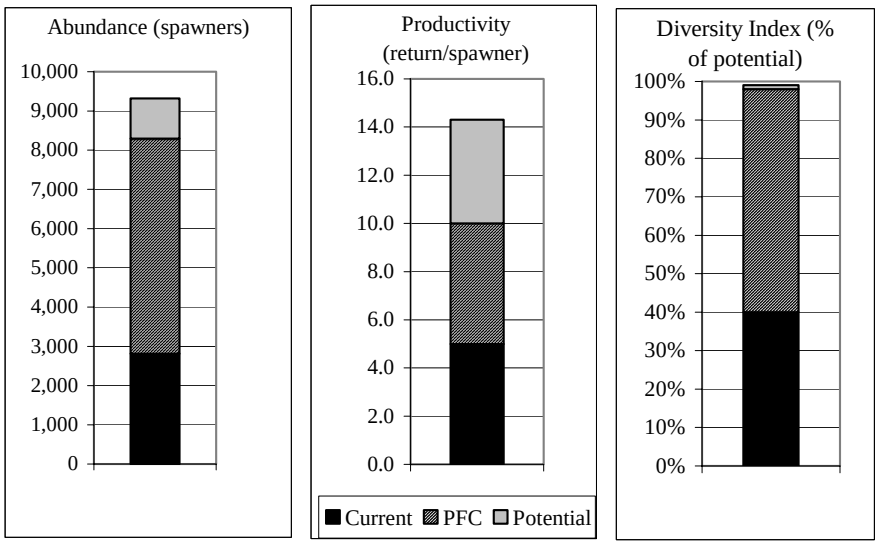

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Figure 158. Estimated potential of the Umatilla River for coho under three scenarios.

Umatilla Coho

Scenario	Diversity index	Productivity	Abundance
Current without harvest	14%	0.4	-
PFC Scenario	49%	2.5	3,136
Reference potential	97%	3.6	4,504

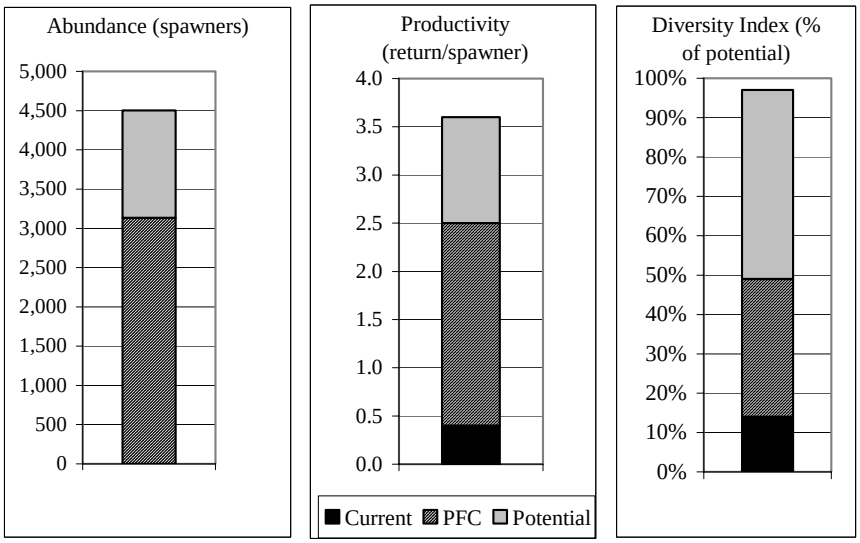

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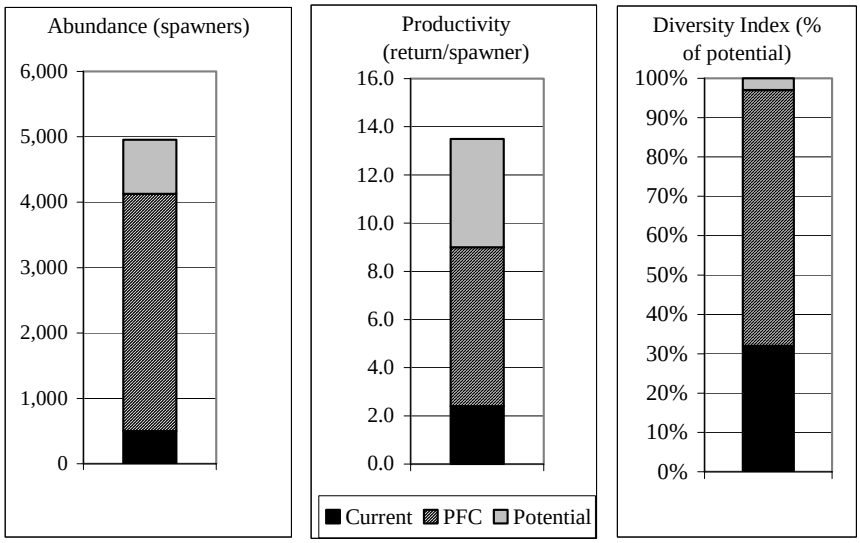
Figure 159. Estimated potential of the Umatilla River for spring Chinook under three scenarios.

Umatilla Spring Chinook

Scenario	Diversity index	Productivity	Abundance
Current without harvest	32%	2.4	498
PFC Scenario	97%	9.0	4,126
Reference potential	100%	13.5	4,958

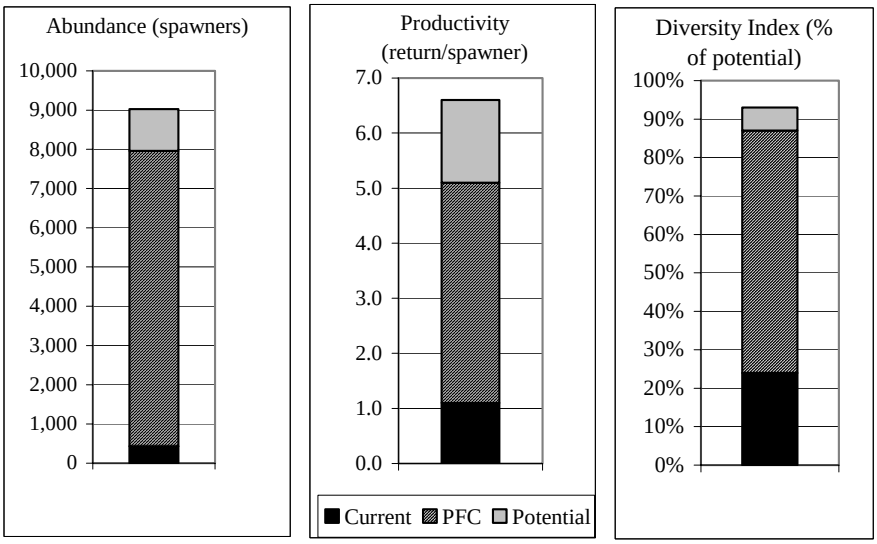


May 18, 2004

Figure 160. Estimated potential of the Umatilla River fall Chinook under three scenarios.

Umatilla Fall Chinook

Scenario	Diversity index	Productivity	Abundance
Current without harvest	24%	1.1	434
PFC Scenario	87%	5.1	7,960
Reference potential	93%	6.6	9,027



May 18, 2004

As can be seen from the analysis by Mobrand Biometrics, PFC conditions enhance the abundance and productivity of all anadromous focal species greatly, bringing them close to historic (i.e., "reference") values. While PFC does not represent current management goals (achieving PFC in all areas of the subbasin will be a tremendous and costly amount of work), it does provide an estimate of the current potential of the system and a very long-term, 75 year, goal.

3.6.2 Terrestrial Wildlife Synthesis and Interpretation

The terrestrial assessment was conducted using existing data on the Umatilla/Willow subbasin in combination with new products, such as IBIS, which were made available through the subbasin planning effort. The results from that assessment that are most relevant to the development of the management plan are synthesized and interpreted in this section. These results, organized by focal habitat type, include a summary of the focal species, habitat status, limiting factors, desired future conditions, working hypotheses, opportunities, and significant data gaps and uncertainties.

Several aspects of the terrestrial wildlife assessment differ from the aquatic assessment in notable ways. The term "limiting factor" is used more generally in the wildlife assessment than in the aquatic assessment. Limiting factors for wildlife are generally described in terms of activities or conditions that are believed to negatively impact wildlife primarily through their effect on habitat (e.g., timber harvest, the invasion of exotic vegetation). These activities or conditions are believed to impact focal and obligate wildlife species via a variety of mechanisms that affect key environmental correlates. In contrast, limiting factors for the aquatic assessment are often discussed in a more specific way (e.g., sedimentation, increased water temperature). Wildlife and aquatic assessments also differ with respect to the specificity of the desired future conditions and the working hypotheses. Desired future conditions for wildlife are framed in terms of having a sufficient amount of high quality habitat to support healthy populations of focal and obligate species, with high quality habitat defined with respect to key environmental correlates. However, wildlife managers cannot at this point quantitatively define how much high quality habitat is needed to support healthy, self-sustaining populations of wildlife species. In contrast, aquatic managers have much more detailed information about the 1) the status of certain aquatic focal species, 2) the relationship of environmental variables and population attributes of those focal species, and 3) a quantitative model (EDT) that can be used to quantify desired future conditions. Likewise, the EDT used in the aquatic assessment allows for working hypotheses to relate strategies to specific quantitative population responses in focal species. Wildlife working hypotheses are not as quantitative; although they assume that addressing limiting factors through management strategies will positively influence focal species populations, they cannot predict the magnitude or mechanism of that response. This limitation results from insufficient information about focal wildlife species and the lack of a quantitative model (such as EDT) for terrestrial wildlife.

Finally, although opportunities are described for each habitat below, there exists a general opportunity to protect and enhance wildlife habitat and populations that applies to all habitat types. As described in Section 3.1, a large portion of the subbasin's economy is

related to agriculture, which is often pitted against fish and wildlife interests in other areas. The Umatilla/Willow subbasin is unique in that agricultural, tribal, and governmental groups, as well as other stakeholders, have worked together to form mutually acceptable solutions to fisheries and wildlife problems in the past. This past history of success is an opportunity in the sense that it has developed a foundation of trust and cooperation that can be capitalized on in the future. Thus, subbasin planners are committed to continuing with this cooperative model as they develop and implement terrestrial wildlife objectives and strategies.

The synthesis and interpretation for each habitat that follows is based on previous sections. Information on focal species can be found in Section 3.2.4.1, data on habitat status, limiting factors, and protection opportunities can be found in Sections 3.2.4.2 and 3.5.2, and information on key environmental correlates can be found in Section 3.4.2. For the sake of brevity, primary literature citations and data sources that are cited in these past sections are not repeated in this section.

MIXED CONIFER FOREST

Focal Species: Pileated Woodpecker

Habitat Status: As indicated in Table 52, 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.

Table 52. Estimated acreages of historic and current mixed conifer habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
83,522 acres (3%)	167,299 acres (6%)	+83,777 acres (+100%)

Limiting Factors: The quality of mixed conifer forest in the Umatilla/Willow subbasin is believed to have declined due to timber harvest, altered fire regimes, ponderosa pine encroachment, development, outbreaks of western spruce budworm and Douglas-fir tussock moth, and exotic plant invasion (see Section 3.5.2 for more description). These factors have resulted in direct loss of old growth habitat and fragmentation and degradation of remaining mixed conifer forest. Loss of old growth habitat has occurred primarily because of timber harvesting, while habitat degradation is primarily associated with altered fire regimes. Fire suppression has promoted less fire-resistant, shade-tolerant trees, and led to mixed conifer forests with low snag density, high tree density, and stands dominated by smaller and more shade-tolerant trees.

Desired Future Conditions: The desired future condition of mixed conifer forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Pileated Woodpecker and other mixed conifer obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- complex multi-layered closed canopies with a major component of large trees (>90 feet in height) and a high basal area
- mature seed producing trees
- numerous uneven-aged individual trees and an understory of smaller woody plants with emphasis on multi-conifer species composition including lodgepole pine, Douglas fir, Western larch, Engelmann spruce, subalpine fir, and white pine
- dead and dying trees 39 – 69 feet tall, 100-300 years old, and > 20 inches dbh
- dead and decaying wood, with an abundance of insects
- a minimum forest parcel size of 2,000 acres

Working Hypothesis: The key assumptions that make up the working hypothesis for mixed conifer forest are:

1. Wildlife species associated with mixed conifer forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Pileated Woodpecker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of mixed conifer habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with mixed conifer by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving mixed conifer habitat in ways that benefit the Pileated Woodpecker and other obligate mixed conifer species are primarily dictated by current ownership and protection. As seen in Tables 53 and 54, most (>90%) of the mixed conifer habitat in Umatilla/Willow subbasin is under no or low protected status and most (67%) is federally owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with federal agencies should be emphasized.

Table 53. Estimated protected status of mixed conifer forest in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
12,788 acres (8%)	543 acres (<1%)	98,825 acres (59%)	55,143 acres (33%)

Table 54. Estimated ownership of mixed conifer forest in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
111,535 acres (67%)	11,661 acres (7%)	1,039 acres (<1%)	0 acres (0%)	43,065 acres (26%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for mixed conifer habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of mixed conifer habitat in the Umatilla/Willow subbasin, including data on structural state, seral stage, and ecological function as related to the Pileated Woodpecker and other obligate species. Use these data to refine existing information on habitat suitability for the Pileated Woodpecker (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of mixed conifer in the subbasin.
- Identify areas in the subbasin that could be converted to mixed conifer habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Pileated Woodpecker and other species associated with mixed conifer in the Umatilla/Willow subbasin.
- Determine the amount of high quality mixed conifer habitat needed to support viable populations of the Pileated Woodpecker in the subbasin.

PONDEROSA PINE FOREST

Focal Species: White-headed Woodpecker

Habitat Status: As indicated in Table 55, 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.

Table 55. Estimated acreages of historic and current ponderosa pine habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
143,321 acres (5%)	162,257 acres (6%)	+18,936 acres (+13%)

Limiting Factors: The quality of ponderosa pine forest habitat is believed to have declined due to mixed forest encroachment, altered fire regimes and stand-replacing fires, timber harvest, exotic plant invasion, outbreaks of western spruce budworm and Douglas-fir tussock moth, livestock grazing, development, and recreational activities (see Section 3.5.2 for more description). Two of the major factors responsible for habitat loss and

degradation of functional ponderosa pine forest are harvest of late and old structure pine and the encroachment of Douglas-fir and grand fir into ponderosa pine dominated habitats. The encroachment is due primarily to fire suppression and intense, stand-replacing wildfires; the latter results from high fuel loads associated with increases in brushy species and the establishment of ladder fuels from encroaching shade tolerant understory trees.

Desired Future Conditions: The desired future condition of ponderosa pine forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of White-headed Woodpecker and other ponderosa pine obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- large patches (> 800 acres) of open mature/old growth-dominated ponderosa pine
- canopy closures between 30-50%
- 2.5 snags per acre, with each snag > 24 inches dbh
- sparse understory vegetation

Working Hypothesis: The key assumptions that make up the working hypothesis for ponderosa pine forest are:

1. Wildlife species associated with ponderosa pine forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the White-headed Woodpecker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of ponderosa pine habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with ponderosa pine by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving ponderosa pine habitat in ways that benefit the White-headed Woodpecker and other obligate ponderosa pine species are primarily dictated by current ownership and protection. As seen in Tables 56 and 57, most (98%) of the ponderosa pine habitat in Umatilla/Willow subbasin is under no or low protected status and most (61%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 56. Estimated protected status of ponderosa pine forest in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
3,504 acres (2%)	135 acres (<1%)	43,058 acres (27%)	115,559 acres (71%)

Table 57. Estimated ownership of ponderosa pine forest in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
45,648 (28%)	16,425 acres (10%)	825 acres (<1%)	0 acres (0%)	99,359 acres (61%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for ponderosa pine habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of ponderosa pine habitat in the Umatilla/Willow subbasin, including data on structural state, seral stage, and ecological function as related to the White-headed Woodpecker and other obligate species. Use these data to improve existing information on habitat suitability for the White-headed Woodpecker (see Section 3.2.4.1).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of ponderosa pine.
- Identify areas that could be converted to ponderosa pine habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the White-headed Woodpecker and other species associated with ponderosa pine.
- Determine the amount of high quality ponderosa pine habitat needed to support viable populations of the White-headed Woodpecker in the subbasin.

QUAKING ASPEN FOREST

Focal Species: Red-naped Sapsucker

Habitat Status: As indicated in Table 58, an estimated 94% of quaking aspen forest in the Umatilla/Willow subbasin has been lost since historic times (c. 1850). In addition, 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.

Table 58. Estimated acreages of historic and current quaking aspen habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
1,236 acres (<1%)	78 acres (<1%)	-1,158 acres (-94%)

Limiting Factors: The major factors affecting aspen habitat in the Umatilla/Willow subbasin are intensive grazing by livestock and native ungulates, fire suppression, and the invasion of coniferous species.

Desired Future Conditions: The desired future condition of quaking aspen forest in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Red-naped Sapsucker and other quaking aspen obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- > 1.5 snags per acre
- trees > 39 feet in height and > 10 inch dbh
- patch size > 10 acres
- an abundance of trees with shelf fungus

Working Hypothesis: The key assumptions that make up the working hypothesis for quaking aspen forest are:

1. Wildlife species associated with quaking aspen forest are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Red-naped Sapsucker and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of quaking aspen habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with quaking aspen by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving quaking aspen habitat in ways that benefit the Red-naped Sapsucker and other obligate quaking aspen species are primarily dictated by current ownership and protection. Although no data are available from IBIS 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. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with federal and tribal agencies should be emphasized.

Significant Data Gaps and Uncertainties:
Several significant data gaps and uncertainties exist for quaking aspen habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of quaking aspen in the subbasin.
- Obtain data on the quality of quaking aspen habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Red-naped Sapsucker and other obligate species. Use these data to improve existing information on habitat suitability for the Red-naped Sapsucker (see Section 3.2.4.1).
- Identify areas in the subbasin that could be converted to quaking aspen habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.

- Generate population and distribution data for the Red-naped Sapsucker and other species associated with quaking aspen.
- Determine the amount of high quality quaking aspen habitat needed to support viable populations of the Red-naped Sapsucker in the subbasin.

WESTERN JUNIPER WOODLAND

Focal Species: Ferruginous Hawk

Habitat Status: As indicated in Table 59, 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). However, planners believe the current acreage is overestimated. As described in Section 3.2.4.2, 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 historic conditions is unclear (see Section 3.2.4.2), it has probably increased slightly or remained relatively constant. In contrast, juniper habitat associated with grassland and shrub-steppe is believed have decreased by 50-65% since historic times. Regardless of the amount currently in existence in the subbasin, subbasin planners believe the quality of this habitat has declined, although no quantitative data on habitat quality of historic or current western juniper in the subbasin are available through assessment databases, such as IBIS.

Table 59. Estimated acreages of historic and current western juniper habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
2,741 acres (<1%)	36,795 acres (1%)	+34,054 acres (+1,377)

Limiting Factors: The most important limiting factors of juniper woodlands, especially of mature trees or stands associated with shrub-steppe or grasslands, are agricultural conversion, altered fire regimes, overgrazing, and exotic plant invasions.

Desired Future Conditions: The desired future condition of western juniper woodland in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Ferruginous Hawk, its prey, and other western juniper obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- isolated, mature juniper trees with a density > one per square mile

- native perennial grasses and other low shrub cover between 6-24 inches to support ground squirrels and jackrabbits, which are major prey of Ferruginous Hawks
- mature, short (< 33 ft. in height) juniper for Ferruginous Hawk nesting trees

Working Hypothesis: The key assumptions that make up the working hypothesis for western juniper woodlands are:

1. Wildlife species associated with western juniper woodlands are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Ferruginous Hawk, its prey, and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of western juniper habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with western juniper by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving western juniper habitat in ways that benefit the Ferruginous Hawk and other obligate western juniper species are primarily dictated by current ownership and protection. As seen in Tables 60 and 61, virtually all of the western juniper habitat in Umatilla/Willow subbasin is under no or low protected status and most (99%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 60. Estimated protected status of western juniper woodland in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
0 acres (0%)	18 acres (<1%)	525 acres (1%)	35,952 acres (99%)

Table 61. Estimated ownership of western juniper woodland in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
525 (1%)	0 acres (0%)	18 acres (<1%)	0 acres (0%)	35,952 acres (99%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for western juniper habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Gather comprehensive data on the location, size, spatial distribution, ownership, and protected status of western juniper in the subbasin.
- Obtain data on the quality of western juniper habitat in the Umatilla/Willow subbasin, including data on its ecological function as related to the Ferruginous Hawk and its

prey and other obligate species. Use these data to refine existing information on habitat suitability for Ferruginous Hawk (see Section 3.2.4.1).
- Identify areas that could be converted to western juniper habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Ferruginous Hawk, it prey, and other species associated with western juniper.
- Determine the amount of high quality western juniper habitat needed to support viable populations of the Ferruginous Hawk in the subbasin.

SHRUB-STEPPE

Focal Species: Sage Sparrow

Habitat Status: 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. As indicated in Section 3.2.4.2, the estimate produced by IBIS for current shrub-steppe habitat acreage in the Umatilla/Willow subbasin is believed to be inaccurate, so information from an alternative source (Kagan et al. 2000) was used to estimate historic and current acreages of low elevation shrub-steppe (see Section 3.2.4.2 for more details). Acreage estimates shown in Table 62 suggest that significant losses of both big sagebrush steppe and bitterbrush habitat have occurred in the subbasin. 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 62. 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

Limiting Factors: Major factors affecting both low and higher elevation shrub-steppe habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP lands back into croplands), exotic plant invasion, alteration of fire regimes, purposeful seeding of non-native grasses, and livestock grazing (see Section 3.6.2). These factors result in habitat loss, fragmentation, and degradation. Historically, the single largest factor responsible for shrub-steppe habitat loss in the Umatilla/Willow subbasin is conversion to agriculture. Remaining shrub-steppe habitat continues to be

threatened by agricultural conversion, but of even greater concern is the proliferation of exotic weeds. Cheatgrass is especially problematic, as described in Section 3.1.1.9, because it increases the frequency and severity of range fires, which can lead to the replacement of sagebrush, bitterbrush, and other native shrubs with cheatgrass. The invasion of exotic plants is facilitated by the loss of cryptogamic crusts resulting from soil disturbances associated with tillage and inappropriate livestock grazing practices. Non-native animal species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also negatively affect obligate species in this habitat. The effects of non-native species are magnified by habitat fragmentation. Additionally, shrub-steppe habitats in proximity to agricultural, recreational, and residential areas may be subject to high levels of human disturbance.

Desired Future Conditions: Characterizing very specific critical environmental correlates that apply to all shrub-steppe habitat is difficult because shrub-steppe habitats are highly variable with respect to structure and plant species composition, both of which are strongly influenced by site conditions (e.g., hydrology, soil, topography). However, general ranges of critical environmental correlates that support the Sage Sparrow and most other obligate shrub species (e.g., Loggerhead Shrike, Burrowing Owl, Sage Thrasher) are as follows:

- late seral big sagebrush or bitterbrush with patches of tall shrubs with a height > 3 feet.
- mean sagebrush cover of 5-30%
- mean native herbaceous cover of 10-20% with <10% cover of non-native annual grass (e.g., cheatgrass) or forbs
- mean open ground cover, including bare ground and cryptogamic crusts > 20%
- mean native forb cover > 10%

Working Hypothesis: The key assumptions that make up the working hypothesis for shrub-steppe habitat are:

1. Wildlife species associated with shrub-steppe habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Sage Sparrow and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of shrub-steppe habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with shrub-steppe by increasing the availability of suitable habitat.

Opportunities: Opportunities for protecting and enhancing shrub-steppe habitat differ from other habitats in the Umatilla/Willow subbasin because five areas (Horn Butte-Willow Creek, Boardman Bombing Range, Boeing Lease Lands, the Umatilla Army Depot, and Juniper Canyon; see Section 3.2.4.2 for description) contain not only 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 63 and 64. These five areas represent an excellent opportunity to protect and enhance some of the best existing low-elevation shrub-steppe in the Umatilla/Willow subbasin through cooperation with the federal government, TNC, and private landowners.

In contrast, the estimated 124,480 acres of higher-elevation shrub-steppe (primarily rigid sage/sandberg bluegrass) are generally dispersed in small fragments, primarily on private land, and with little to no protection (Tables 63 and 64). Opportunities for protection and enhancement of this habitat are best taken advantage of by strategies that emphasize cooperative actions with private landowners.

Table 63. Estimated area (in acres) of shrub-steppe habitat in the Umatilla/Willow subbasin in four levels of protected status.

Type of Shrub-Steppe	High Protection	Medium Protection	Low Protection	No Protection
Low Elevation Shrub-Steppe				
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%)
Higher Elevation Shrub-Steppe				
Rigid Sage/Sandberg Bluegrass	0 (0%)	5,468 (4%)	16,904 (14%)	102,467 (82%)

Table 64. Estimated area (in acres) of shrub-steppe habitat in the Umatilla/Willow subbasin in five categories of ownership. Ownership of big sage/bluebunch wheatgrass is not known.

Type of Shrub-Steppe	Federal Lands	State Lands	Native American Lands	NGO Lands	Private Lands
Low Elevation Shrub-Steppe					
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%)
Higher Elevation Shrub-Steppe					
Rigid Sage/Sandberg Bluegrass	22,370 (18%)	502 (<1%)	25 (<1%)	0 (0%)	101,940 (82%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for shrub-steppe habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of shrub-steppe habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Sage Sparrow and other obligate species. Use these data to improve existing information on habitat suitability for the Sage Sparrow (see Section 3.2.4.1).
- Reconcile differences between IBIS and other data with regard to the total acreage and distribution of shrub-steppe habitat in the subbasin, and refine and field-truth data on ownership and protected status of shrub-steppe in the subbasin.
- Identify areas in the subbasin that could be converted to shrub-steppe habitat to enlarge habitat remnants, provide new reservoir habitat, or enhance connectivity between two or more extant remnants.
- Generate population and distribution data for the Sage Sparrow and other species associated with shrub-steppe in the Umatilla/Willow subbasin.
- Determine the amount of high quality shrub-steppe habitat needed to support viable populations of the Sage Sparrow in the subbasin.

INTERIOR GRASSLANDS

Focal Species: Grasshopper Sparrow

Habitat Status: As indicated in Table 65, 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, such as IBIS.

Table 65. Estimated acreages of historic and current interior grassland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
2,030,959 acres (78%)	528,269 acres (20%)	-1,502,690 acres (-74%)

Limiting Factors: As indicated in Section 3.5.2, major factors affecting grassland habitat in the Umatilla/Willow subbasin are agricultural conversion (including the conversion of CRP back into cropland), exotic weed invasion, purposeful seeding of non-native grasses, overgrazing, and human-altered fire regimes. These factors result in direct habitat loss, fragmentation, and degradation. The single largest factor in habitat loss is conversion to agriculture. The largest factor in habitat degradation is the proliferation of annual grasses and exotic weeds, such as cheatgrass and yellow starthistle, which either replace or radically alter native bunchgrass communities. This invasion of exotic plants is facilitated by the loss of cryptogamic crusts, resulting from soil disturbances associated with tillage and livestock grazing. Non-native animal

species, including nest competitors (e.g., European Starlings, House Sparrow), nest parasites (e.g., Brown Headed Cowbirds), and domestic predators (e.g., cats, dogs) also impact native species productivity. The effects of non-native species are magnified by habitat fragmentation. Additionally, grassland habitats in proximity to agricultural and recreational areas may be subject to high levels of human disturbance.

Desired Future Conditions: The desired future condition of interior grasslands in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Grasshopper Sparrow and other grassland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

For Native Grasslands

- native bunchgrass cover > 15% and comprising > 60% of total grassland cover
- tall bunchgrass (> 10 inches tall)
- native shrub cover < 10%

For Non-Native and Agricultural Grasslands (e.g. CRP lands)

- grass forb cover > 90%
- shrub cover < 10%
- variable grass heights (6-18 inches)

Landscape Level

- patch size > 100 acres or multiple small patches greater than 20 acres, within a mosaic of suitable grassland conditions

Working Hypothesis: The key assumptions that make up the working hypothesis for interior grasslands are:

1. Wildlife species associated with interior grasslands are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Grasshopper Sparrow and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of grassland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with grasslands by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving grassland habitat in ways that benefit the Grasshopper Sparrow and other obligate grassland species are primarily dictated by current ownership and protection. As seen in Tables 66 and 67, 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. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners should be emphasized.

Table 66. Estimated protected status of interior grasslands in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
3,964 acres (<1%)	0 acres (0%)	37,603 acres (7%)	486,702 acres (92%)

Table 67. Estimated ownership of interior grasslands in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
41,224 acres (8%)	54,430 acres (10%)	225 acres (<1%)	0 acres (0%)	432,390 acres (82%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for grassland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of grassland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Grasshopper Sparrow and other obligate species. Use these data to refine existing information on habitat suitability for the Grasshopper Sparrow (see Section 3.4.2).
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of grassland in the subbasin.
- Identify areas in the subbasin that could be converted to grassland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Grasshopper Sparrow and other species associated with grassland in the Umatilla/Willow subbasin.
- Determine the amount of high quality grassland habitat needed to support viable populations of the Grasshopper Sparrow in the subbasin.

HERBACEOUS WETLANDS

Focal Species: Columbia spotted frog

Habitat Status: As indicated in Table 68, the area of herbaceous wetland habitat in the Umatilla/Willow subbasin is estimated to have declined by 75% since historic times (c. 1850). In addition, planners believe that the quality of remaining herbaceous wetlands has deteriorated, although no quantitative data on habitat quality of historic or current herbaceous wetland habitat of the subbasin are available through assessment databases, such as IBIS.

Table 68. Estimated acreages of historic and current herbaceous wetland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
18,286 acres (<1%)	4,670 acres (<1%)	-13,616 acres (-75%)

Limiting Factors: Major factors that have led to the destruction and degradation of herbaceous wetlands in the Umatilla/Willow subbasin are habitat conversion and draining, lowering of ground water level, separation of floodplain from the stream channel due to dikes and levees, exotic plant and animal invasions, and livestock grazing.

Desired Future Conditions: The desired future condition of herbaceous wetland habitat in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Columbia spotted frog and other herbaceous wetland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- Abundant aquatic vegetation dominated by herbaceous species such as grasses, sedges, rushes. and emergent vegetation
- Clear, slow-moving or ponded perennial surface waters
- Relatively exposed, shallow-water (< 24 inches)
- Deep silt or muck substrate
- Small mammal burrows
- Undercut banks and spring heads

Working Hypothesis: The key assumptions that make up the working hypothesis for herbaceous wetland habitat are:

1. Wildlife species associated with herbaceous wetland habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Columbia spotted frog and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of herbaceous wetland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with herbaceous wetland by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving herbaceous wetland habitat in ways that benefit the Columbia spotted frog and other obligate herbaceous wetland species are primarily dictated by current ownership and protection. As seen in Tables 69 and 70, most (86%) of the herbaceous wetland habitat in Umatilla/Willow subbasin is under no or low protected status and most (74%) is privately owned. Thus, these opportunities suggest that strategies aimed at increasing protection and enhancement by working with landowners, especially through cooperative programs and education, should be emphasized.

Table 69. Estimated protected status of herbaceous wetland habitat in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
657 acres (14%)	12 acres (<1%)	140 acres (3%)	3,861 acres (83%)

Table 70. Estimated ownership of herbaceous wetland habitat in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
768 acres (18%)	118 acres (3%)	260 acres (6%)	0 acres (0%)	3,229 acres (74%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for herbaceous wetland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Obtain data on the quality of herbaceous wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Columbia spotted frog and other obligate species.
- Refine and field-truth data on the location, size, spatial distribution, ownership, and protected status of herbaceous wetlands in the subbasin.
- Identify areas in the subbasin that could be converted to herbaceous wetland habitat to enlarge existing wetlands, provide new reservoir habitat, or enhance connectivity between two or more extant wetlands.
- Generate population and distribution data for the Columbia spotted frog and other species associated with herbaceous wetlands in the Umatilla/Willow subbasin.
- Determine the amount of high quality herbaceous wetland habitat needed to support viable populations of the Columbia spotted frog in the subbasin.

RIPARIAN WETLANDS

Focal Species: Great Blue Heron, Yellow Warbler, and American beaver

Habitat Status: The amount of riparian wetland presently occurring in the Umatilla/Willow subbasin is uncertain. Credible estimates of existing riparian wetlands range from 1,137 acres to 11,020 acres, compared to an historic estimate of approximately 80,000 acres (Table 71) (see Section 3.4.2 for a detailed description of the sources of these estimates). Several studies support the conclusion of subbasin planners that the quality of remaining riparian wetland habitats has declined, although no quantitative data on historic riparian wetland habitat of the subbasin are available.

Table 71. Estimated acreages of historic and current riparian wetland habitat in the Umatilla/Willow subbasin.

Historic Acreage (Historic Percent)	Current Acreage (Current Percent)	Change in Acreage (Percent Change)
~80,000 acres (3%)	1,137 – 11,020 acres (<1%)	-68,980 to -78,863 acres (-86% to -99%)

Limiting Factors: Major factors affecting riparian wetlands in the Umatilla/Willow subbasin are agricultural and urban development, exotic weed invasion, timber harvest, livestock grazing, transportation corridors, hydropower, and recreational activities. Hydropower, agricultural, urban, and transportation corridor development have led to habitat loss through conversion and channelization, have resulted in the separation of the floodplain from the stream, and have contributed to the degradation and fragmentation of remaining riparian habitat. Most of the extensive cottonwood galleries once found in riparian wetlands of the subbasin have been harvested. Existing riparian wetlands also continue to be degraded by exotic plant invasions and livestock grazing.

Desired Future Conditions: The desired future condition of riparian wetland habitat in the Umatilla/Willow subbasin is to have a sufficient amount of high quality habitat to support healthy populations of Great Blue Heron, Yellow Warbler, and American beaver and other riparian wetland obligates. High quality habitat for these species is currently understood to be habitat with the following key environmental correlates:

- 40-60% tree canopy closure of cottonwood or other hardwood species
- multi-structure/age tree canopy (including trees 6 inches dbh and mature/decadent trees)
- woody tree groves > 1 acre and within 800 feet of water, where applicable
- vegetation within 328 feet of shoreline
- 40-80% native shrub cover, with more than 50% of shrub species being hydrophilic
- multi-structured shrub canopy > 3 ft tall

Working Hypothesis: The key assumptions that make up the working hypothesis for riparian wetland habitat are:

1. Wildlife species associated with riparian wetland habitat are primarily limited by the availability of suitable habitat in the Umatilla/Willow subbasin.
2. Suitable habitat for the Great Blue Heron, Yellow Warbler, and American beaver and other obligate species can be described by certain environmental conditions (i.e., the key environmental correlates described above).
3. The limiting factors described above negatively impact these wildlife species through their effect on the quality of riparian wetland habitat.
4. Management strategies that address these limiting factors will benefit wildlife species associated with riparian wetlands by increasing the availability of suitable habitat.

Opportunities: The opportunities for improving riparian wetland habitat in ways that benefit the Great Blue Heron, Yellow Warbler, and American beaver and other obligate

riparian wetland species are primarily dictated by current ownership and protection. Table 72 shows estimates of protected status from two sources (see Section 3.2.4.2 for details); both agree that the large majority of existing riparian wetlands in the subbasin have no protection. However, the ownership of these wetlands is unclear; one source (IBIS 2004) suggests that most riparian wetlands are found on CTUIR lands and the other (Kagan et al. 2000) suggests that most are privately owned (Table 73). This information points to the great need of employing strategies that increase protected status of riparian wetlands in the subbasin, either primarily through CTUIR or private landowners.

Table 72. Estimated protected status of riparian wetland habitat in the Umatilla/Willow subbasin.

High Protection	Medium Protection	Low Protection	No Protection
(0%)	(2%)	(0-4%)	(94-98%)

Table 73. Estimated ownership of riparian wetland habitat in the Umatilla/Willow subbasin.

Federal Lands	Native American Lands	State Lands	NGO Lands	Private Lands
(2-7%)	(1-64%)	(0-3%)	(0%)	(26-97%)

Significant Data Gaps and Uncertainties: Several significant data gaps and uncertainties exist for riparian wetland habitat and its associated wildlife in the Umatilla/Willow subbasin. To fill these gaps, the following actions are needed:

- Supplement, refine, and field-truth existing data on the location, size, spatial distribution, and protected status of riparian wetlands in the subbasin. Reconcile differences in estimates of ownership of riparian wetlands in the subbasin.
- Obtain data on the quality of riparian wetland habitat in the Umatilla/Willow subbasin, including data on ecological function as related to the Great Blue Heron, the Yellow Warbler, and the American beaver and other obligate species. Use these data to create maps of habitat suitability for the Great Blue Heron, the Yellow Warbler, and the American beaver.
- Identify areas in the subbasin that could be converted to riparian wetland habitat to enlarge habitat patches, provide new reservoir habitat, or enhance connectivity between two or more extant patches.
- Generate population and distribution data for the Great Blue Heron, Yellow Warbler, and American beaver and other species associated with riparian wetland in the Umatilla/Willow subbasin.
- Determine the amount of high quality riparian wetland habitat needed to support viable populations of the Great Blue Heron, Yellow Warbler, and American beaver in the subbasin.