# 3.4 Environment/Population Relationships

## 3.4.1 Aquatic

All focal species in the Umatilla/Willow subbasin and the taxa of interest (lamprey and mussels) require cold water free of pollutants (Close et al. 1995; McMahon 1991; NRC 1996). In addition, they require substrate that is complex and contains both areas that are a gravel-cobble complex with little fine sediment as well as depositional areas with higher amounts of coarse sediment. Sediment-free substrate provides the appropriate habitat for spawning by steelhead, salmon, and bull trout as well as appropriate habitat for rearing of fingerlings (Buchanan et al. 1997; NRC 1996); while areas that include coarse sediment are important spawning sites for lamprey (Close et al. 1995). Depositional areas are important because they act as nutrient traps, preventing both allochthonous material (i.e., material derived from the riparian zone) and salmon carcasses (an important source of nutrients to streams) from simply being flushed out of the system during high flow events (Bisson and Bilby 1998). Finally, the focal species also require abundant habitat that includes structure or complexity. This complexity provides cover from predators and high flows (Reinhardt and Healey 1997; Swales et al. 1988).

Perhaps two of the most important ecosystem factors that affect the quality of habitat for the focal species in the Umatilla/Willow subbasin are adequate flows and a properly functioning riparian area. Low flows are a particular problem in the lower and middle reaches of both Willow Creek and the Umatilla River during the summer. Low flows combined with passage barriers have eliminated anadromous steelhead from Willow Creek. Low flows in the lower Umatilla river help create high temperatures that are limiting to focal species (see Section 3.5). However, efforts to enhance flow, especially in the lower Umatilla River, have already begun and plans have been developed to continue these efforts through Phase III of the Umatilla Basin Project (see Section 3.1.3.2). Restoration of adequate flows in the subbasin will enhance populations of the focal species by decreasing water temperatures, increasing the amount of habitat, and flushing sediment from the system.

Riparian vegetation losses have been extensive throughout the subbasin; for example, Kagan et al. (2000) estimate that the lower and mid Umatilla/Willow subbasin has lost over 90% of its historic coverage of riparian areas. Riparian areas can greatly decrease water temperatures by shading streams and enhancing the exchange of surface water and ground water (NRC 2002). Riparian areas decrease water pollutants and sediment input by filtering overland flow that includes runoff from agricultural and urban lands that can be high in sediment and certain types of pollutants (Peterjohn and Correll 1984). Finally, riparian areas add greatly to the habitat complexity of stream reaches because they are the source of large woody debris (NRC 2002). Large woody debris adds to the habitat complexity of stream reaches by directly providing cover for fish and other aquatic organisms and indirectly by influencing the geomorphology of streams (influencing channel width, stabilizing gravel bars, and creating pools) (Bilby and Bisson 1998).

More information on the environmental needs of the focal species and taxa of interest can be found in Sections 3.1.1.9, 3.1.3.2, and 3.2.3. In addition, the environmental factors limiting populations are discussed in Section 3.5.1 and strategies designed to ameliorate those impacts are outlined in Section 5.1.

### 3.4.2 Terrestrial Wildlife Environment and Population Relationships

This section describes the relationship between environmental factors and populations of focal species for each of the eight focal habitat types in the Umatilla/Willow subbasin. It begins with a discussion of preliminary efforts to use habitat condition to map suitability for six focal species. The effort was partially successful for some species. The next section describes the specific key environmental correlates for focal species and other species with a close association with the focal habitat. The section ends with information about functional redundancy.

#### 3.4.2.1 Habitat Suitability

The following maps of habitat suitability were generated by ONHP. The following description was provided by E. Gaines at ONHP (personal communication: May 2004) explaining the process used to generate the maps:

> Species suitability maps were generated using several different data layers.
>
> A hexagon data set, last updated in 2002, showed species presence in each of 441 equal-area hexagons. The hexagons were originally developed for the Environmental Monitoring and Assessment Program (EMAP) of the US EPA. These hexagon distribution maps are a very coarse first filter, and have been reviewed by experts for each species group.
>
> For this project, we overlaid the hexagon distribution maps with sixth field watersheds. This resulted in suitability maps with more 'natural' looking boundaries (watershed boundaries as opposed to hexagon boundaries). These are smaller areas, so can be used to better confine a species distribution. For each watershed, species were assigned a value (primarily from the hexagon data set):
>
> C (Confident) – 95% confident that the species occurs in the watershed (based on a specimen or confirmed observation.
>
> P (Probable) – 80-95% confident that the species occurs in the watershed.
>
> ? (Possible) – 20-75% confident that the species occurs in the watershed
>
> For the distribution maps, we used all watersheds that were either confident or probable (C or P)
>
> A revised vegetation map was put together with 30 meter pixel resolution and using the NatureServe Ecological System Classification. The vegetation map was crosswalked to a wildlife habitats map with 59 habitat types.
>
> Wildlife Habitats Relationships matrices (WHR) were created for each ecoregion. For each species, each habitat's suitability within the ecoregion was scored from 0 to 6, as follows:

| | |
|---|---|
| 0 | Seldom or never used habitat |
| 1 | Unsuitable habitat infrequently used |
| 2 | Poor potential habitat |
| 3 | Mediocre potential habitat |
| 4 | Good potential habitat |
| 5 | High quality potential habitat |

To create the species suitability maps, we intersected the habitat map with the watershed-based distribution map. The WHR was used identify those habitats where the species could be expected to be found, and the watershed occurrence limits the predicted distribution to only the regions where species have a confirmed or probable occurrence. To minimize confusion, in most cases we will only show those habitats where the suitability ranking was 3 or higher (mediocre or better).

Each map is presented below with a brief discussion of the subbasin wildlife managers' judgment of the success of the map in illustrating potential habitat for the focal species.

**Pileated Woodpecker:** The habitat suitability map generated for the Pileated Woodpecker (Figure 107) was judged to be fairly accurate except that subbasin managers felt that the quality of the habitat was overestimated. Particularly, managers believe that habitat identified as good was moderate at best, especially along the western-most portion of the map.

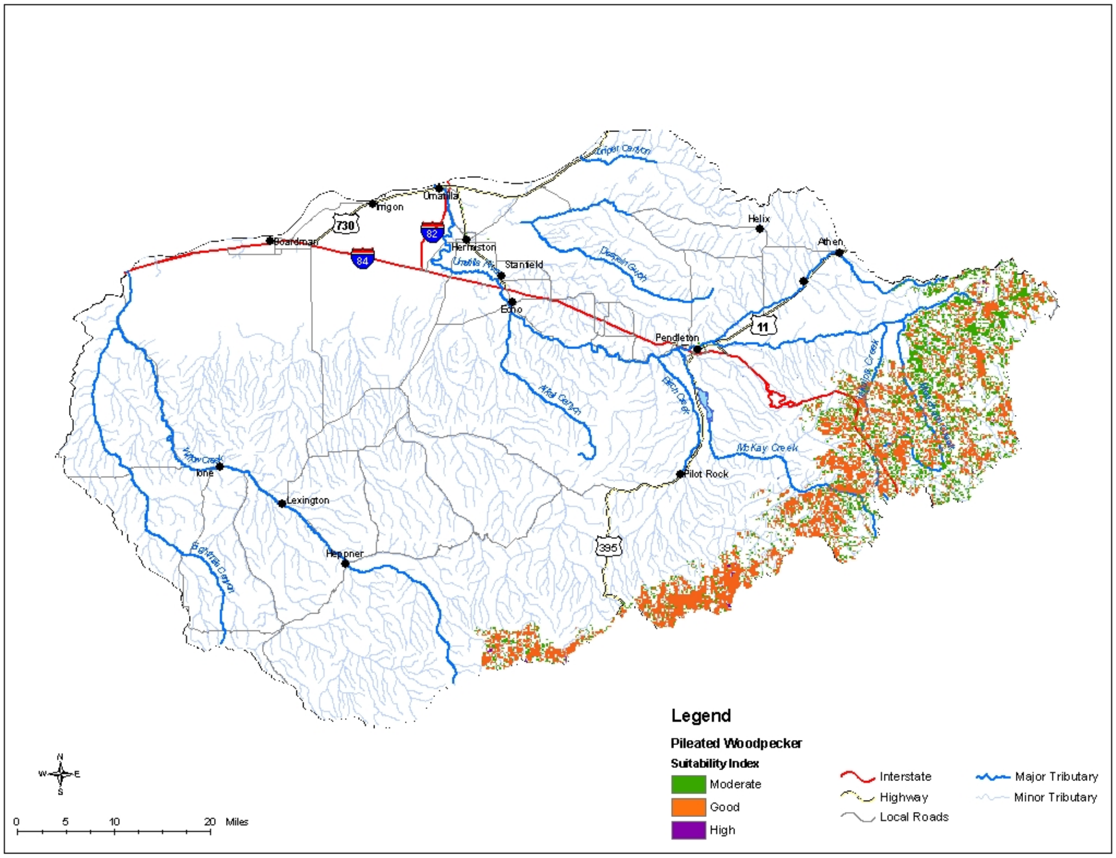


Figure 107. The distribution of potential habitat for the Pileated Woodpecker in the Umatilla/Willow subbasin as described by a suitability index.

**White-headed Woodpecker:** Subbasin managers believe that the map in Figure 108 vastly overestimates the suitability of habitat for the White-headed Woodpecker. Managers believe that only moderate quality habitat can be found in the subbasin, at best, and that even this is very rare.

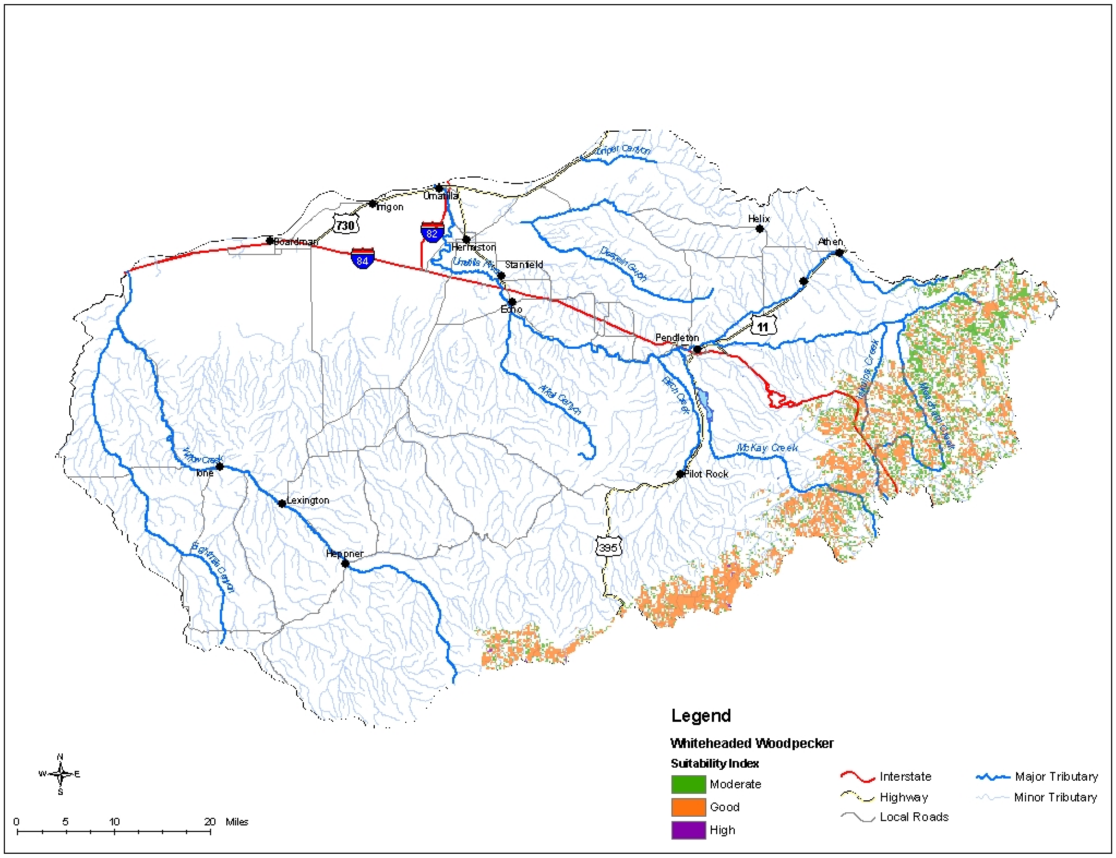


Figure 108. The distribution of potential habitat for the White-headed Woodpecker in the Umatilla/Willow subbasin as described by a suitability index.

**Red-naped Sapsucker:** Subbasin managers believe the map in Figure 109 vastly overestimates the amount of good and high quality habitat available for the Red-naped sapsucker. Given the rarity of aspen habitat and its importance to the Red-naped Sapsucker, managers believe that suitable habitat is much less than shown, and only of moderate quality, at best.

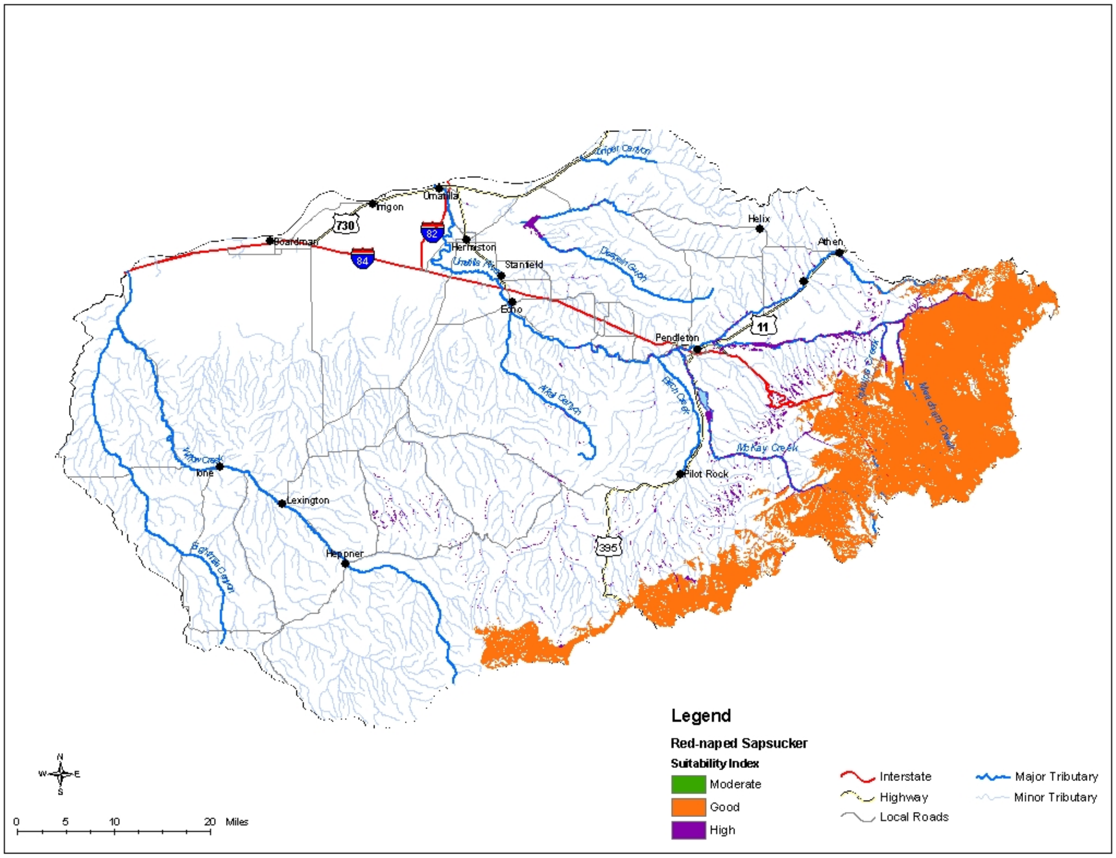


Figure 109. The distribution of potential habitat for the Red-naped Sapsucker in the Umatilla/Willow subbasin as described by a suitability index.

**Ferruginous Hawk:** The map generated for the Ferruginous Hawk (Figure 110) was deemed to be fairly accurate with the exception that no suitable habitat is shown in the western part of the subbasin. Managers believe that the same pattern seen in the eastern part of the subbasin applies to the western portion as well. Of areas that were mapped, managers only questioned the quality of habitats depicted east of Pendleton, especially that area in and around Hermiston; managers believe that the quality of this habitat is probably overestimated.

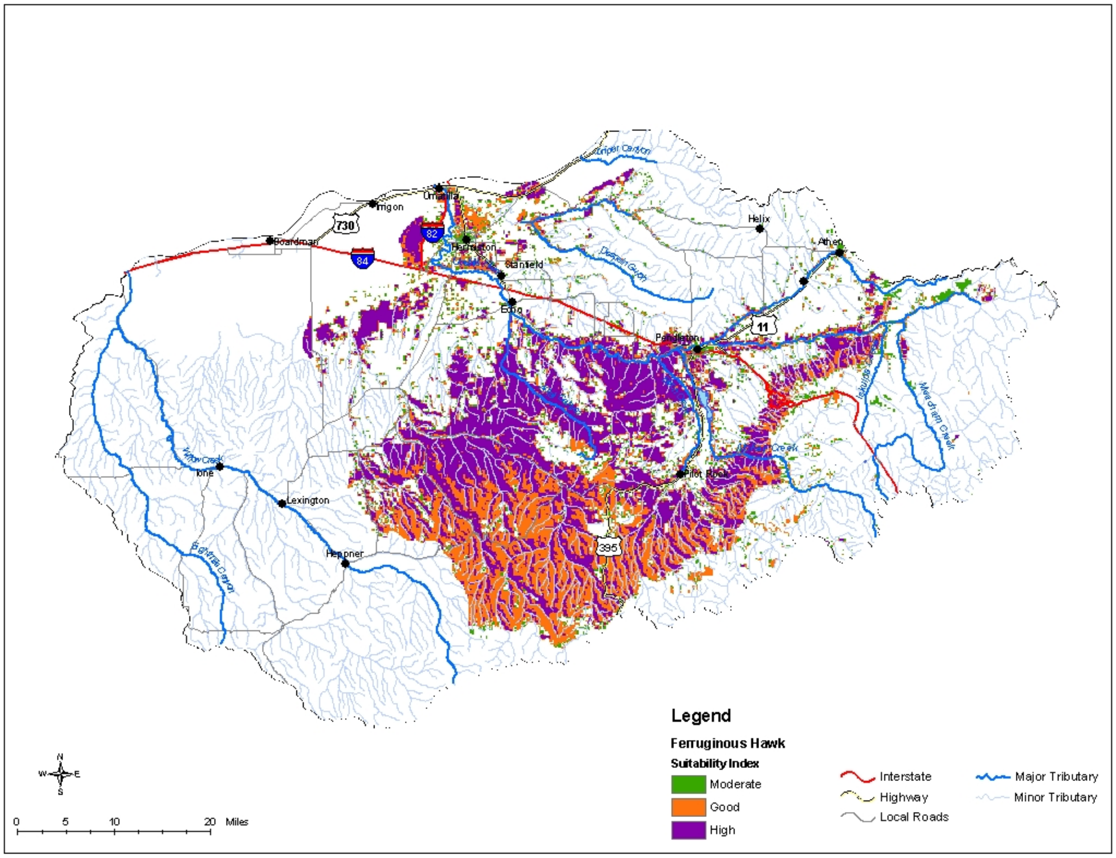


Figure 110. The distribution of potential habitat for the Ferruginous Hawk in the Umatilla/Willow subbasin as described by a suitability index.

**Sage Sparrow:** The map generated for Sage Sparrow is believed to be very inaccurate. Many of the areas that are shown as being highly suitable for the Sage Sparrow are small areas between irrigated crop circles, which are not considered to be viable Sage Sparrow habitat at all. In addition, other areas known to be

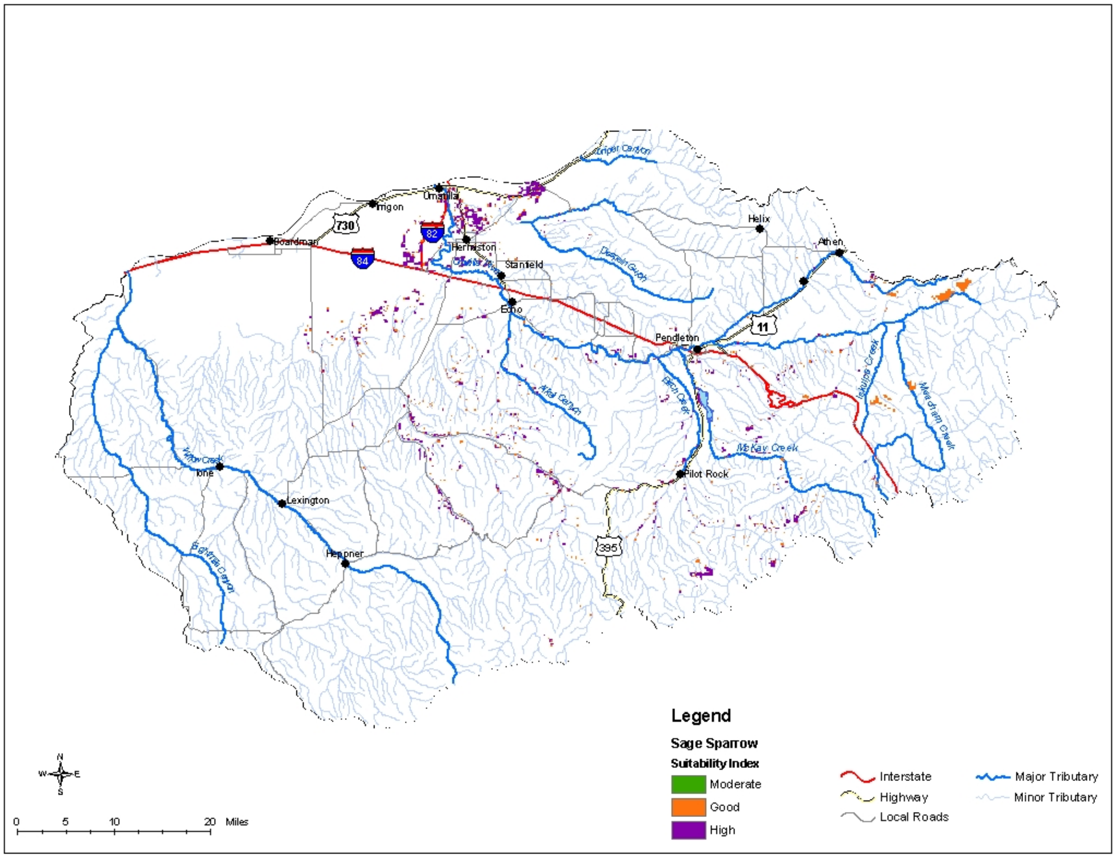


Figure 111. The distribution of potential habitat for the Sage Sparrow in the Umatilla/Willow subbasin as described by a suitability index.

**Grasshopper Sparrow:** Managers concluded that some of the same problems found in the suitability map for the Ferruginous Hawk also applies to the map of Grasshopper Sparrow habitat suitability (Figure 112). Specifically, no suitable habitat is shown in the western portion of the subbasin even though managers believe that suitable habitat exists in that area.

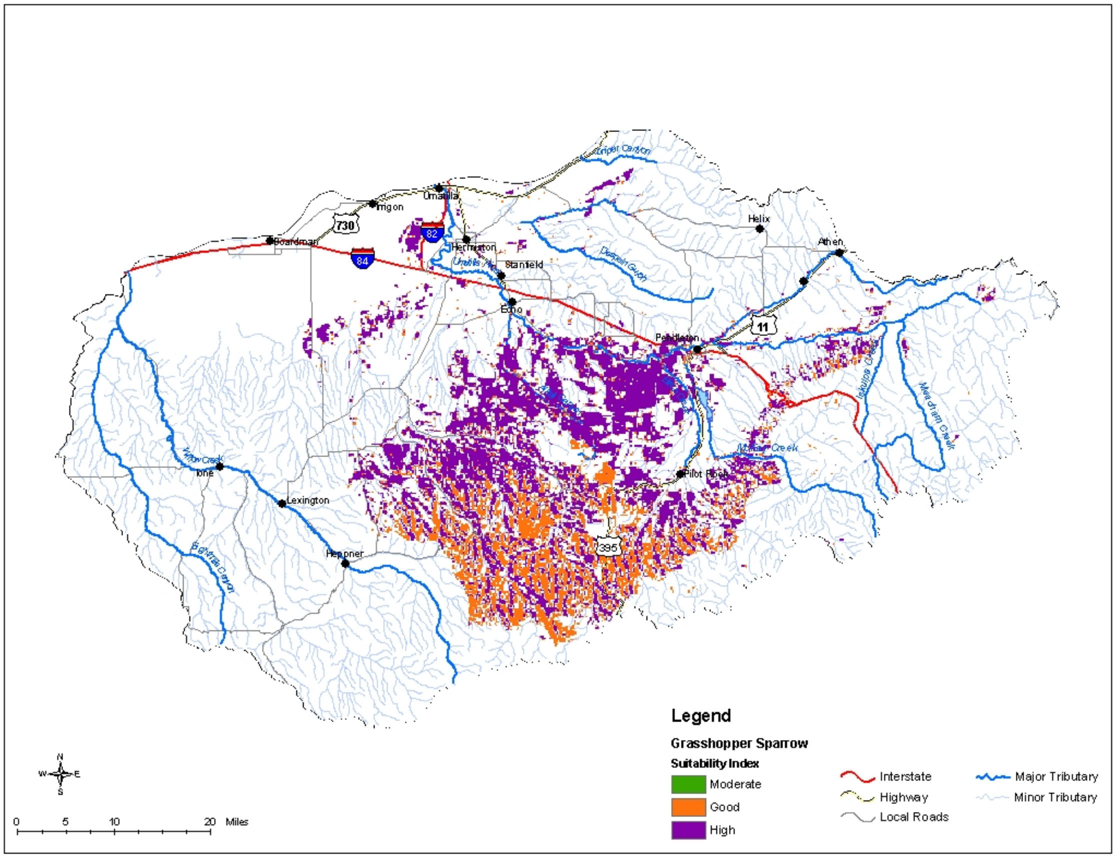


Figure 112. The distribution of potential habitat for the Grasshopper Sparrow in the Umatilla/Willow subbasin as described by a suitability index.

**Conclusion:** Although these preliminary maps vary in their accuracy, they illustrate excellent potential as a useful tool in directing management efforts. These initial attempts can be reworked or refined as further information is gathered on the ability of existing habitat to provide the key environmental correlates discussed below.

### 3.4.2.2 Key Environmental Correlates

Using the information provided in Appendix C, key environmental correlates, or environmental factors that influence the presence or viability of the focal species, were determined for each habitat. In some cases, environmental correlates of other obligate species were also included, using information presented by Altman and Holmes (2000a, b).

## MIXED CONIFER FOREST

**Focal Species:** Pileated Woodpecker

High quality habitat for the Pileated Woodpecker and other species closely associated with mixed conifer 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

## PONDEROSA PINE FOREST

**Focal Species:** White-headed Woodpecker

High quality habitat for the White-headed Woodpecker and other species closely associated with ponderosa pine 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

## QUAKING ASPEN FOREST

**Focal Species:** Red-naped Sapsucker

High quality habitat for the Red-naped Sapucker and other species closely associated with quaking aspen incies 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

## WESTERN JUNIPER WOODLAND

**Focal Species:** Ferruginous Hawk

High quality habitat for the Ferruginous Hawk and other species dependent on Western Juniper Woodland 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

## SHRUB-STEPPE

**Focal Species:** Sage Sparrow

Characterizing very specific key 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%

## INTERIOR GRASSLANDS

**Focal Species:** Grasshopper Sparrow

High quality habitat for the Grasshopper Sparrow and other grassland associated species is currently understood to be habitat with the following key environmental correlates:

<u>For Native Grasslands</u>

- 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
-

## HERBACEOUS WETLANDS

**Focal Species:** Columbia spotted frog

High quality habitat for the Columbia spotted-frog and other obligate 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

## RIPARIAN WETLANDS

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

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

### 3.4.2.3 Functional Redundancy

In most cases, a number of species in a habitat have the same key ecological function, resulting in a habitat displaying a degree of functional redundancy. In general, as habitats are degraded and biodiversity is lost, the amount of functional redundancy is expected to decline. This section describes changes in functional diversity:

1) for species that create feeding, roosting, denning, or nesting opportunities (Figure 113)
2) for fungivores (Figure 114)
3) for grazers (Figure 115)
4) for species that affect soil structure and aeration (Figure 116)
5) for species that create structures (Figure 117)
6) for species that excavate trees and live in snags (Figure 118)
7) for total functional diversity (Figure 119)

Although changes in functional diversity vary according to ecological function, a general pattern exists for all ecological functions – a loss of functional redundancy in the eastern portion of the subbasin (indicated by the red area) in areas that were historically grasslands and that now are primarily agricultural lands.

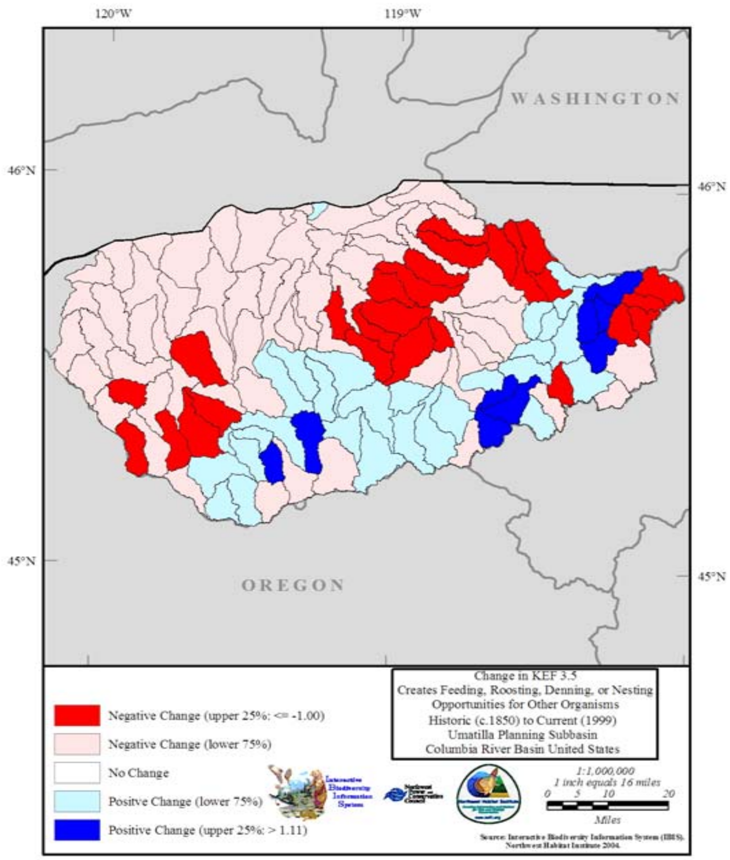


Figure113. Changes in key ecological function associated with species that create feeding, roosting, denning, or nesting opportunities for other species in the Umatilla/ Willow subbasin from c. 1850 to present.

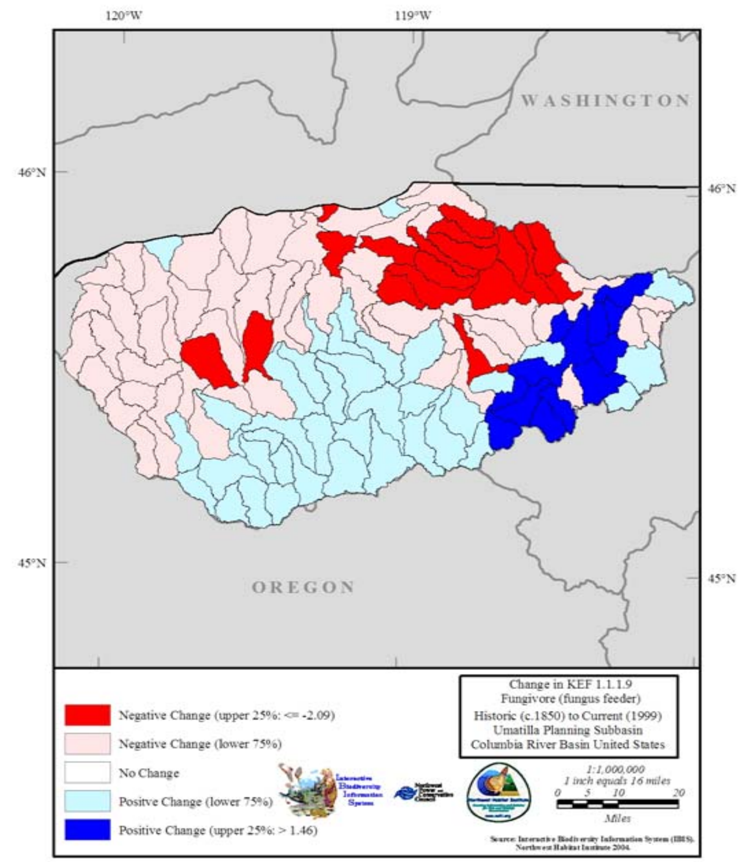


Figure 114. Changes in key ecological function associated with fungivores in the Umatilla/Willow subbasin from c. 1850 to present.

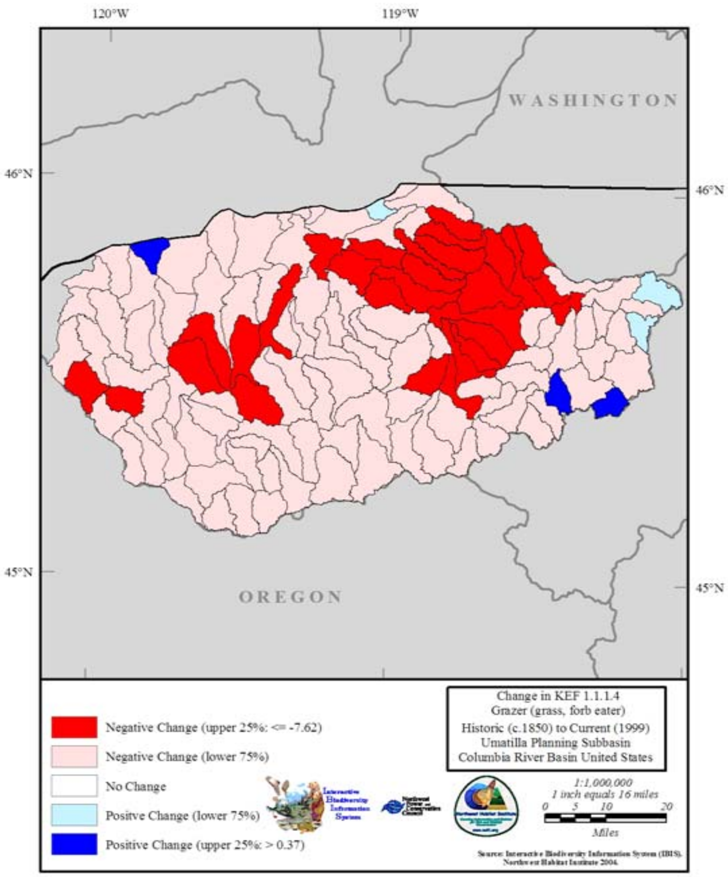


Figure 115. Changes in key ecological function associated with grazers in the Umatilla/ Willow subbasin from c. 1850 to present.

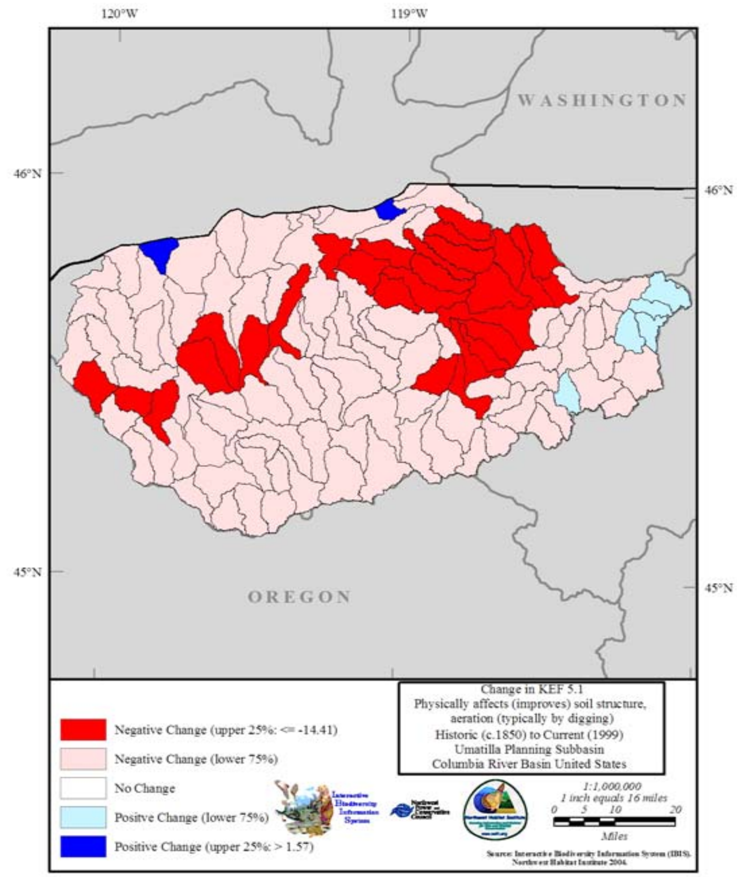


Figure 116. Changes in key ecological function associated with species that affect soil structure and aeration in the Umatilla/Willow subbasin from c. 1850 to present.

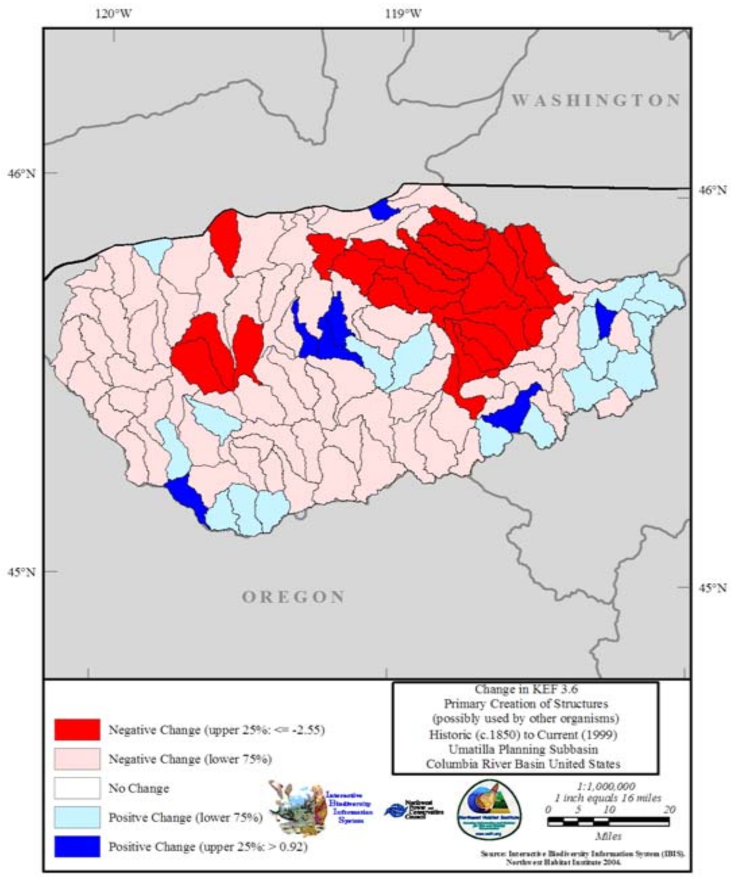


Figure 117. Changes in key ecological function associated with species that create structures in the Umatilla/Willow subbasin from c. 1850 to present.

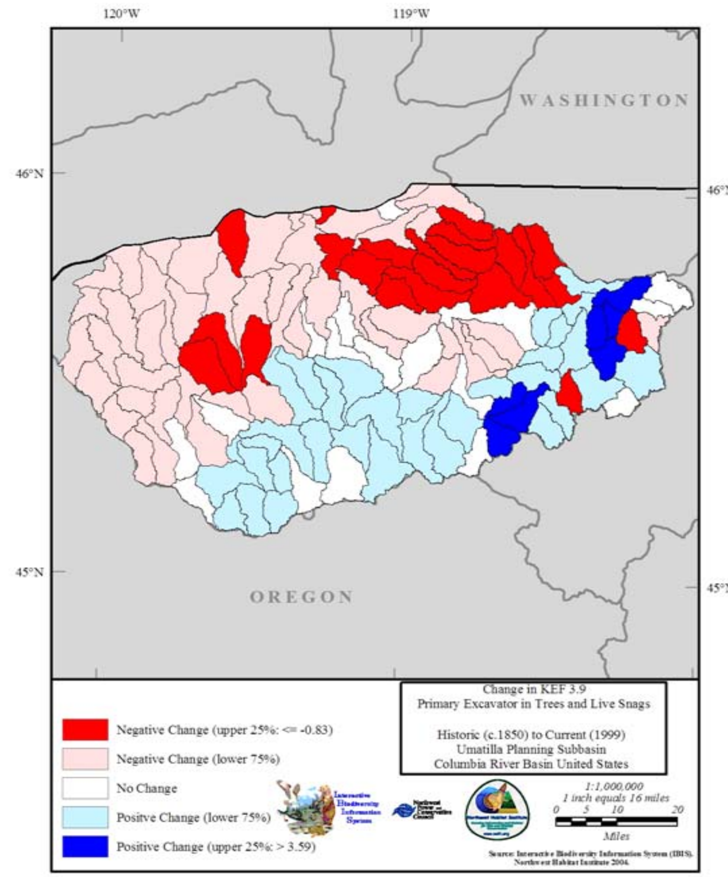


Figure 118. Changes in key ecological function associated with species that excavate trees and lives in snags in the c. 1850 to present.

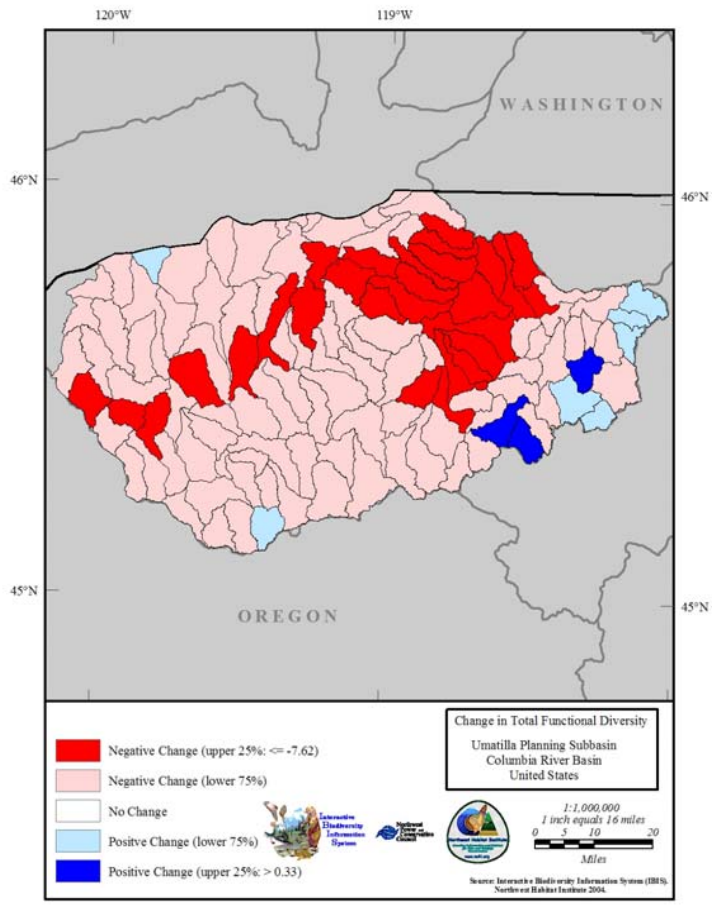


Figure 119. Changes in total functional diversity in the Umatilla/ Willow subbasin from c. 1850 to present.

## 3.4.3 Inter-species Interactions

### 3.4.3.1 Fish Inter-species Interactions

To date, no work has been conducted in the Umatilla/Willow subbasin that directly addresses interspecific interactions among fish, and this is a significant data gap for the subbasin. However, anecdotal evidence suggests that competition among fish species might be important in the growth rates of salmonids. In 1974 the Umatilla River was treated with rotenone to reduce the density of "trash" fish. ODFW personnel noted that fingerling rainbow trout stocked in the river for several years after the treatment grew rapidly. However, once other fish species came back into the river, the growth rates of juvenile trout were not as rapid and it is suspected that interspecific competition from several species of dace and shiners as well as squawfish, peamouth, and carp might have caused this reduction in trout growth rate (personal communication: J. Phelps, retired ODFW, April 2004).

Work in other subbasins provides additional information on species interactions that might occur in the Umatilla/Willow subbasin. These interactions include competition among salmonid species that can reduce reproductive success (Essington et al. 2000) and growth of individuals (Harvey and Nakamoto 1996). Competitive impacts might be particular severe on naturally produced salmonids when they compete with hatchery reared juveniles. McMichael et al. (2000) outline conditions for the Yakima subbasin in which hatchery reared steelhead had particularly harsh competitive impacts on naturally produced rainbow trout and spring Chinook. These impacts were particularly severe when:

- hatchery fish did not emigrate quickly
- water temperatures were above 8°C
- hatchery fish were the same species as wild fish
- habitat and/or food were limiting
- the number of hatchery fish releases was over 30,000

Predatory interactions might also be important. Steelhead are known to eat Chinook salmon eggs; however, the extent of this predation and its impact on Chinook is unclear (Vander Haegen et al. 1998). Squawfish are important predators of outmigrating smolts in the John Day reservoir (Rieman et al. 1991; Vigg et al. 1991) and these fish are considered common in the Umatilla River and some of its tributaries. Thus, it is possible that these fish are important predators on salmon and steelhead juveniles in the subbasin. Another potentially important predator-prey interaction in the subbasin involves bull trout. Large bull trout juveniles and adults are piscivorous, and include juvenile salmon in their diets (references in Buchanan et al. 1997). The distributions of reintroduced spring Chinook and bull trout overlap (see Figures 34 and 59 in Section 3.2.3.1) and juvenile spring Chinook are potentially a new and important food resource for the resident bull trout populations (personal communication: J. Phelps, ODFW retired, April 2004). However, whether reintroduced spring Chinook are important components of bull trout diets in the subbasin and what effect this might have on bull trout productivity is unknown at this time.

### 3.4.3.2 Wildlife Inter-species Relationships

A variety of interspecies relationships occur among the wildlife found within the subbasin. Many of the most important relationships are either trophic (i.e., predator-prey) or competitive in nature, which can impact the productivity and diversity of the wildlife community. Predation is an important interaction and in the subbasin. Birds of prey, including the American Kestrel, Osprey, and Golden Eagle, consume large numbers of small non-game wildlife such as rodents, and these predators potentially control the populations of their prey; however, this has not been examined in the subbasin. Predatory mammals might also be important in controlling their prey populations. Rodents, jack rabbits, and cottontails are all prey for red fox, black bear, bobcat, and lynx. Bobcat, lynx, and black bear also prey on both mule and white-tailed deer. However, these relationships have not received much attention in the subbasin.

Competition is also an important factor that can potentially impact wildlife communities. Species that compete most strongly are those that use similar resources and are essentially functionally redundant (see Section 3.4.2.3). As with predation, competitive interactions among wildlife species have received little attention in the subbasin and therefore it is not clear how important these interactions are in driving the population and community dynamics of wildlife.

### 3.4.3.3 Fish-Wildlife Interactions

A variety of interactions occur between fish and terrestrial wildlife. Perhaps three of the most important are: 1) fish as a food resource for terrestrial wildlife, 2) wildlife as "engineers" of salmonid habitat, and 3) the impact of marine-derived nutrients from anadromous fish on terrestrial wildlife habitat. These interactions are outlined below; however, very little work has been conducted on them in the Umatilla/Willow subbasin.

Many wildlife species consume salmon and steelhead. Table 25 in section 3.2.1.3 provides a list of 75 wildlife species that occur in the Umatilla/Willow subbasin that are known to consume salmon or steelhead eggs, fry, fingerlings, parr, smolts, adults, or carcasses (IBIS 2004). The recent hatchery supplementation of steelhead and the reintroduction of coho and fall and spring Chinook salmon into the subbasin has greatly increased the availability and abundance of all life history stages of salmon and steelhead as a food resources for these wildlife species. At this time, no studies have been conducted to specifically address changes in distribution, abundance or productivity of any of these species of wildlife with the recent increases in salmon and steelhead. However, ODFW biologists have noted a dramatic increase in the number of black bears gathering at the North Fork of the Umatilla River during spring Chinook spawning over the past five years (personal communication: T. Bailey, ODFW, April 2004), which suggests that the reintroduction of spring Chinook has had an impact on the behavior, distribution and possibly productivity of the black bear population in the subbasin.

Wildlife can also have important positive impacts on salmonids through their direct impact on stream habitat. The best example of this interaction is the creation of complex dynamic stream habitat by beaver (Naiman et al. 1988). Pools created by beaver dams might be particularly important habitat for juvenile salmon and steelhead. For example, in two coastal Oregon streams beaver ponds were important habitat for coho juveniles during summer low flows (Leidholt-Bruner et al. 1992). Beaver ponds were also found to be important overwintering habitat for bull trout and cutthroat trout in headwater streams in Montana (Jakober et al. 1998) and for juvenile coho salmon in Washington (Peterson 1982). Beaver abundances have most likely declined in the Umatilla/Willow subbasin since the time of the first fur trappers coming to the Blue Mountains in 1811 and driving beaver nearly extinct throughout the Northwest by 1840 (Langston 1995). It is unclear what impact this early removal of beaver had on salmon and steelhead populations in the subbasin.

Another important, but somewhat indirect, interaction between salmon and wildlife is the effect that salmon carcasses have on terrestrial wildlife habitat through the input of marine-derived nutrients. Salmon carcasses often end up in riparian areas either because they are washed up during high flows or because scavengers remove the carcasses from streams and do not consume the entire carcass (Cederholm et al. 1989). Decomposition of these carcasses and waste products from animals that consume these carcasses release nutrients that are then available to plants (Naiman et al. 2002). Work with stable isotopes reveals that marine-derived nitrogen makes up a substantial percentage (up to 26%) of the total nitrogen found in many riparian plants (Bilby et al. 1996; Naiman et al. 2002). This availability of marine-derived nutrients can greatly influence the rate of growth and size of vegetation in riparian zones. For example, Sitka spruce adjacent to streams with spawning salmon grow to a diameter of 50 cm in 86 years. This size is a big enough to create large woody debris that makes an important contribution to salmon habitat in the stream. However, in nearby streams in which salmon passage is blocked, it requires 307 years for Sitka spruce to achieve 50 cm in diameter (Naiman et al. 2002). In addition, marine-derived nutrients appear to have an important impact on the composition of riparian vegetation communities, with communities dominated by relatively large trees and having a species-poor understory characteristic of riparian areas adjacent to streams with salmon and a greater dominance and diversity of shrubs and understory vegetation in streams that lack salmon (Naiman et al. 2002). What impact this change in riparian vegetation growth rates and composition has on wildlife communities is unclear at this time; however, the impact on riparian vegetation suggests that this impact should be important.