Section 3. Subbasin Assessment

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3. Subbasin Assessment

3.1 Subbasin Overview

3.1.1 General Description

3.1.1.1 Location

The Umatilla and Willow Creek subbasins are two of a number of subbasins included within the Columbia Plateau ecological province[1] (Figure 1). Adjacent to these subbasins are two smaller drainages, Six-Mile Canyon and Juniper Canyon, which, along with the Umatilla and Willow Creek subbasins (Figure 2), are the subject of this plan. For the purpose of brevity, the term "Umatilla/Willow subbasin" will be used to refer to all four of these areas collectively.

The Umatilla subbasin lies within Umatilla and Morrow Counties, Oregon, with a negligible portion of the headwaters located in Union County. The Umatilla River originates in the Blue Mountains of northeastern Oregon and flows north and west to enter the Columbia River at river mile (RM) 289. The Umatilla subbasin extends west to Hermiston and the Sand Hollow drainage, south to Butter, Birch and McKay headwaters, east to Meacham and the North and South Fork Umatilla headwaters, and north to the Cold Springs drainage.

The Willow Creek subbasin lies to the west of the Umatilla subbasin, with 78% of it lying in Morrow County and 22% in Gilliam County. Willow Creek originates near Bald Mountain in the Umatilla National Forest and flows north and west to enter the Columbia River at RM 253. The Willow Creek western boundary is formed by the Eight-Mile Canyon drainage.

The Six-Mile Canyon drainage lies between the Umatilla and Willow Creek subbasins in Morrow County. This semi-arid area is drained by intermittent streams, which seldom enter into the Columbia River. The tributaries of this drainage include Six-Mile Canyon, Sand Hollow, and Juniper Canyon creeks. The "Juniper Canyon" which lies within the Six-Mile Canyon drainage will henceforth be called "Juniper Canyon-Ione," to distinguish it from the Juniper Canyon drainage that lies east of the Umatilla subbasin. When flow is sufficient, Juniper Canyon-Ione Creek enters the Columbia west of the Umatilla subbasin, 16 river miles downstream from the Umatilla/Columbia River confluence.

The fourth and smallest drainage of the Umatilla/Willow subbasin is the Juniper Canyon drainage, located north of the Umatilla subbasin in Umatilla County. Juniper Canyon Creek enters the Columbia River in Lake Wallula, approximately 11 miles upstream of McNary dam.

[1] The term "ecological province" used in this plan corresponds to the NWPCC definition of ecological province as a "group of adjoining subbasins with similar climates and geology" (NWPCC 2000). NWPCC recognized 11 ecological provinces (also termed "ecoprovinces") in the Columbia River basin (NWPCC 2000).

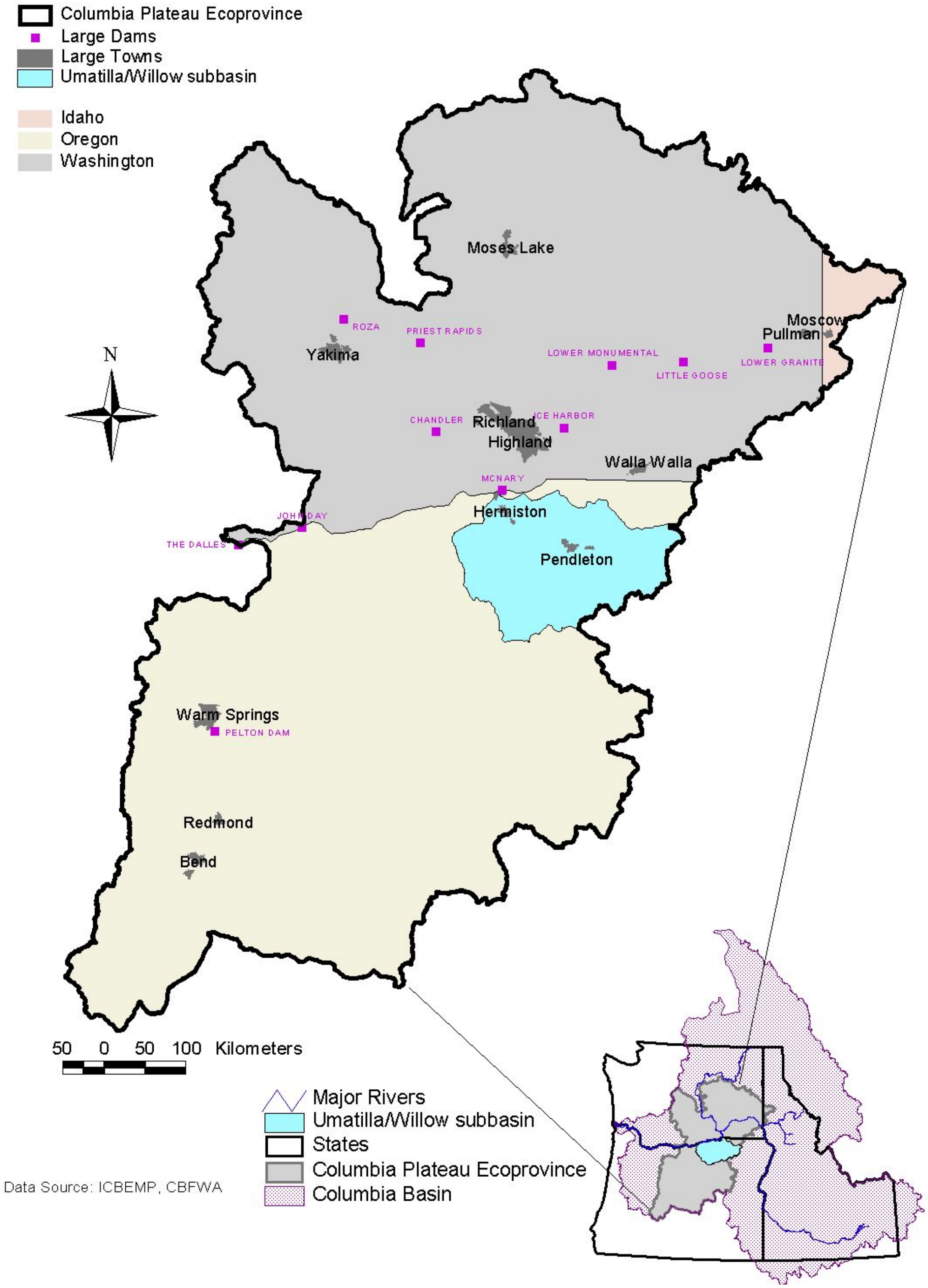


Figure 1. The Umatilla/Willow subbasin within the Columbia Plateau ecological province.

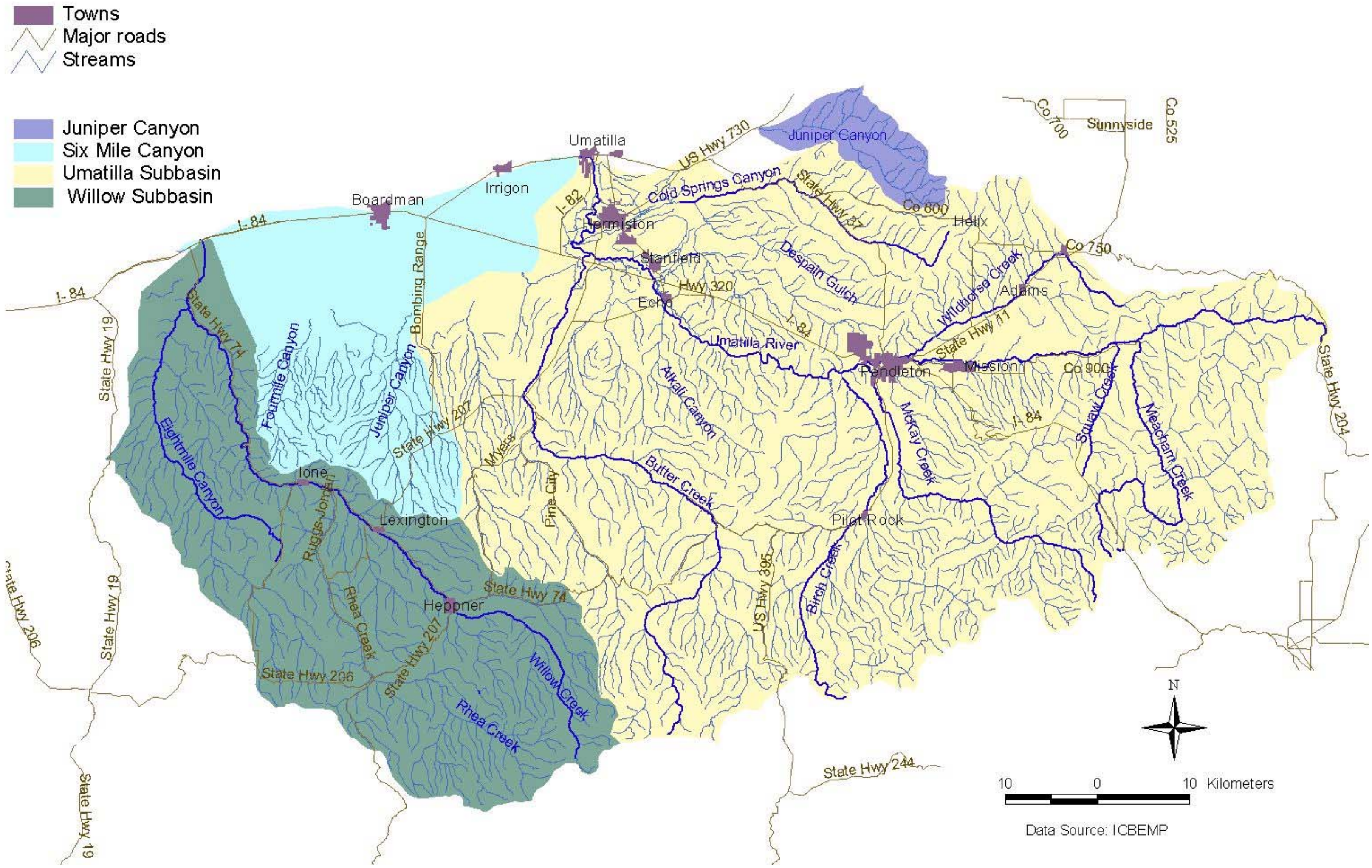


Figure 2. Assessment units and major features of the Umatilla/Willow subbasin.

3.1.1.2 Size

The mainstem Umatilla River is 89 miles long and the river and its tributaries drain an area of nearly 2,290 square miles (Gonthier and Harris 1977). Elevations in the Umatilla subbasin range from about 5,800 feet near Pole Springs on Thimbleberry Mountain to 260 feet at the mouth of the Umatilla River (Figure 3). Willow Creek is 79 miles long and drains an area of about 880 square miles. This subbasin ranges from 5,583 feet in elevation at its headwaters near Bald Mountain in the Umatilla National Forest to 260 feet at its confluence with the Columbia River (Figure 3). The Six-Mile Canyon area is 472 square miles and ranges in elevation from 3,084 feet at the headwaters of Sand Hollow Creek to 260 feet at its confluence with the Columbia River. The mainstem of Juniper Canyon Creek is 19 miles long and it drains 72 square miles. The headwaters of this creek occur at 1,935 feet and it enters the Columbia River at an elevation of 344 feet. The total area of the Umatilla/Willow subbasin is 3714 square miles.

3.1.1.3 Geology

The Umatilla/Willow subbasin consists of two geologic provinces: the Blue Mountains and the lower basin (sometimes referred to as the Umatilla plain). The Umatilla River and its tributaries begin in the Blue Mountains, which are characterized by deeply incised upland surfaces and a ramp-like slope called the Blue Mountain slope or foothills (USCOE 1947). The flat-topped ridges and steep stair-stepped valley walls of the Blue Mountains were formed by thousands of feet of Miocene basalt flows (USCOE 1947). These flows were part of a regionally widespread series of flows that formed the Columbia basin basalts and resulted in three major formations: the Saddle Mountain, Wanapum, and the Grande Ronde formations. Each basalt formation is an aggregation of smaller individual flows sharing similar flow histories and chemistry.

These flows were extruded from a regional volcanic vent system and filled the shallow basin of the Columbia Plateau (Gonthier and Bolke 1993). The thickness of each of these flow units ranges from five feet to as much as 150 feet, and collectively is estimated to be hundreds to thousands of feet thick (Newcomb 1965). As the mountains were further uplifted and the horizontal basalt layers warped into a series of folds, streams carved canyons through the basalt layers, creating a highly dissected landscape (Davies-Smith et al. 1988). The structural deformation of the basalt and its subsequent erosion created the varied topography of the Blue Mountains and their foothills.

Streams leaving the canyons of the Blue Mountains cross a wide expanse of plains and terraces making up the lower basin (Newcomb 1965). The lower basin is comprised of tertiary and quaternary loess, alluvium, glacio-fluvial, and lacustrine sediment deposits which mantle the Columbia River basalts across much of the lower elevations (Newcomb 1965). During the tertiary period, ancestral streams washed the oldest of the valley sedimentary deposits down from the canyons of the Blue Mountains and deposited them along the mountain front (Gonthier and Bolke 1993). Quaternary deposits of wind-borne silt, or loess, blanket much of the tertiary deposits and basalt flows in the subbasin. The

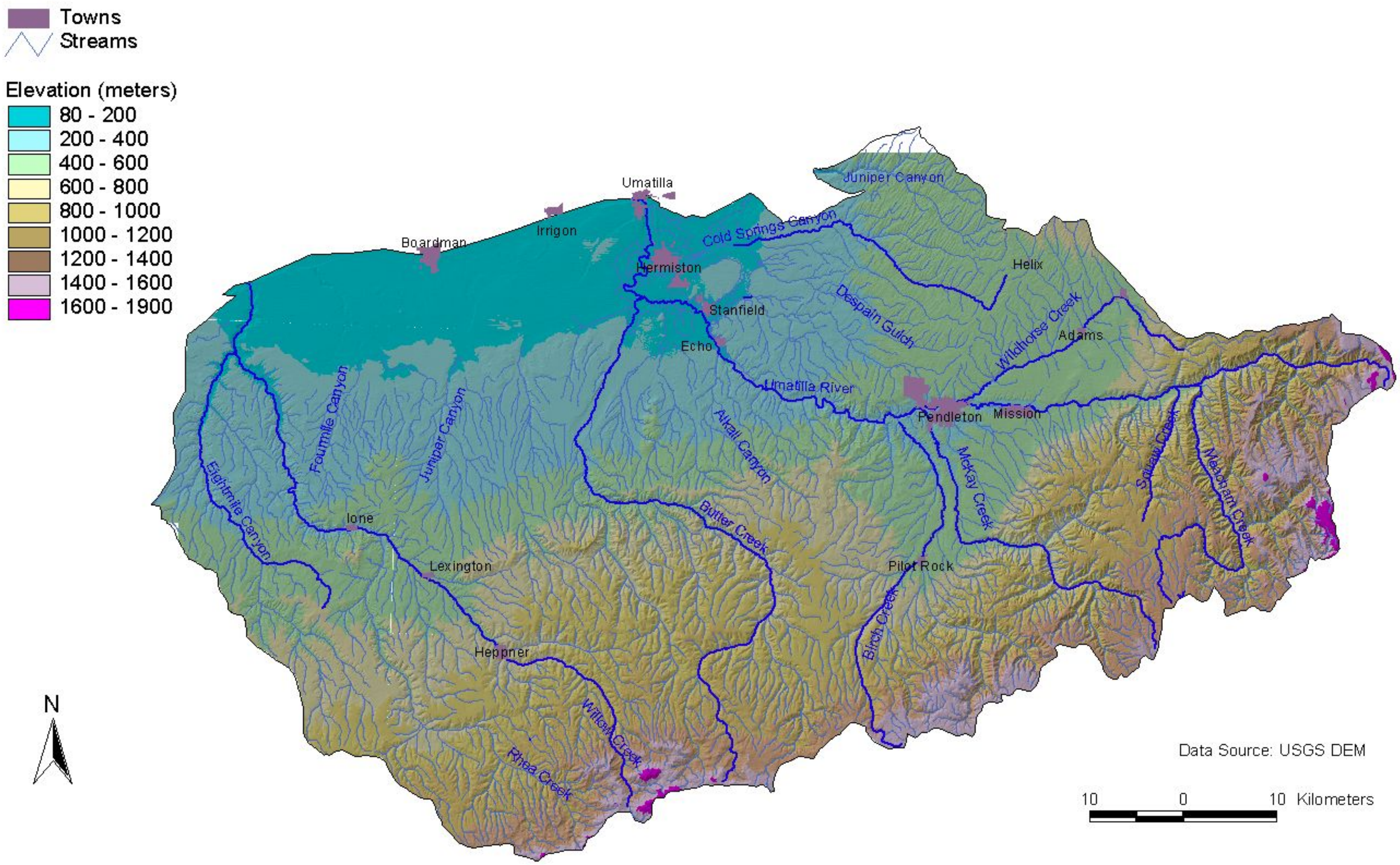


Figure 3. Elevation ranges in the Umatilla /Willow subbasin.

massive Missoula Floods that periodically inundated large areas of the Columbia Plateau from 12,800 to 15,000 years ago (Gonthier and Bolke 1993) also deposited approximately one meter of loess on top of lacustrine sediment. The highly productive soils that make the region famous for its agriculture are largely derived from these quaternary and tertiary deposits.

There are about 75 different soils in the Umatilla/Willow subbasin ranging from highly fertile loess and sand to ash derived from eruptions of volcanoes such as Mt. St. Helens in 1980, Mt. Mazama 6,000 years ago, and Glacier Peak 11,250 years ago (Johnson and Makinson 1988). Soils in the Blue Mountains and their foothills were formed in a variety of parent materials, including volcanic ash, residuum, loess, and colluvium (Johnson and Makinson 1988). Soils in the lower basin were formed in aeolian sand, loess, alluvium and lacustrine sediment (Johnson and Makinson 1988). Sandy soils are common at lower elevations of the Umatilla/Willow subbasin near the Columbia River, where swiftly moving waters, such as those associated with the Missoula Floods, deposited large-sized particles such as sand and gravel. These soils do not retain water well because of their low organic matter and coarse texture, and most sandy soils of the lower basin are not considered arable without pivot irrigation. Flooding from the Columbia River has also resulted in extensive silt deposits throughout the lower basin. Soils formed in silt often have a thin layer of loess at the surface. Although silty soils retain more water than sandy soils, irrigation is often still necessary in areas of low rainfall.

3.1.1.4 Climate and Weather

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6). The major influence on the regional climate is the Cascade Mountains to the west, which form a barrier against warm moist fronts from the Pacific Ocean (Johnson and Clausnitzer 1992). The Columbia Gorge provides a break in the curtain of the Cascade Mountains and occasionally allows moisture laden marine air to penetrate into the northern Blue Mountains. This induces light to moderate precipitation (depending on elevation), and results in vegetation common to the west slopes of the Cascades (Johnson and Clausnitzer 1992).

The subbasin experiences strong seasonal fluctuations in both temperature and precipitation. In the summer the subbasin experiences a continental climate with warm days, cool nights and little precipitation. Winters are much colder, with average temperatures often only slightly above freezing (Figure 4). Precipitation also changes dramatically with the seasons, with most precipitation in the subbasin falling during the fall, winter and spring (Figure 5).

The climate of the subbasin is also strongly influenced by elevation. Warm and dry conditions exist in the northwestern, low elevation portion of the subbasin. Here precipitation falls mainly as rain and often only nine inches fall annually (Figure 6). In contrast, up to 55 inches of precipitation falls in high elevation areas of the Blue Mountains (Figure 6) with much of this precipitation occurring as snowfall. These gradients in elevation and precipitation are also found in the Willow subbasin and Six-Mile

Canyon area, as demonstrated by differences recorded at the Boardman (elevation = 620 feet) and Heppner (elevation = 1890 feet) climate stations (Figure 7).

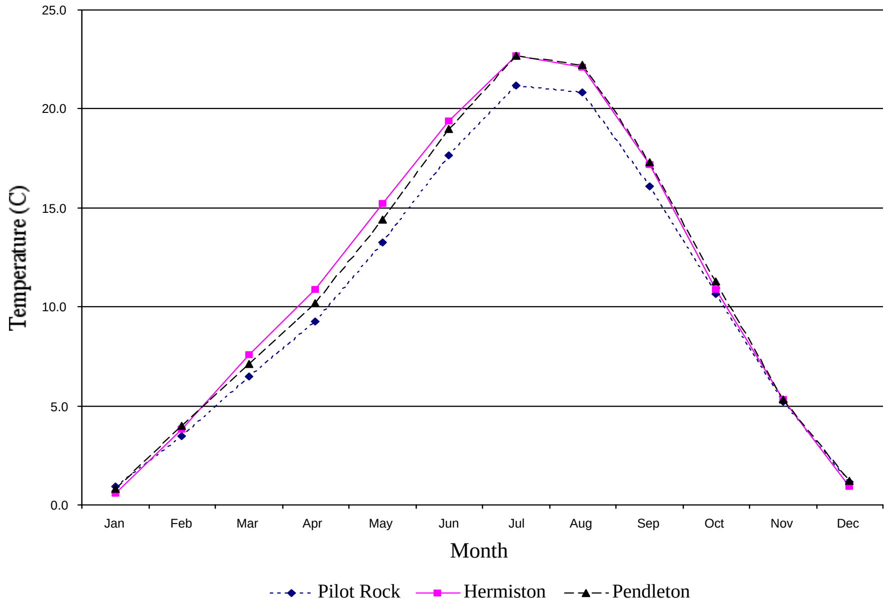


Figure 4. Average monthly temperature for three climate stations, Pilot Rock (elevation = 1,637 feet), Pendleton (elevation = 1,069 feet), and Hermiston (elevation = 450 feet), in the Umatilla subbasin, 1961-1990 (Oregon Climate Service 1999).

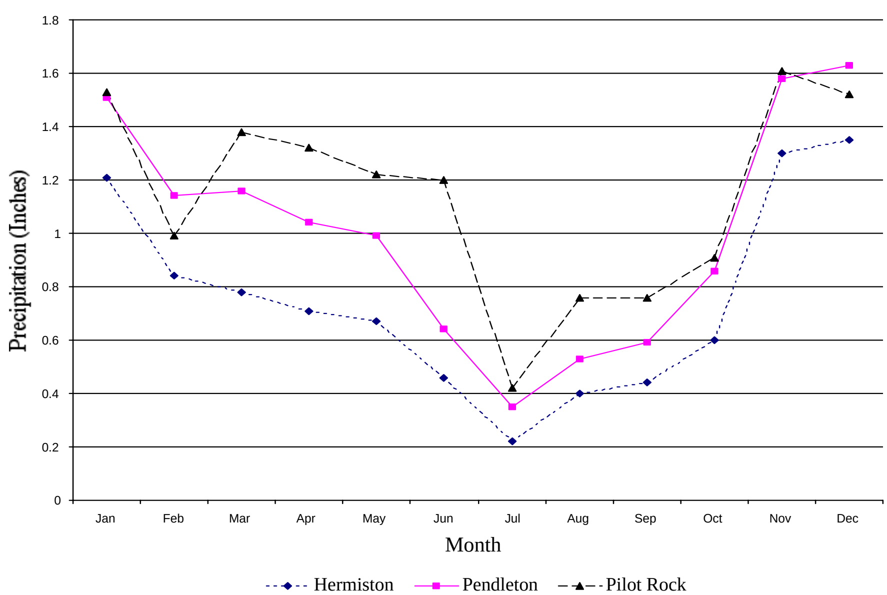


Figure 5. Average monthly precipitation at three climate stations, Pilot Rock (elevation = 1,637 feet), Pendleton (elevation = 1,069 feet), and Hermiston (elevation = 450 feet), in the Umatilla subbasin, 1961-1990 (Oregon Climate Service 1999).

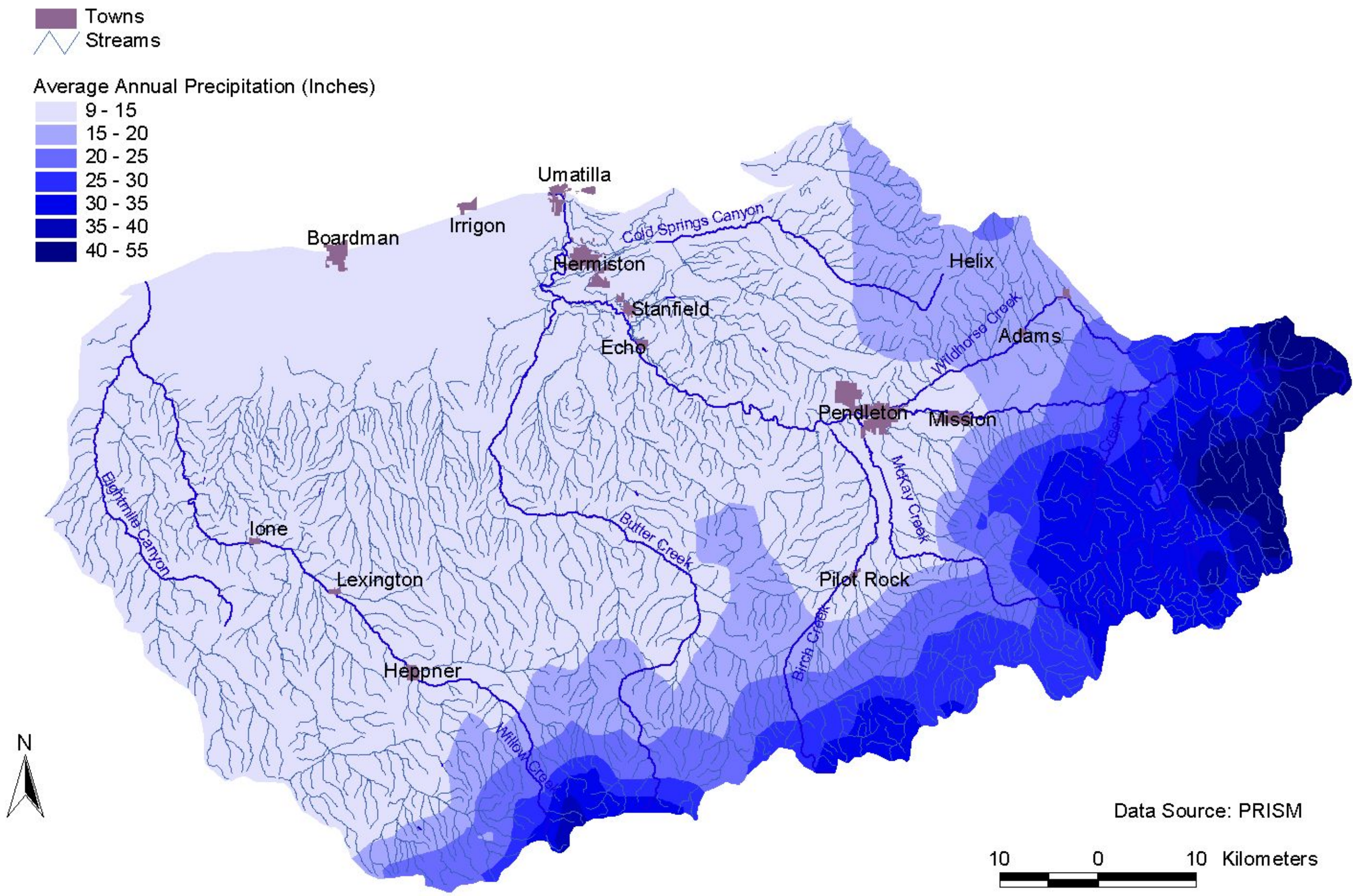


Figure 6. Precipitation ranges in the Umatilla /Willow subbasin.

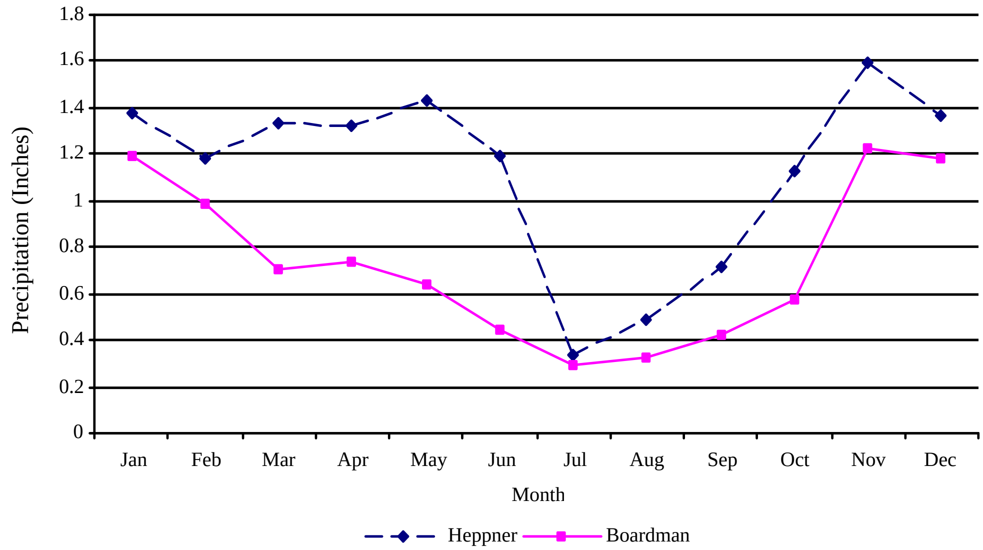


Figure 7. Average monthly precipitation at the Heppner and Boardman climate stations in the Willow Creek subbasin and Six-Mile Canyon area (respectively) (Oregon Climate Service 1999).

3.1.1.5 Land Cover

General types of land cover found in the Umatilla/Willow subbasin, in order of prevalence, include agricultural areas, shrub-steppe, grasslands, forested communities, urban areas, and riparian areas and other wetlands (Figure 8). Forested communities are associated with higher elevations and grassland and shrub-steppe are more common at lower elevations. General descriptions of the composition of natural vegetation land covers follow, but see Section 3.2.4.2 for more details.

Forested communities make up approximately 14% of the subbasin land cover (IBIS 2004), and are found primarily in the southern portion of the subbasin at mid and high elevations (Figure 8). Three types of forest communities are recognized: subalpine fir, mixed coniferous forest, and ponderosa pine forests. The subalpine fir community is found at the highest elevations and/or on north facing slopes. This community is generally limited by a short growing season and by low moisture availability on some sites. Coniferous species found in this community include subalpine fir, Engelmann spruce, and lodgepole pine. There is some overlap in species composition between the subalpine fir community and the mixed coniferous forest community (Quigley and Arbelbide 1997). The mixed coniferous forest community occurs primarily at mid to upper elevations and on all aspects in transitional areas between drier, lower elevation forests (ponderosa pine) and higher elevation subalpine forests. Mixed coniferous forests can include a variety of species such as grand fir, Englemann spruce, lodgepole pine, Douglas fir, western larch, and ponderosa pine (Quigley and Arbelbide 1997). The ponderosa pine forest occurs predominately at the mid and lower elevations and on southerly aspects in the forested zone. These forests are generally limited by low water availability and are often subject to drought. This group primarily consists of ponderosa pine as the cover type, but Douglas fir is also common at the upper elevations and moister sites (Quigley and Arbelbide 1997).

Additionally, while not recognized as a specific forest community, stands of western juniper occur sporadically throughout the low elevation western and northern portions of the subbasin (Kagan et al. 2000).

Historically (c. 1850), the majority of the subbasin was covered primarily by grasslands (78%) and shrub-steppe communities (10%) (IBIS 2004). While much of these communities have been replaced by agriculture, some tracts of these communities still exist (Figure 8). Much of the remaining grasslands are "needle-and-thread" grasslands (composed of *Agropyron dasystachyum, A. spiciatum, Poa secunda,* and *Stipa comata*) and cheatgrass-dominated grasslands (Kagan et al. 2000). Shrub-steppe communities dominate the drier sections of the subbasin, and species include big sagebrush and Sandberg's bluegrass, and in moister sections, Idaho fescue (Clarke and Bryce 1997).

Riparian areas contain the most biologically diverse habitats in the subbasin because of their variety of structural features (including live and dead vegetation) and proximity to water bodies. This combination of features provides a wide array of habitats that support more species than any other land cover type (Quigley and Arbelbide 1997). Common deciduous trees and shrubs in riparian areas include cottonwood, alder, willow, red-osier dogwood, common chokecherry, and black hawthorn (USFS and BLM 2000; Wooster and DeBano 2003).

3.1.1.6 Land Use and Population

The majority of land in Umatilla and Morrow Counties is used for agricultural purposes, as defined by the proportion of the total area designated as cropland, pasture, and rangeland (Figure 9). Cropland, both dryland and irrigated, comprise about 39% of the Umatilla/Willow subbasin (IBIS 2004). Approximately 73% of the cropland in the subbasin is dryland and 27% is irrigated (personal communication: R. Denny, Umatilla County SWCD, March, 2004). Rangeland and range-forest transition areas account for 42% of land cover, forest accounts for approximately 14%, and urban and developed areas account for approximately 1% (Umatilla SWCD 2001, IBIS 2004).

According to the US Census Bureau's estimate for 2000, 70,548 people live in Umatilla County, resulting in a density of 21.9 people per square mile (US Census Bureau 2002). The majority of these people (51.2%) live in rural areas and towns of less than 2,000 people. In 2000, approximately 48.8% of Umatilla County's population lived in the three largest towns, Pendleton (population 16,354), Hermiston (population 13,154), and Umatilla (population of 4,978). These three towns are all found along the mainstem of the Umatilla River (Figure 9). In Morrow County the Census Bureau's 2000 estimate for population size was 10,995, resulting in a density of only 5.4 people per square mile (US Census Bureau 2002). Only one town in Morrow County, Boardman (population 2,855), has a population larger than 2000. This town's population represents 26% of Morrow County's entire population (US Census Bureau 2002).

The Bureau of Indian Affairs (BIA) estimated the total resident Native American population on or near the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) at more than 2,400 in 1998 (including Native Americans enrolled with other Tribes). The

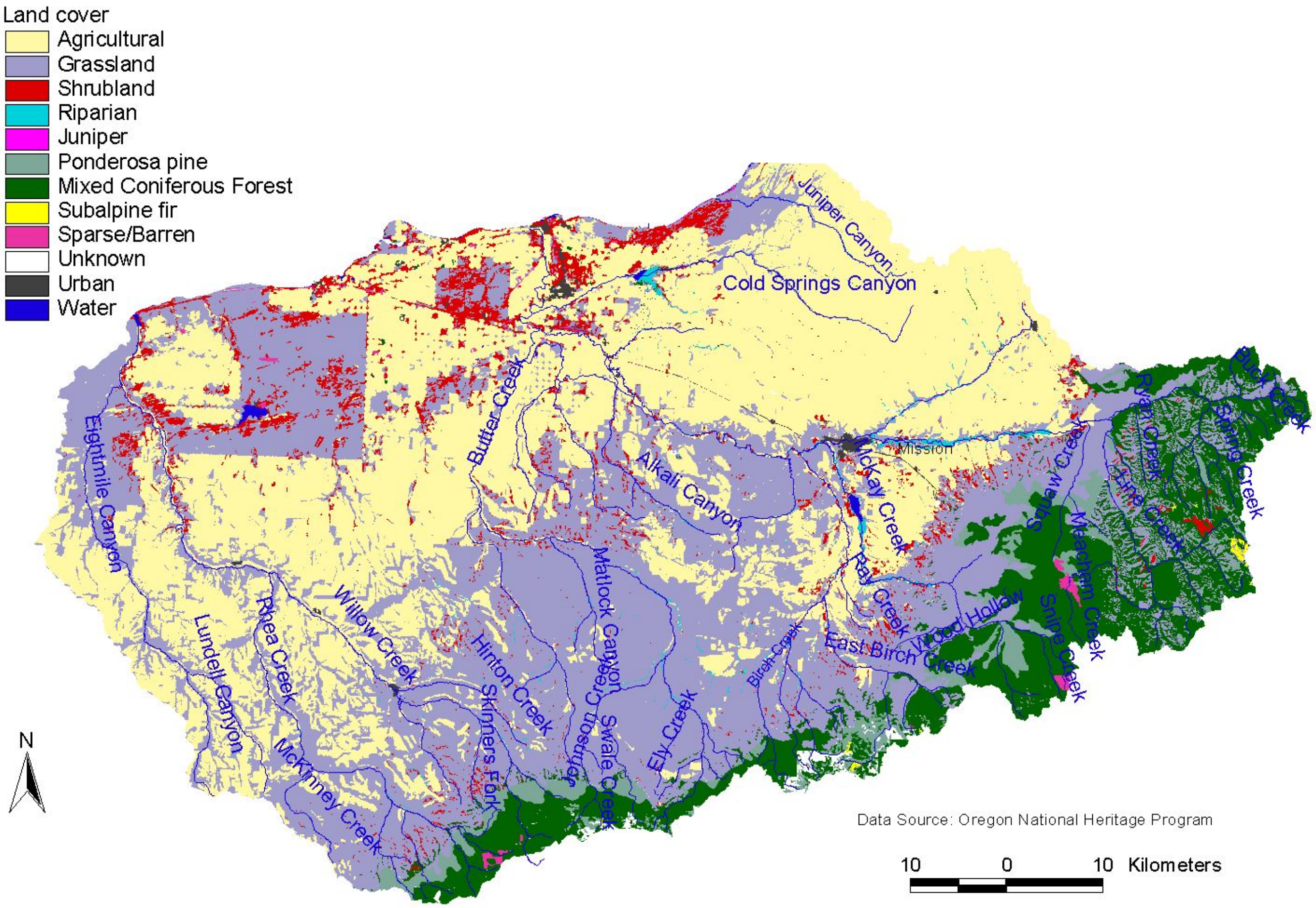


Figure 8. Land cover types occurring throughout the Umatilla/Willow subbasin.

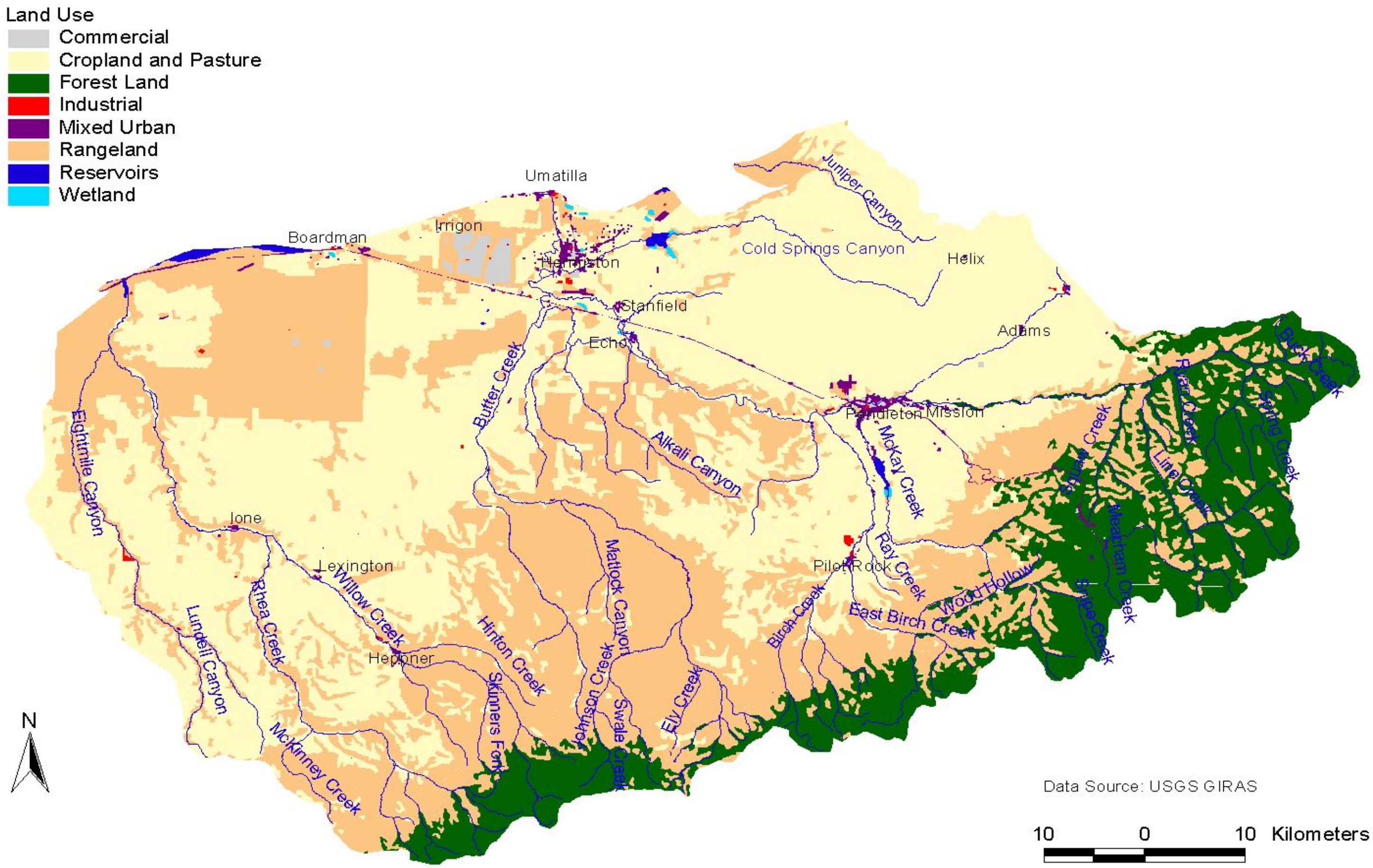


Figure 9. Land use in the Umatilla/Willow subbasin.

August 1998 CTUIR membership numbered 2,140 members living on and off Reservation lands. The Reservation is also home to about 1,700 non-Native Americans.

3.1.1.7 Economy

The economies of Umatilla and Morrow Counties, as measured by total earnings, rose steadily from 1990 to 2000 (Figure 10). Earnings from government sources made up the largest component of the economy in Umatilla County from 1990-2000 (Figure 11a). Manufacturing (especially of lumber and wood products and food processing) and service industries were also important contributors to the Umatilla County economy (Figure 11a). In Morrow County, manufacturing, government, and farming were all large components of the economy throughout the same decade (Figure 11b).

In both counties, part of the service and retail industry is generated from wildland recreation opportunities available on public lands in the county, where hunting, fishing, hiking, and other outdoor activities are common. Although the dollar amount related to wildland recreation is not known, camping, hunting and fishing are all popular attractions in the area that draw in people from western Oregon, Washington, and Idaho. A large variety of animals are hunted in the area, including ducks, quail, ring-necked pheasant, black bear, mountain lion, and deer. Fishing is also very popular and the area is considered a world-class small-mouth bass fishery; walleye, sturgeon, and salmon are also part of a popular sports fishery.

Although direct earnings from farms in 2000 made up less than 5% of the economy in Umatilla County and less than 25% of the economy in Morrow County, it is important to note that significant portions of other categories, such as transportation, manufacturing, and government, are related to agricultural activities. For example, in 2001, Umatilla County farmers and ranchers employed 5,750 workers involved in the production of agricultural commodities (OSU Extension Service 2001). The total value of agriculture to the economy of Umatilla County was estimated at $685 million in 2001 (OSU Extension Service 2001). Food processing of potatoes alone accounts for $15-20 million of payroll annually in the subbasin (personal communication: D. Horneck, OSU Extension Service, February 2004).

The importance of agriculture in the Umatilla/Willow subbasin is further evident by commodity sales. In 2003, Umatilla County ranked fifth in the state in agricultural commodity sales at $200 million (OSU Extension Service 2003), with approximately 78% of gross farm sales coming from crops and 22% from animal products (Table 1). Wheat is one of the most important crops in Umatilla County, which is the largest wheat producing county in Oregon, accounting for about 1/3 of the state's production (Oregon Wheat Growers League, 2003). Cattle, potatoes, hay and vegetables are other large contributors, with alternative crops emerging as new commodities. In contrast, the timber industry has declined dramatically in recent years primarily due to harvest reductions on national forest lands (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee et al. 1999).

Morrow County is also an important agricultural center and is ranked eighth in the state for agricultural commodity sales at $180 million in 2003 (OSU Extension Service 2003). During that year, approximately 52% of gross farm sales came from livestock and 48% from crops (Table 1). In the northern irrigated part of the Willow Creek subbasin the major crops include potatoes, onions, corn and alfalfa hay, with smaller acreages planted in mint and other vegetables. In the central portion of the subbasin, dryland wheat is the major crop, and cattle are the main commodity in the southern region. Other agricultural industries of importance in Morrow County include the world's largest hybrid poplar plantation, a relatively new dairy industry with extensive facilities in the towns of Boardman and Ione, and a growing food-processing industry (Willow Creek Local Advisory Committee et al. 2003).

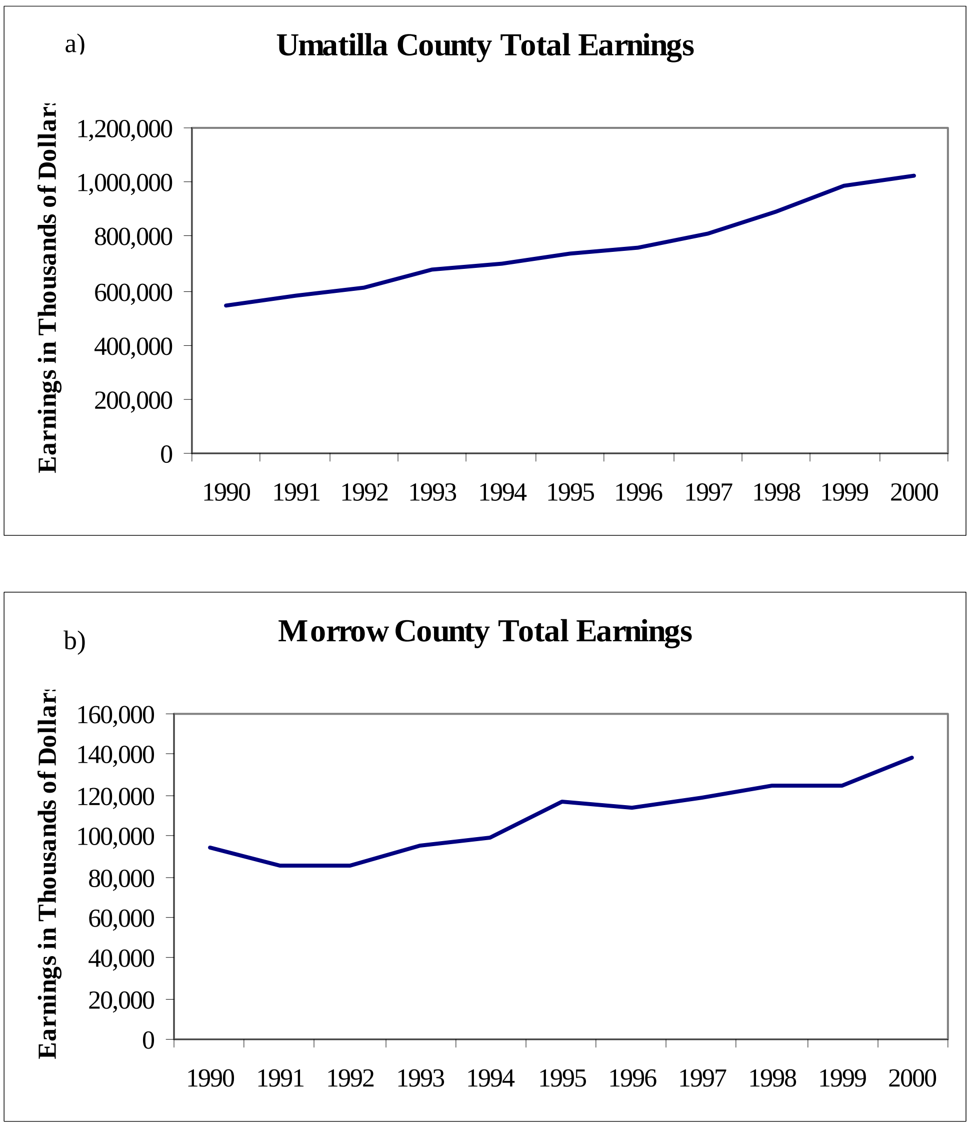
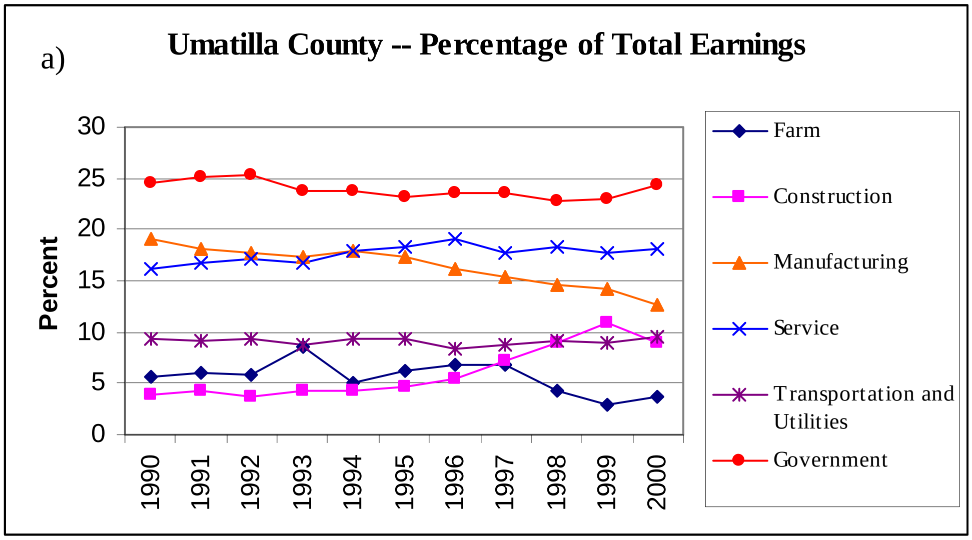


Figure 10. The total earnings of a) Umatilla and b) Morrow Counties (WSU Cooperative Extension 2002).



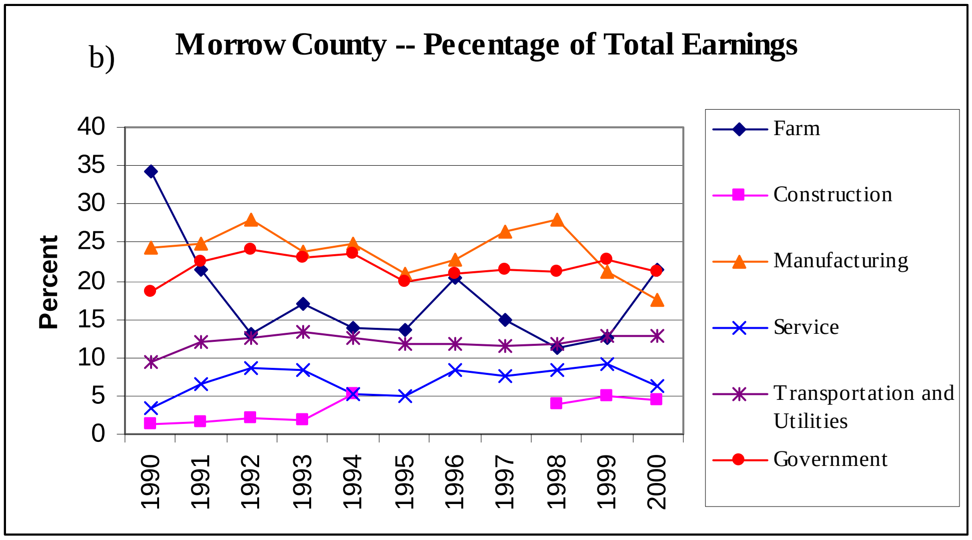


Figure 11. The proportion of total earnings for different types of industry for (a) Umatilla and (b) Morrow Counties. Several categories that make up relatively small percentages of the economy are not included in the graphs, including “Wholesale Trade”, “Finance, Insurance, and Real Estate”, and “Ag. Services, Forestry, Fishing and Other” (WSU Cooperative Extension 2002).

Table 1. Gross farm sales for Umatilla and Morrow Counties for 2002 and 2003, rounded to the nearest $1000 (OSU Extension Service 2003).

Commodity	Umatilla County		Morrow County	
	2002	2003	2002	2003
Grains	$36,919,000	$36,954,000	$10,929,000	$15,306,000
Hays and Forage	$14,658,000	$9,223,000	$8,895,000	$14,936,000
Grass and Legume Seeds	$18,374,000	$11,486,000	$2,264,000	$2,506,000
Field Crops	$43,957,000	$33,093,000	$39,827,000	$37,326,000
Tree Fruit and Nuts	$16,433,000	$20,563,000	$0	$527,000
Small Fruit and Berries	$12,000	$12,000	$0	$0
Vegetable Crops	$33,206,000	$30,978,000	$7,217,000	$12,245,000
Other Crops	$18,441,000	$13,451,000	$9,682,000	$3,785,000
All Crops	$182,000,000	$155,760,000	$78,814,000	$86,631,000
Livestock	$34,614,000	$43,530,000	$78,910,000	$93,123,000
Dairy Products	$619,000	$594,000	*	**
All Animal Products	$35,233,000	$44,124,000	$78,910,000	$93,123,000
Total Gross Sales	$217,233,000	$199,884,000	$157,724,000	$179,754,000

* Unavailable

** Not reported for 2003, but estimated value for that year is $30-35 million (personal communication: Oregon Agricultural Statistics Service, March 2004)

3.1.1.8 Land Ownership

The majority of land in the Umatilla/Willow subbasin is privately owned (Table 2; Figure 12). Approximately 11% of the drainage is managed by federal agencies, including the United States Forest Service (USFS), which manages over 70% of federally owned lands. Other landowners in the subbasin include the State of Oregon, counties, cities, and the CTUIR (CTUIR and ODFW1990).

Table 2. Land ownership and percentage of area owned in the Umatilla/Willow subbasin.

Land Ownership	Land Area Owned (acres)	Percentage of Total Area
Private Land	2,230,370	85.25
U. S. Forest Service	200,213	7.65
Bureau of Land Management	14,000	0.54
Corps of Engineers	591	0.02
Department of Defense	66,563	2.54
U. S. Fish & Wildlife Service	4,558	0.17
Umatilla Indian Reservation	96,457	3.69
State of Oregon	3,414	0.13

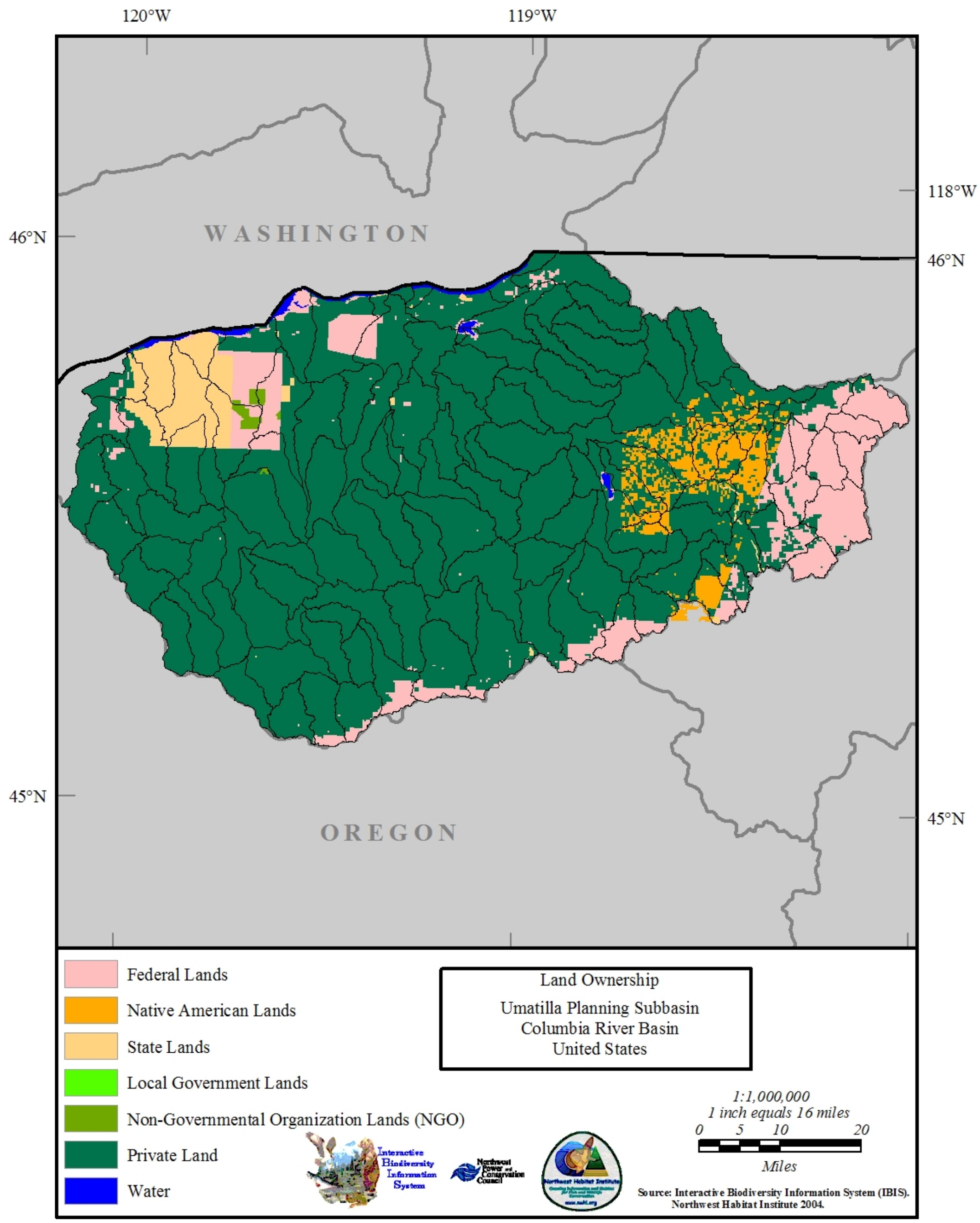


Figure 12. Land ownership in the Umatilla/Willow subbasin (IBIS 2004).

3.1.1.9 Human Influences on Aquatic and Terrestrial Environments

It is important to note that all of the human activities discussed in this section provide widespread and well-recognized benefits to Oregon's citizens, communities, and economies. However, the narrow focus of this section limits it to a discussion of how these activities influence aquatic and terrestrial environments that are important to fish and wildlife in the subbasin. Therefore, this section briefly describes how humans in the subbasin currently impact aquatic and terrestrial environments in the Umatilla/Willow subbasin through agriculture, exotic weed introduction, forest practices, livestock grazing, transportation, urbanization, and water development. The order in which these topics are presented is alphabetical, and does not reflect the magnitude of their impact. Negative impacts of these activities, their ecological effects, and the extent of their effects in the subbasin, if known, are summarized in Table 4. Positive impacts of these activities on aquatic and terrestrial environments are discussed in the text. Later sections in this document (3.1.3.2) discuss how these activities, and their effects on hydrology and ecology in the subbasin, have changed through time.

Agriculture: Agriculture is an important land use in the area, covering 39% of the Umatilla/Willow subbasin (IBIS 2004). Agriculture has affected fish and wildlife in the subbasin through water withdrawals for irrigation, stream channelization, loss of riparian vegetation, increased sediment input, and the loss of wildlife habitat and changes in hydrology associated with land conversion.

Currently, there are six major irrigation diversions in the lower Umatilla River that withdraw approximately 129,000 acre-feet on an average year (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee et al. 1999). The irrigation withdrawals dewater the river below Dillon Dam, resulting in an average daily flow over a 14-day period of less than 1 cfs (Table 3). However, return flows from these operations significantly enhance flows in this area in late summer and fall. In addition, releases from McKay Reservoir for irrigated agriculture brought about by the second phase of the Umatilla Basin Project have resulted in increased flows and decreased temperatures in the Umatilla River from Pendleton to Echo from June through September (see discussion below on Water Development and Section 3.1.3.2 for more details on the benefits of water exchange projects in the subbasin).

Irrigation in the Willow Creek subbasin can also have extensive effects on instream flow. For example, the upper Willow Creek drainage has a total annual flow of approximately 30,000 acre-feet; however, by RM 4, total annual flow is reduced to an estimated 23,000 acre-feet due to extensive irrigation withdrawals and stream channel losses (Willow Creek Local Advisory Committee et al. 2003). The effect of water withdrawals in summer is particularly significant. Willow Creek below Ione is almost entirely dry from late June until early September as irrigation diversions during summer low flow periods results in the total diversion of flow (personal communication: K. Ramsey, USFS, January 2004). The few pools that remain provide a limited and fragmented habitat for aquatic species in the summer.

Another impact resulting from use of water by agriculture is an increase in summer water temperatures, which further decreases the availability of the lower river to salmon as habitat. Importantly, many other factors besides agriculture influence summer water temperatures in the Umatilla/Willow subbasin (e.g., see Table 4 and Section 3.1.2.2). Summer water temperatures in the lower Umatilla River frequently exceed the incipient lethal limit for salmonids of 21°C (ODEQ et al. 2001; Contor 2003). However, as noted above, releases from McKay Reservoir from June to September have a beneficial impact on temperature and flow from June through September between Pendleton and Echo.

Table 3. Low-flow statistics for the Umatilla River below McKay Creek (ODEQ et al. 2001).

Return Period	Umatilla River at Yoakum (cfs)			Umatilla River near Umatilla		
	1-Day	**7-Day**	**14-Day**	**1-Day**	**7-Day**	**14-Day**
1-year	129.8	138.1	143.7	0.2	0.7	0.7
2-year	36.2	38.8	40.9	0.1	0.4	0.6
5-year	25.7	27.8	29.5	0.0	0.1	0.3
10-year	22.0	24.0	25.4	0.0	0.1	0.3
25-year	19.0	20.9	22.2	0.0	0.1	0.2
50-year	17.4	19.2	20.4	0.0	0.1	0.2
100-year	16.2	17.9	19.0	0.0	0.1	0.2

Streams are often channelized in agricultural fields to prevent flooding of fields and natural channel movement into fields. Channelization has a number of detrimental effects on stream and riparian ecosystems. It compresses the period of water conveyance, makes streams flashier, and increases and concentrates the energy of the water within the channel itself (instead of dissipating that energy across the floodplain). This increased energy can accelerate erosion of the stream channel, leading to channel incision and gully creation (NRC 2002). Channelization influences stream reaches downstream of channelized areas by creating higher flood peaks and delivering greater loads of sediment and nutrients (NRC 2002). Channelization also destroys riparian areas either directly, through human activity when the channel is being created, or indirectly, by decreasing subsurface water exchange with riparian areas and lowering the water table (NRC 2002). The decrease in subsurface water exchange and the lowering of the water table not only impacts riparian vegetation, but has an impact on agriculture by decreasing the recharge of shallow groundwater aquifers that provide well-water for many rural residents (personal communication: G. Reed, OSU, April 2004). Channelization can also reduce the exchange of water between the hyporheic zone and the stream channel. This exchange is beneficial in moderating temperatures in the stream. Reduced exchange results in higher temperatures in the summer and lower temperatures in the winter (ODEQ et al. 2001). Finally, channelization greatly decreases winter habitat (e.g., braided channels, sloughs) for juvenile salmon and steelhead. This habitat is very important for overwinter survival and growth of juvenile salmon (Swales et al. 1986, 1988) and the removal of this type of habitat results in severe reductions in the number of overwintering juvenile salmon (Tschaplinski and Hartman 1983). The loss of this type of habitat in the Umatilla River and its tributaries is thought to be one of the most significant causes of the reduction in naturally surviving salmonid and steehead (personal communication: C. Contor, CTUIR, April 2004).

Stream sediment derived from agricultural practices that result in erosion-causing runoff is another important impact of agriculture in the Umatilla/Willow subbasin. Dryland crop erosion problems stem from traditional winter wheat/summer fallow operations. Rasmussen et al. (1993) suggest that the winter wheat/summer fallow monoculture cropping system of Oregon's Columbia basin in 9" to 20" rainfall zones is not sustainable, either biologically or economically. According to the USDA Agricultural Research Service (ARS) and Natural Resources Conservation Service (NRCS), this cropping system is subject to significant soil erosion problems, especially when rain falls on frozen soils. Summer fallow has decreased the soil organic matter to half or less of its original levels under native grassland, contributing to erosion and crusting problems after seeding dryland crops. However, the use of crop residue management practices such as direct seeding and reduced tillage can virtually eliminate erosion from traditional farming systems (personal communications: T. Straughan, ODA, September 2002; T. Bennett, NRCS, January 2004). While some form of residue management is widely used, especially on shallower soils and wind erosion prone areas, direct seeding is not yet widely accepted in the area as an economically viable alternative. Other programs, such as the Conservation Reserve Program (CRP), help decrease erosion by reducing the amount of land under cultivation by planting to permanent vegetation that is similar to native vegetation (see Sections 3.1.3.2 and 4.3).

The conversion of large areas of native vegetation to croplands has resulted in a significant loss of wildlife habitat in the Umatilla/Willow subbasin. Shrub-steppe and grasslands habitats have been the most heavily affected (see Sections 3.1.3.2 and 3.2.4.2 for more details). The conversion of native vegetation to cropland has also changed the hydrology of the subbasin, beyond those effects associated with irrigation and channelization. For example, the conversion of large tracts of land into winter wheat/summer fallow crop systems results in slower infiltration into the ground and greater runoff of water into streams during precipitation events.

Exotic Weed Introduction: The term "exotic weeds" in this plan refers specifically to non-native, invasive plants. The spread of exotic weeds is facilitated by humans, either intentionally (e.g., planting exotic ornamental plants on private property, seeding exotic grasses on public lands to prevent erosion) or unintentionally (e.g., accidental transfer of exotic seeds or other plant material though human travel, livestock movement, or in nursery products). Regardless of the method of introduction, the problem of exotic weeds in the Umatilla/Willow subbasin is as prevalent and troublesome as elsewhere in Oregon and the United States. For example, Kagan et al. (2000) reported that all shrub-steppe and grassland habitats in the lower Umatilla/Willow subbasin contained well-established populations of cheatgrass and/or medusahead. Another study conducted during the summer of 2001 in the floodplain of the lower 80 miles of the Umatilla River revealed that approximately 44% of the plant species were exotic (Adamus et al. 2002). A study of 20 riparian sites along streams in the Patawa-Tutuilla watershed (a subwatershed of the Umatilla River watershed) found 1) that all sites had exotic weeds, 2) that 35 of the 52 herbaceous species found in the study were exotic, and 3) that the average percent coverage of herbaceous exotic weeds in these riparian areas was over 70% (Wooster and DeBano 2003).

Several exotic plant species are particularly problematic in the subbasin. For example, knapweed and yellow starthistle, natives of the Mediterranean, are rapidly increasing in the subbasin because of the similarities in climate between the two locations (Quigley and Arbelbide 1997). Both are widespread and rapidly invade areas that have been disturbed to replace native plant species. Other serious exotic species includes rush skeletonweed, spikeweed, medusahead, and perennial pepperweed. Russian olive is a major problem in wet meadows and riparian areas to which it has escaped from residential plantings. Other widespread exotic species identified in a recent study in the Umatilla floodplain include desert false indigo, reed canarygrass, Himalayan blackberry, and ripgut brome (Adamus et al. 2002). In the Patawa-Tutuilla watershed, cheatgrass, poison hemlock, and common teasel were found to be the most prevalent exotic weeds (Wooster and DeBano 2003).

The invasion of cheatgrass into shrub-steppe habitats is especially problematic as it increases the frequency and severity of range fires (Paige and Ritter 1999). This change in fire regime is a result of cheatgrass growing at much higher densities compared to native vegetation (providing an unbroken flammable medium to carry fire), its property of drying out early in the season, and its ability to quickly reestablish itself after fire. In most instances, cheatgrass-dominated shrub-steppe results in complete conversion to cheatgrass and other exotic weeds once the area burns. Sagebrush and other native shrubs take several years to decades to reestablish themselves after these intense fires. Since the cheatgrass returns quickly, and may burn as frequently as every five years, native shrubs have no opportunity to reestablish. The reestablishment of sagebrush in cheatgrass dominated rangelands is a major problem throughout the sagebrush zone of the Interior Western U.S., and no solution to the problem has been found. To date, the only method found for reestablishment is to plant individual sagebrush plants by hand, something that is not practical for any but the smallest areas.

Exotic weed invasions not only affect native plants species, but can also impact terrestrial wildlife in the Umatilla/Willow subbasin. Loss of native plant cover can reduce the suitability of habitat available to wildlife (Quigley and Arbelbide 1997, Dobler et al. 1996) (see Section 3.4.2 for effects on specific wildlife species). Exotic weeds may also affect aquatic food webs of streams. For example, leaf litter derived from exotic plants is less palatable to aquatic invertebrate shredders than leaf litter derived from native plants in Australia (Schulze and Walker 1997), although studies examining this effect in the U.S. are lacking.

The problem of exotic weed invasion may be less severe in forested headwaters. For example, a recent study in the headwaters of the Umatilla River found that between 87-98% of plant species encountered were native, although the extent of acreage occupied by exotic weeds was not determined (Umatilla National Forest 2001).

Forestry Practices: Harvesting of timber occurs primarily along the North and South Forks of the Umatilla River, accounting for 32% of timber cut on the forest, and along Meacham Creek, which constitutes an estimated 18% of the harvest (Umatilla National Forest 2001). This harvest has occurred on only 10% of the forested land since the early 1960s (Umatilla National Forest, 2001). Most of the timber sale activity occurs on slopes less than 30% (Umatilla National Forest 2001). The Umatilla National Forest has designated a large area surrounding the North Fork of the Umatilla River as a Wilderness Area, precluding it from further harvest activities.

Two subwatersheds within the National Forest that are designated as areas of concern due to extensive clearcutting (greater than 15% of the forested area) are Spring Creek (28.2% clearcut) and Upper Meacham/Wilbur subwatersheds (28.6% clearcut). Several other subwatersheds are of concern due to high road densities (over 2.0 miles/square mile), including Upper North Fork of the Umatilla, Buck Creek, Thomas Creek, Spring Creek, Shimmiehorn Creek, Upper South Fork of the Umatilla, East Meacham Creek and Owsley Creek (Umatilla National Forest 2001).

Harvesting of timber also occurs in Morrow County, with some extensive logging occurring on private property in the headwaters of Rhea Creek within the last year (personal communication: K. Ramsey, USFS, January 2004). Although Oregon forest practices are being followed, these are less stringent than USFS practices, and the harvest may affect water quality in Rhea Creek (personal communication: K. Ramsey, USFS, January 2004).

Intact forests serve several important ecological functions. They retard runoff during heavy rains and periods of rapid melting of snows, and increase the amount of water that percolates into the ground. By decreasing and desynchronizing snowmelt and runoff, and increasing percolation, forested areas lower flood levels and raise low water levels (Whitaker 1947). Deforestation, both past and present, has likely altered runoff rates by reducing riparian and water storage capacities (Shaw and Sexton 2000). These effects are particularly severe in steep headwater areas.

Livestock Grazing: Rangeland and range-forest transition are common in the Umatilla/Willow subbasin (42%). Although horses and sheep were the main type of livestock grazed in the subbasin historically (see Section 3.1.3.2), cattle now comprise the majority of livestock in the area. Livestock grazing has impacted the Umatilla/Willow subbasin by changing vegetation composition, decreasing the amount of native vegetation, and reducing vegetative cover, which leads to increased water and wind erosion (Shelford and Hanson 1947). Cattle, horses, and sheep can also destroy riparian vegetation and destabilize stream banks if allowed to forage in riparian zones (Waters 1995).

Transportation: The construction of transportation corridors, primarily paved and gravel roads, and railroads, is another human activity that has impacted rivers and streams in the Umatilla/Willow subbasin. Transportation corridors are often built along waterways, and this is true for both the Umatilla and Willow Creek subbasin. For example, both State Highway 74 and the Union Pacific Railroad run almost the entire length of Willow Creek (from near the mouth to Heppner). Similarly, asphalt county roads and the Union Pacific Railroad run adjacent to the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79). Roads and railroads are also found along the great majority of the length of two of the Umatilla's tributaries, Wildhorse Creek and Meacham Creek. Abandoned railroads also impact streams in the subbasin. For example, [0]Union Pacific and Northern Pacific had railroads running out of Pendleton to Adams/Athena and Helix /East Juniper Canyon respectively until 1978. The legacy of those road-beds is still a major influence on Wildhorse Creek and its tributaries (personal communication: J. Williams, USDA-ARS, January 2004).

Four important impacts of transportation corridors on fish and wildlife are loss of riparian vegetation, increased water temperatures, increased surface water run-off into stream channels, and increased flashiness in flow followed by reduced low flows. Loss of riparian vegetation occurs during the construction of transportation corridors and re-growth is often cut back to prevent vegetation from interfering with the use of the corridors. Increased water temperature occurs as a result of the decrease in shading from the riparian vegetation removal (NRC 2002). Many transportation surfaces are impervious to water and thus increase surface run-off (which would normally be absorbed by the soil), making streams more prone to flooding. Sediment loads into streams can be increased by erosion at construction sites, failure of embankments and cut slopes, and inadequately designed drainage ditches or erosion caused by funneling hillside runoff through culverts (Swanson et al. 1987; Waters 1995). Channelized streams are also very efficient conveyors of sediment (NRC 2002).

Urbanization: Although only 1% of the land in the Umatilla/Willow subbasin has been urbanized (IBIS 2004), cities and towns have impacted the aquatic and terrestrial environment of the subbasin. These impacts include changes in streamflow, water quality, channel morphology, and available fish and wildlife habitat.

Flow is influenced by water withdrawals. Pendleton has historically diverted approximately 3.8 cfs of flow between June and December from a series of infiltration galleries, commonly known as Thornhollow Springs, located approximately 17 miles east of the city near the Umatilla River. During the lowest flow conditions of late summer, this withdrawal represents an approximately 10% diversion of flow of the Umatilla River. However, the City of Pendleton is currently undertaking a series of water supply development projects that will improve both instream flows and temperature in the Umatilla River. These projects are described in greater detail in Section 4.3.

Urbanization can also impact water quality in a number of ways. Runoff from developed areas in towns and cities can negatively impact water quality when pollutants are conveyed into stream systems. The Umatilla River Basin WQMP (ODEQ 2001) is designed to address this issue, and the City of Pendleton has taken steps to reduce the runoff of pollutants into streams and riparian areas (see Section 4.3 for more detail). Effluent from wastewater treatment plants can also affect water quality. The release of effluents can increase or decrease temperatures and elevate concentrations of ammonia and chlorine in streams and rivers. For example, higher levels of ammonia have been measured in the lower Umatilla River from 1996 to 1999 during the summer low flow months when the Hermiston wastewater treatment plant discharges effluent into the river (ODEQ 2001); the median ammonia concentration in the river downstream of the discharge was 1.29 mg/L higher than the upstream median concentration. National Pollutant Discharge Elimination System permits limit the concentration of ammonia and chlorine below toxic levels. New permit limits have been established to address the related water quality issues at the Hermiston and Pendleton wastewater treatment plants. Notably, high levels of fecal coliform that have been recorded in the Umatilla River in Pendleton are not attributable to the release of wastewater effluent into the river. Regular, required monitoring of effluent at the Pendleton wastewater treatment plant shows no evidence of elevated levels of fecal coliform (personal communication: S. Lawrence, City of Pendleton, February 2004). The cause of these elevated levels of fecal coliform is unclear, although non-point sources are suspected.

Dikes, levees, and rip-rapped banks created to protect homes, farm buildings, and roads within the floodplain have straightened and confined stream channels and reduced riparian vegetation in many parts of the subbasin, leading to a decline in available fish and wildlife habitat (Contor et al. 1997; Shaw and Sexton 2003). For example, the majority of the south bank of the Umatilla River in Pendleton is levied. Uplands are also affected by urbanization; approximately 1% of wildlife habitat in the Umatilla/Willow subbasin has been lost to land conversion through urban development.

Water Development: Three general types of water development projects impact aquatic and terrestrial environments in the Umatilla/Willow subbasin: impoundments, irrigation diversions, and water exchange projects. The largest impoundment projects in the Umatilla subbasin are McKay Reservoir, with a design capacity of 73,800 acre-feet, and Cold Springs Reservoir, with a design capacity of 50,000 acre-feet (ODEQ et al. 2001). These reservoirs function to supply irrigation flows to three irrigation districts (Stanfield, Westland, and Hermiston Irrigation Districts) and to some individuals during high-demand summer months (personal communication: M. Ladd, OWRD, January 2004). The impacts of irrigation diversions on water temperature and flow are discussed in the preceding discussion on agriculture in this section.

Two phases of a water exchange program that are part of the Umatilla Basin Project (described in more detail in Section 3.1.3.2) have helped to restore stream flows that were reduced as a result of these impoundments and diversions. Phase I of the project involves pumping water (up to 140 cfs) from the Columbia River into the West Extension Irrigation District system, to offset diversion of Umatilla River water when flows in that river drop below target values. Phase II involves exchanging up to 240 cfs of Umatilla River and McKay Reservoir water for Columbia River water for use by the Stanfield and Hermiston Irrigation Districts. This results in water that had historically been diverted from live flow and from McKay Reservoir releases being retained for instream uses. As a result, in 2003, approximately 65,000 acre-feet of water were used to maintain instream flow in the Umatilla River below McKay Creek (personal communication: M. Ladd, OWRD, January 2004).

While the water exchanges associated with the Umatilla Basin Project do not increase flows year-round, they do increase flows during critical times for salmon and steelhead adult returns and juvenile outmigration (see Section 3.1.3.2 for more detail). In addition, releases of water from McKay Reservoir during summer generally positively impact temperatures of reaches of the Umatilla River below the McKay Creek confluence (RM 50.5) (Figure 13). Surveys determined that hypolimnetic releases of cool water from the reservoir during early summer months kept temperatures suitable for salmonids in areas between the McKay Creek confluence and Westland Dam (RM 27.2) (Contor et al. 1997). However, McKay Reservoir releases for fish are not continuous during the summer, and water temperatures in the river can become extreme at times. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion and can contribute to unsuitable habitat conditions for salmonids (Contor et al. 1997).

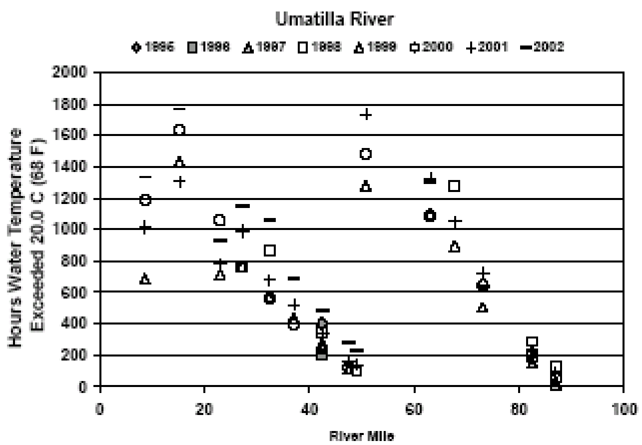


Figure 13. The number of hours water temperatures exceeded 20°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87 (Contor 2003).

Willow Creek subbasin also has several water development projects that affect aquatic and terrestrial habitats. Willow Creek Reservoir, with a design capacity of 14,000 acre-feet, was created when the USCOE constructed a 160-ft high dam just upstream of Heppner in an effort to control flash flood events, which in the past have claimed both lives and property. The construction of the reservoir has altered the hydrology of lower Willow Creek by eliminating high peak flows caused by snowmelt and cloudburst events and providing more constant flows during late winter and spring (Willow Creek Local Advisory Committee et al. 2003). Controlled releases by USCOE from the reservoir, which often result in extended periods of greater than bankfull flows when the ground is already saturated from spring rain events, maintains the channelized morphology of Willow Creek (Willow Creek Local Advisory Committee et al. 2003; personal communication: K. Ramsey, USFS, January 2004). Aquatic environments in Willow Creek subbasin are also substantially affected by irrigation diversions, as described in the preceding discussion on agriculture in this section.

Table 4. Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and Practice Causing Impact	Ecological Effect	Examples of Extent in Umatilla/Willow Subbasin
Impact: Stream Channelization **Practices Causing Impact:** • Agriculture • Transportation Corridors • Urbanization	• Increased flood frequency • Increased erosion of stream channel, leading to "gully" channels • Increased sediment deposition downstream • Increased water temperature • Channel is separated from floodplain, destroying riparian vegetation • Loss of complexity/habitat for aquatic life • Loss of exchanges between the hyporheic zone and river flow with a subsequent increase of summer water temperatures and decrease in winter water temperatures • Loss of winter habitat for juvenile salmon and steelhead	• Large portions of the mainstem Umatilla and its tributaries have been levied or channelized • Large sections of Willow Creek below the Willow Creek Reservoir (RM 55.5) have been channelized[1] .
Impact: Reduced Instream Water Volume **Practices Causing Impact:** • Agriculture • Urbanization	• Decreased habitat for fish • Increased water temperatures • Decreased water quality (dissolved oxygen, pH, bacteria)	• Average summer low flow from Three Mile Dam (RM 4) to mouth of Umatilla River is 1cfs compared to 143 cfs above all diversions (RM 32)[2] • total annual flow of upper Willow Creek drainage is ~ 30,000 acre-feet, but reduced to 23,000 acre-feet by RM 4[1]
Impact: Riparian Vegetation Loss **Practice Causing Impact:** • Agriculture • Forestry • Livestock Grazing • Transportation Corridors • Urbanization	• Habitat lost for wildlife • Increased water temperature through loss of shading • Disrupts aquatic ecosystems through loss of woody debris and food base (organic inputs)	• 87% or greater loss of bottomland hardwood and willow riparian communities in the lower Umatilla/Willow subbasin[7] • Approximately 70% of mainstem Umatilla and its tributaries would benefit from riparian restoration[3]

Table 4 (continued). Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and Practice Causing Impact	Ecological Effect	Examples of Extent in Umatilla/Willow Subbasin
Impact: Increased Erosion/Sedimentation into streams **Practice Causing Impact:** • Agriculture • Forestry • Livestock Grazing • Transportation Corridors • Water Development	• Loss of quality spawning sites for salmonids • Loss of macroinvertebrate taxa that are potentially important food sources • Decreased water quality • Loss of concealment cover for immature salmonids when interstitial spaces between gravel and cobble fill with sediment	• Umatilla mainstem: turbidity exceeded 30 NTUs over 48 hours (TMDL standard) 7 and 9 times in water years 1999-2000 and 2000-2001, respectively[5] • Numerous tributaries of the Umatilla River §303(d) listed for sediment (see Table 9) • Meacham Creek: substrate embeddedness greater in managed areas than in reference areas[4] • Significant erosion problems during high flow below Willow Creek Reservoir (RM 55.5)[1]
Impact: High Water Temperatures **Practices Causing Impact:** • Agriculture • Irrigation Diversions • Forestry • Livestock Grazing • Transportation Corridors • Urbanization	• Direct impact on salmonid health	• 287 stream miles in Umatilla subbasin and Willow Creek from mouth to Willow Creek Lake on 1998 303(d) list[6]

Table 4 (continued). Negative impacts on the aquatic and terrestrial environments in the Umatilla/Willow subbasin resulting from agriculture, forestry practices, livestock grazing, transportation corridors, and urbanization. The order of listed practices is alphabetical and does not reflect the magnitude of their impact.

Impact and Practice Causing Impact	**Ecological Effect**	**Examples of Extent in Umatilla/Willow Subbasin**
Impact: Land Conversions **Practices Causing Impact:** • Agriculture • Livestock Grazing • Reservoir Development • Transportation Corridors • Urbanization	• Loss of wildlife habitat • Loss of riparian vegetation (see above)	• Approximately 53% of grassland and shrub-steppe in Umatilla/Willow subbasin converted to agriculture and rangeland[7] • Wetlands: in a 6 mile stretch of the upper Umatilla River (RM 72.5 to 78.5), a total of 420 of 1,330 acres (35%) of the floodplain was "stranded" or lost due to the construction of dikes, railways, and roadway[8]. In the Echo/Umatilla Meadows complex of the lower Umatilla River, approximately 5,370 of 6,340 acres (90%) of the meadow area has been stranded or cut off from the floodplain due to conversion to farmland, construction of transportation routes, and channel and dike construction.[8]

Sources:
1 Willow Creek Local Advisory Committee et al. 2003
2 ODEQ et al. 2001
3 Reported in CTUIR and ODFW 1990, p. 10, which states this estimate originated from an ODFW inventory of 422 miles of streams in the Umatilla subbasin.
4 Umatilla National Forest 2001
5 Shaw and Sexton 2003
6 ODEQ 2003
7 Kagan et al. 2000: based on comparisons of General Land Office surveyor reports c. 1850 with current cover maps generated by Kagan et al.
8 CTUIR 1997, p. 6: based on analyses of aerial photos

In addition to their effect on instream flow and temperature, water development projects can also impact aquatic environments by introducing passage barriers to migrating fish and by fragmenting aquatic habitats. Passage problems on the mainstem Umatilla River from the construction of diversion dams have been largely mitigated, as have many passage problems on tributaries; however, a number of significant passage barriers remain, particularly in Birch, Butter, and Willow Creeks. Flows in Willow Creek are only substantial enough in the spring to allow passage of remnant mid-Columbia steelhead over the diversion dams located downstream of Heppner (personal communication: K. Ramsey, USFS, January 2004). In addition, unscreened water diversions can also have a substantial impact on anadromous fish. Although all known gravity feed diversions in the anadromous portion of the Umatilla subbasin are screened, it is not known to what extent pump diversions have been screened in the anadromous portion of the subbasin. In addition, although the total number of unscreened diversions in Butter and Willow Creeks is unknown, several diversions on Willow Creek are known to lack screens (personal communication: K. Ramsey, USFS, January 2004).

Further details on the development of water and trends in their effects on the hydrology and ecology of the Umatilla\Willow subbasin are found in Section 3.1.3.2.

3.1.2 Subbasin Existing Water Resources

3.1.2.1 Watershed Hydrography and Hydrologic Regime

Originating at nearly 6,000 feet in elevation, the Umatilla River headwaters flow out of the Blue Mountains through narrow, well-defined canyons. After leaving the mountains, the North and South Fork join to form the mainstem, an 89 mile reach of river that flows through a series of broad valleys that drain low rolling lands (USCOE 1997, ODEQ et al. 2001). The mainstem Umatilla River has eight main tributaries: the North and South Forks of the Umatilla River and Meacham Creek in the upper subbasin; Wildhorse, Tutuilla, McKay and Birch Creeks in the mid subbasin; and Butter Creek in the lower subbasin (Figure 14; Table 5).

Except for Wildhorse Creek, the main tributaries of the Umatilla River drain the Blue Mountains and enter the Umatilla River from the south. Wildhorse Creek drains the divide between the Umatilla River and the Walla Walla River to the north. The North and South Forks of the Umatilla River and Meacham Creek account for approximately 14% of the Umatilla River subbasin drainage area, yet supply 40-50% of the average flow to the Umatilla River. At its confluence with the Umatilla River, Meacham Creek effectively doubles the water supply of the mainstem. For example, average discharge of the mainstem directly upstream of Meacham Creek in 2000 was 212 cfs and discharge of Meacham Creek was 192 cfs. During the same year, average discharge near the mouth of the Umatilla River was 525 cfs.

Besides these main tributaries there are many smaller tributaries of the Umatilla River (Figure 14). Deep, incised channels characterize most of these creeks particularly in the plateau area, and most are intermittent, carrying water only during periods of snowmelt or sustained rainfall.

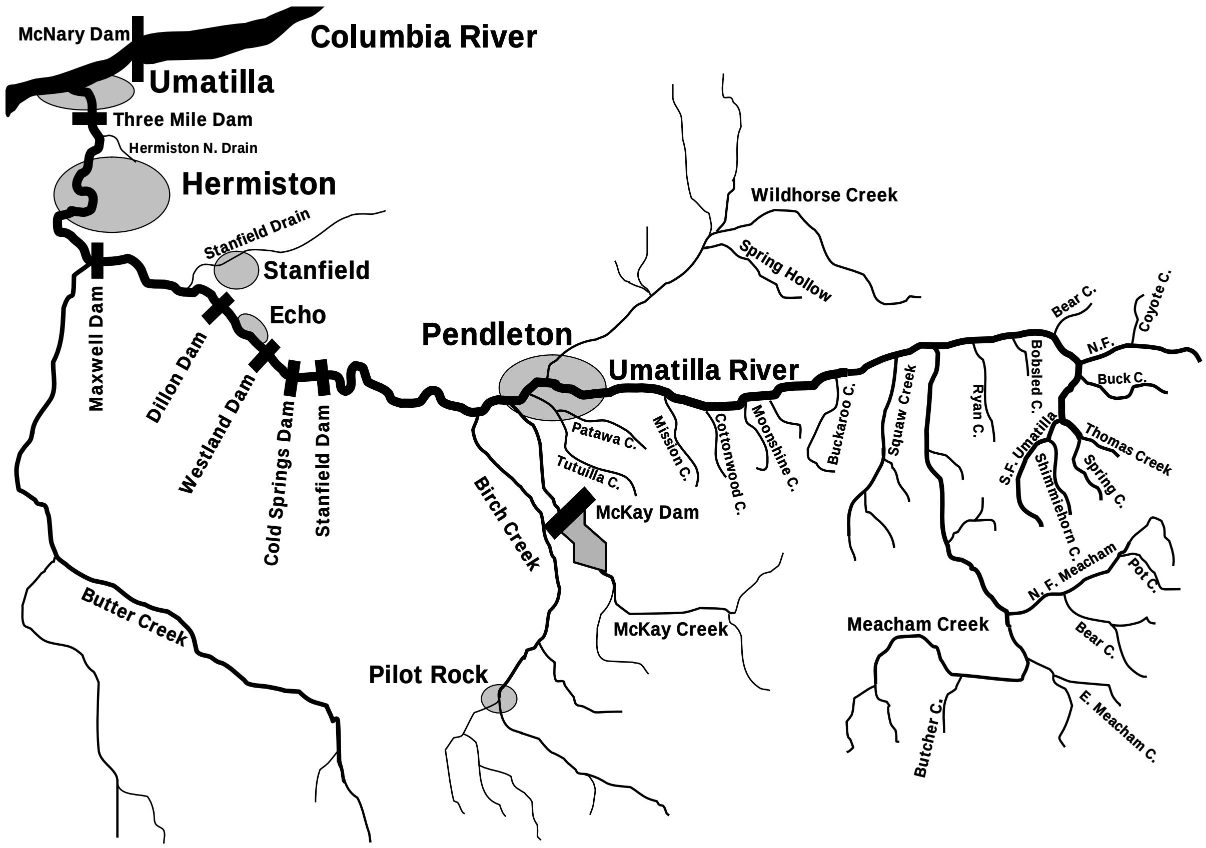


Figure 14. The Umatilla River and some of its tributaries.

Table 5. Umatilla River tributary lengths and drainage areas.

Drainage	Length (miles)	Area (sq. miles)	Distance from the mouth of the Umatilla River (miles)
North Fork Umatilla	9	34	89
South Fork Umatilla	10	57	89
Meacham Creek	31	165	79
Wildhorse Creek	34	190	55
Tutuilla	10	61	52
McKay Creek	32	191	51
Birch Creek	31	291	47
Butter Creek	57	465	14

The headwaters of Willow Creek and Juniper Canyon Creek are also found in the Blue Mountains. Willow Creek originates near Bald Mountain at over 5,500 feet. It is 79 miles long and drains an area of 880 square miles. The primary tributaries of Willow Creek are Eightmile Creek and Rhea Creek (Figure 2). The headwaters of Juniper Canyon Creek begin at nearly 2000 feet. The mainstem is 19 miles long and drains 72 square miles. The primary tributaries of Juniper Canyon Creek are the North and South Forks of Juniper Canyon.

Flows in the Umatilla/Willow subbasin are characterized by high peaks during the early spring and often extremely low flows in the summer. This hydrologic pattern is exhibited in the Umatilla River mainstem (Figure 15), its tributaries (Figures 16 and 17), and in Willow Creek (Figure 18). Hydrologic data for Juniper Canyon is limited; however, this watershed is characterized by intermittent flows with spring peaks.

The patterns in flow observed in the Umatilla/Willow subbasin are the result of snow melt and rain in late winter and early spring which cause peaks in flow. Water runoff peaks in April, while the lowest flows, or baseflows, generally occur in September. The average monthly discharge of the Umatilla River near its mouth (measured at RM 2.1) varies from 23 cubic feet per second (cfs) in July to 1095 cfs in April (low flow at the mouth occurs in July rather than September because of upstream removals for irrigation) (Figure 15). This difference in monthly discharge largely reflects seasonal variation in precipitation and snow melt. Summer baseflows can be extremely low and many of the larger tributaries lose all surface flow during the summer through parts of their lengths. Flows in sections of Birch, McKay, Butter, and Meacham Creeks are subsurface during low flow periods (ODEQ 1998).

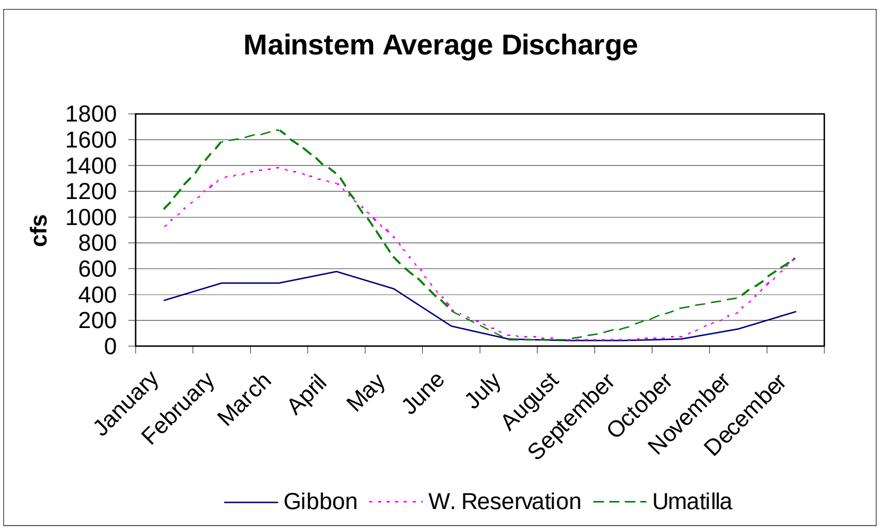


Figure 15. Monthly discharge of the Umatilla River at three gauging stations averaged over 5 years (1996-2000) (USGS 2004). The Gibbon station is at RM 83.1, the West Reservation station is at RM 58.3, and the Umatilla station is at RM 2.1.

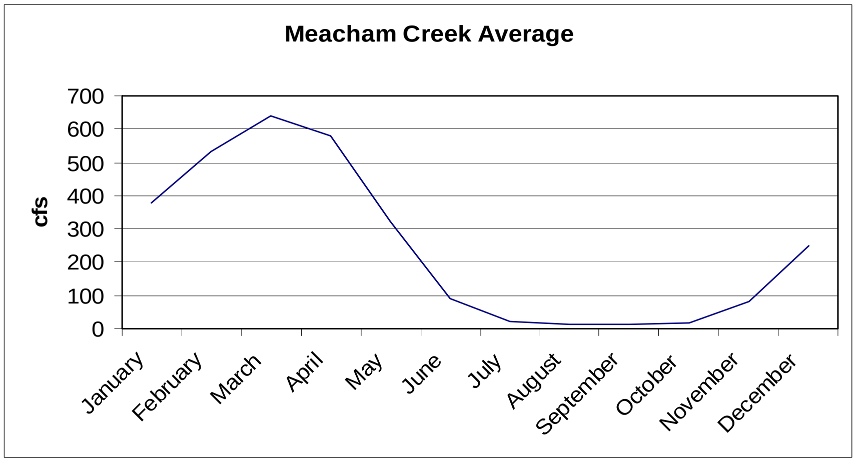


Figure 16. Monthly discharge at Meacham Creek averaged over 5 years (1996-2000) (USGS 2004). The gauging station is at RM 1.4, near Gibbon, Oregon.

The episodic hydrographs are exacerbated in the upper elevations of the Umatilla subbasin by steep-sided canyons, relatively impervious basalt bedrock, and diminished vegetation, which contribute to rapid runoff and poor groundwater recharge (CTUIR 1996). In contrast, in the lower subbasin, little runoff from uplands occurs due to the area's low precipitation, flat surface relief, and sandy soils (BOR 1954).

Peak flows in Willow Creek near Arlington occur in January, while further upstream, near Heppner, they occur between March and April (Figure l8). Peak annual discharges for Willow Creek, near Arlington, average 4,575 cfs. Base flows typically occur during the months of July – September, during which time channels may run intermittently or dry completely for prolonged periods, particularly in the lower reaches (OWRD 1988). However, isolated storm events may cause locally high flows for short periods during the summer and early fall (OWRD 1988).

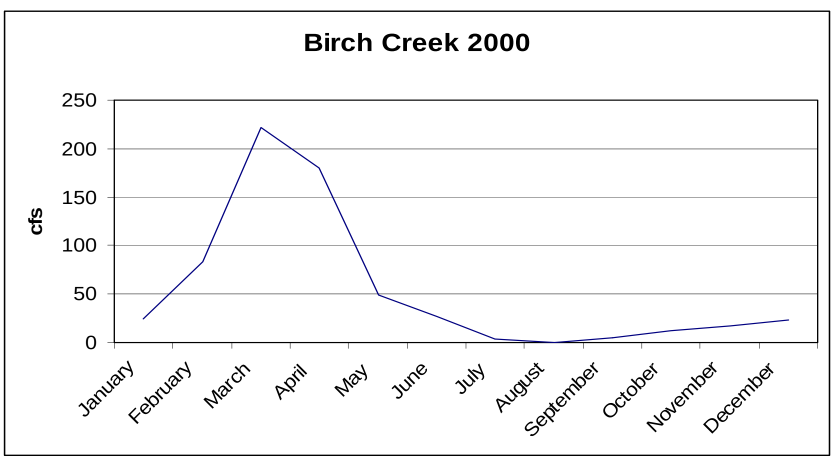


Figure 17. Monthly discharge at Birch Creek for the year 2000 (USGS 2004). The gauging station is located near the creek's mouth.

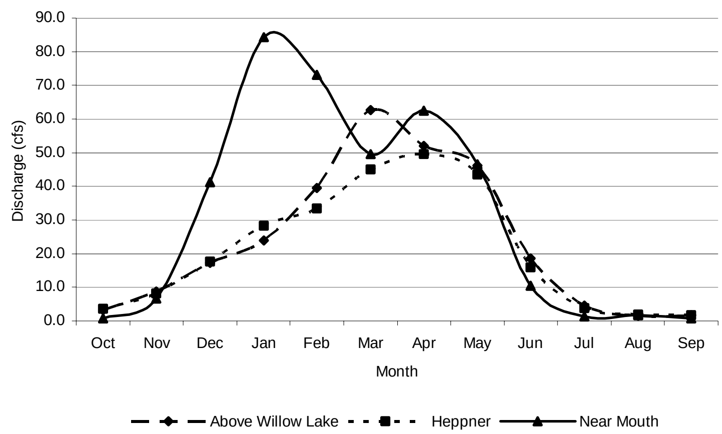


Figure 18. Mean monthly flows for Willow Creek at three gauging stations: above Willow Lake, in Heppner, and near Arlington.

Besides annual patterns in flow, gauge data can be used to determine bankfull discharge. Bankfull discharge is the discharge at which channel maintenance is the most effective (i.e., the discharge which is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels) (Dunne and Leopold 1978). In most systems, bankfull discharge is exceeded approximately once every year and a half (Dunne and Leopold 1978). Work in the Umatilla subbasin suggests that bankfull discharge is exceeded approximately once every 1.2 years (CTUIR 1999). Bankfull discharge is shown for six locations along the mainstem of the Umatilla River in Table 6.

Table 6. Bankfull discharge (peak flow with a 1.2 year recurrence interval) for six locations along the Umatilla mainstem (ODEQ et al. 2001).

River Mile	Station	Bankfull discharge (cfs)
80.1	Gibbon	1300
59.5	West Reservation	3000
55.0	Pendleton	3100
37.0	Yoakum Bridge	3700
26.0	Echo	3700
2.1	City of Umatilla	3075

Another significant component of the subbasin's hydrology that is often overlooked is the exchange of ground and surface water in rivers. This exchange is commonly viewed as a unidirectional process where ground water seeps into the river through the streambed. Thus, groundwater dynamics are commonly underestimated as a potential influence on river temperature. In alluvial rivers such as the Umatilla River, ground- and surface-waters circulate continuously and bidirectionally between the river channel and alluvial aquifer, which underlies the river and flood plain. This bidirectional exchange creates a shallow ground-water flow network known as the hyporheic zone. Because hyporheic flow circulates continuously, the potential for ground-water to influence stream temperature may be much higher in streams and rivers with substantial hyporheic flow.

Hyporheic flow is driven by hydraulic gradients within the alluvial aquifer; underground, water flows only when hydraulic gradients are present and ground water always moves along these gradients. In alluvial aquifers, hydraulic gradients are created by interactions between channel geomorphology and river hydrology. The presence of geomorphic features such as pool-riffle sequences, meander bends, backwaters, and side channels all create hydraulic gradients and therefore facilitate hyporheic flow.

If the geomorphic structure of a river influences hyporheic water exchange and if hyporheic dynamics may influence stream temperature, it follows that the geomorphic complexity of a river channel (as indicated by the frequency of pool-riffle sequences, meander bends, etc.) may play an important role in regulating river temperature. This relatively novel idea has been the focus of a three year research effort to test the hypothesis that the geomorphic structure of the Umatilla River controls the patterns of hyporheic flow within the river and therefore influences the river's temperature.

Based on this hypothesis, the research focused on five distinct efforts: 1) testing the utility of various types of remote sensing and other spatial data sets to document flood plain geomorphology and patterns of river temperature at multiple spatial scales; 2) from the most useful data sets, developing techniques to assess the geomorphic structure of the river channel and flood plain at multiple spatial scales; 3) developing modeling techniques to simulate ground- and surface-water dynamics in the river channel and alluvial aquifer; 4) comparing model results to remotely sensed patterns of stream temperature to test the hypothesis that that hyporheic flow is influencing water temperature in the river; and 5) determining if channel engineering (dredging and diking along the river) has resulted in simplified river and flood plain morphology, reduced hyporheic flow, and increased river temperatures. Two major conclusions from this research are:

1) Like many rivers, the Umatilla becomes warmer as water flows from the headwaters downstream. However, areas where hydrologic modeling predicts high rates of hyporheic flux tend to be the same areas where the downstream warming trend is reduced or even reversed. Thus, high rates of hyporheic exchange are associated with cooler stream temperatures.
2) Channel engineering results in substantially simplified channel and flood-plain morphology. Where major channel engineering projects have occurred, modeled rates of hyporheic exchange are noticeably reduced from similar areas where dredging and diking have not occurred. Therefore, reduced hyporheic exchange associated with channel engineering provides a likely mechanism to explain the tendency for the river to warm rapidly as it flows through engineered reaches.

This research has resulted in substantial new understanding of the interactions between geomorphology, hydrology, and river temperature in parts of the Umatilla River. Further, these research results suggest that geomorphic restoration of floodplains could play a vital role in the management of river temperatures and pilot projects that are carefully and cautiously planned, executed, and monitored should be implemented to test their effectiveness.

3.1.2.2 Water Quality

A Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) were completed for the Umatilla subbasin in 2001 (ODEQ et al. 2001). A TMDL is currently being developed for the Willow Creek subbasin and a WQMP was recently completed (Willow Creek Local Advisory Committee et al. 2003). In addition, the Umatilla Tribes have requested to be treated as a state (pursuant to the Water Quality Act of 1987, an amendment to the Clean Water Act of 1972) and have coordinated with the Environmental Protection Agency (EPA) to develop water quality standards pertaining specifically to reservation lands (CTUIR 1999).

Beneficial uses of the Umatilla subbasin waters are varied. Water quality standards are determined to support beneficial uses designated in the Oregon Administrative Rules (Table 7). For the Willow Creek subbasin, a component of the developing draft assessment of the Willow Creek TMDL identifies salmonid spawning and water contact recreation as beneficial uses of the Willow Creek subbasin waters (ODEQ 2001, based on communication with ODFW in 2000).

Table 7. Designated beneficial uses of water in the Umatilla subbasin (from OAR 340-41, Table 11).

Public Domestic Water Supply	Anadromous Fish Passage
Private Domestic Water Supply	Salmonid Fish Rearing
Industrial Water Supply	Salmonid Fish Spawning
Irrigation	Resident Fish and Aquatic Life
Livestock Watering	Wildlife and Hunting
Boating	Fishing
Aesthetic Quality	Water Contact Recreation
	Hydropower

Of these beneficial uses, domestic water supply, salmonid life cycles, and water contact recreation are not fully supported as a result of water quality impairments found throughout the Umatilla/Willow subbasin. Water quality impairments arise from a variety of variables and have resulted in many reaches in the Umatilla/Willow subbasin listed in accord with Section 303(d) of the Clean Water Act of 1972 as being water quality-limited water bodies.

Water quality standards are established to protect beneficial uses of public waters. The most sensitive use is selected and the water quality standard is developed for this use, thus protecting it and all others (Figure 19). Parameter-specific, numeric water quality standards are described in more detail in Table 8. However, two parameters, habitat modification and sedimentation, currently lack numeric standards.

Table 8 describes the standards targeted by the Umatilla subbasin 2001 TMDL effort. In March of 2004, the EPA approved new water quality standards for temperature and dissolved oxygen (ODEQ 2004). Because the temperature TMDL is consistent with the updated standard, no substantive change to the TMDL is expected (personal communication: D. Butcher, ODEQ, March 2004).

The 1998 303(d) listed river and tributary segments were addressed by the 2001 TMDL. TMDL issuance delists the impairments, which are still tracked as water quality limited until TMDL attainment and water quality data indicate no further impairment. The listed reaches that triggered TMDL development are shown in Table 9. In 2002, a new 303(d) listing was developed; these reaches are shown in Table 10.

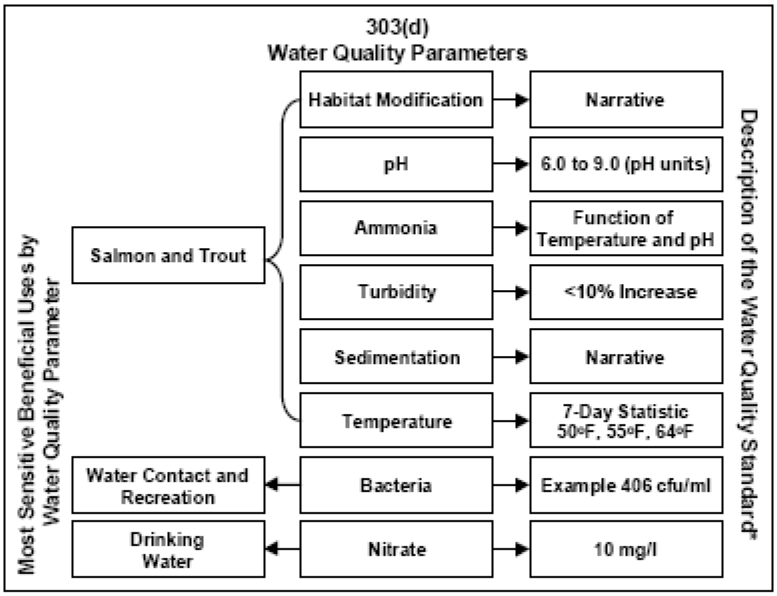


Figure 19. Linkages between beneficial uses and water quality standards (ODEQ et al. 2001).

A brief summary of the major variables resulting in 303(d) listings for the Umatilla/Willow subbasin is presented below. Additional information on these variables can be found in the Umatilla River Basin TMDL report (ODEQ et al. 2001).

Ammonia: Most reaches in the subbasin have low levels of ammonia (less than 0.1 mg/L). Exceptions include the lower Umatilla River and the North Hermiston Drain, which are in violation of EPA ammonia standards, primarily because of excessive temperatures and pH during the summer months (ODEQ et al. 2001). Other problem areas include Butter Creek, where ammonia concentrations have been measured at 0.3 to greater than 0.4mg/L (ODEQ 1998).

Aquatic Weeds/Algae and pH: Excessive growth of attached algae (periphyton) and attendant increases in pH are common during summer months throughout much of the mainstem Umatilla River (from Speare Canyon, RM 44, to the forks) (ODEQ et al. 2001). Large periphyton mats can be found in this section of the Umatilla River in the summer, affecting river odor, aesthetics, contact recreation, and pH. As periphyton obtains carbon dioxide for cell growth it decreases bicarbonate levels in the water. This has the effect of increasing pH levels, which can be stressful to fish. Because periphyton growth is positively influenced by water temperature, patterns in summer water pH are influenced by water temperature. pH increases from the forks to RM 58 (Figure 20), where it frequently exceeds 9.0 (the water quality standard); pH drops at RM 49 because of inputs of cold water from McKay Reservoir and then increases downstream where it

Table 8. Umatilla subbasin water quality standards (from ODEQ et al. 2001, except where noted).

Parameter	Standard
Ammonia	Standards are pH dependent. Chronic standards range from 0.08 mg/L-N at a pH of 8.5-9.0 to 0.85 mg/L-N at a pH of 6.5-7.0. Acute standards range from 0.59 mg/L-N at a pH of 8.5-9.0 to 13.48 mg/L-N at a pH of 6.5-7.0.
Aquatic Weed/Algae	OAR 340-41-645(2)(h): The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or which are injurious to health recreation, or industry, shall not be allowed.
Bacteria	A 30-day log mean of 126 *E. coli* organisms per 100 ml based on a minimum of five samples; or no single sample shall exceed 406 *E. coli* organisms per 100 ml.
Dissolved Oxygen (DO) *	For water bodies providing salmonid spawning during periods from spawning until fry emergence from the gravels, the following criteria apply: DO shall not be less than 11.0 mg/L, but if the minimum intergravel DO measured as a spatial median is 8.0 mg/L or greater, then the DO criterion is 9.0 mg/L. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/L or 9.0 mg/L criteria, DO levels shall not be less than 95% of saturation. For water bodies identified by Oregon Department of Environmental Quality (ODEQ) as providing cold-water aquatic life, the DO shall not be less than 8.0 mg/L as an absolute minimum. The DO level for cool-water aquatic life shall not be less than 6.5 mg/L. The minimum DO level for warm-water aquatic life is 5.5 mg/L.
Iron	Not to exceed 1.0 mg/L (EPA 1986)
pH (Hydrogen Ion Concentration)	pH shall not fall outside the range of 6.5 to 9.0. The ODEQ will determine if any pH values higher than 8.7 are anthropogenic or natural in origin. Where it is proven that any waters impounded by dams existing on January 1, 1996 would not have a pH exceedance if the impoundment was removed, exceptions will be made.
Manganese	Not to exceed 0.10 mg/L (EPA 1986)
Nitrate	Not to exceed 10 mg/L
Temperature *	The basic absolute criterion is ≤ 64°F (17.8°C). Two exceptions exist: when salmonid spawning, egg incubation, and fry emergence for native fish occur, standards for the specific times of use are ≤ 55°F (12.8°C); and when the waters support bull trout the standards are ≤ 50°F (10.0°C) (Boyd et al. 1999).
Turbidity (Nephelometric Turbidity Units, NTU)	The water quality standards are: No more than a 10% cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. A specific turbidity target of 30 NTU not to exceed 48 hours was developed for the Umatilla basin TMDL.

* New EPA standards were developed for these parameters in 2004 (ODEQ 2004).

Table 9. Impaired stream reaches from the 1998 303(d) list and used for development of the 2001 Umatilla subbasin TMDL (ODEQ et al. 2001).

Parameter	Stream	Segment (boundaries)	Criterion
Temperature	Birch Creek	Mouth to headwaters	Rearing 64°F
	Buckaroo Creek	Mouth to headwaters	
	E. Birch Creek	Mouth to Pearson Creek	
	EF Meacham Creek	Mouth to headwaters	
	McKay Creek	Mouth to McKay Reservoir	
	Meacham Creek	Mouth to headwaters	
	NF McKay Creek	Mouth to headwaters	
	NF Meacham Creek	Mouth to headwaters	Oregon Bull Trout
	NF Umatilla River	Mouth to headwaters	
	Shimmiehorn Creek	Mouth to headwaters	
	SF Umatilla River	Mouth to headwaters	
	Squaw Creek	Mouth to headwaters	Rearing 64°F
	Umatilla R.	Mouth to Lick Creek	
	W. Birch Creek	Mouth to headwaters	
	Westgate Canyon	Mouth to headwaters	
	Wildhorse Creek	Mouth to headwaters	
Sediment	Beaver Creek	Mouth to headwaters	See Narrative
	Birch Creek, WF	Mouth to headwaters	
	Boston Canyon Creek	Mouth to headwaters	
	Coonskin Creek	Mouth to headwaters	
	Cottonwood Creek	Mouth to headwaters	
	Line Creek	Mouth to headwaters	
	Little Beaver Creek	Mouth to headwaters	
	Lost Pin Creek	Mouth to headwaters	
	McKay Creek, NF	Mouth to headwaters	
	Meacham Creek	East Meacham Creek to	
	Mill Creek	Mouth to headwaters	
	Mission Creek	Mouth to headwaters	
	Moonshine Creek	Mouth to headwaters	
	Rail Creek	Mouth to headwaters	
	Sheep Creek	Mouth to headwaters	
	Twomile Creek	Mouth to headwaters	
	Umatilla River	Wildhorse Creek to Forks	
Turbidity	Umatilla River	Mouth to Mission Creek	>30 NTU
pH	Umatilla River	Speare Canyon to Forks	pH 6.5-9.0
Nitrate	Wildhorse Creek	Mouth to headwaters	>10mg/L
	Spring Hollow Creek	Mouth to headwaters	
Ammonia	Umatilla River	Mouth to RM 5	pH dependent: see Table 8
	North Hermiston Drain	Mouth to headwaters	
Bacteria	McKay Creek	Mouth to McKay Reservoir	Water Contact Recreation (fecal coliform 96-Std)
	Umatilla River -- Summer	Mouth to Speare Canyon	
Aquatic Weeds/Algae	Umatilla River	Speare Canyon to Forks	Growth considered to be deleterious to aquatic life, public health, recreation or industry

Table 9 (continued). Impaired stream reaches from the 1998 303(d) list and used for development of the 2001 Umatilla subbasin TMDL (ODEQ et al. 2001).

Parameter	Stream	Segment (boundaries)	Criterion
Flow Modification	Birch Creek	Mouth to Headwaters	
	Umatilla River	Mouth to Speare Canyon	
Habitat Modification	Bell Cow Creek	Mouth to Headwaters	ODFW Habitat Benchmarks
	Boston Canyon Creek	Mouth to Headwaters	
	Calamity Creek	Mouth to Headwaters	
	Coonskin Creek	Mouth to Headwaters	
	Cottonwood Creek	Mouth to Headwaters	
	Darr Creek	Mouth to Headwaters	
	E. Birch Creek	Mouth to Headwaters	
	Line Creek	Mouth to Headwaters	
	Little Beaver Creek	Mouth to Headwaters	
	Lost Pin Creek	Mouth to Headwaters	
	Meacham Creek	Mouth to Headwaters	
	Mill Creek	Mouth to Headwaters	
	Mission Creek	Mouth to Headwaters	
	Moonshine Creek	Mouth to Headwaters	
	N.F. McKay Creek	Mouth to Headwaters	
	N.F. Meacham Creek	Mouth to Headwaters	
	Rail Creek	Mouth to Headwaters	
	Umatilla River	Wildhorse Creek to Forks	
	Wood Hollow Creek	Mouth to Headwaters	

Table 10. 2002 303(d) listed stream reaches in the Umatilla/Willow subbasin (ODEQ 2003).

Variable	Stream	Segment (boundaries)	Criterion
Temperature	Willow Creek	Mouth to Headwaters	Rearing 17.8 °C
pH	Hermiston Ditch -- Summer	Mouth to RM 2.7	pH 6.5-8.5
	Willow Creek	Mouth to RM 51.7	
Nitrate	Unnamed Waterbody	Mouth to RM 3.1	>10mg/L
Fecal Coliform	Balm Fork	Mouth to RM 9.5	Geometric mean of 200, No more than 10%>400
Dissolved Oxygen	Umatilla River – Fall through Spring	Mouth to RM 32.1	<95% saturation
Manganese	Umatilla River	Mouth to RM 32.1	>0.10 mg/L
Iron	Birch Creek	Mouth to RM 15.6	>1.0 mg/L
	Butter Creek	Mouth to RM 18	
	McKay Creek	Mouth to RM 15	
	Umatilla River	Mouth to RM 56	
	Wildhorse Creek	Mouth to RM 33.1	

routinely exceeds the water quality standard at Yoakum Bridge (RM 37.2) (Figure 20) (ODEQ et al. 2001). Elevated summertime temperatures and excessive algal growth are also likely contributors to high pH levels recorded in Willow Creek, from the mouth upstream to Heppner.

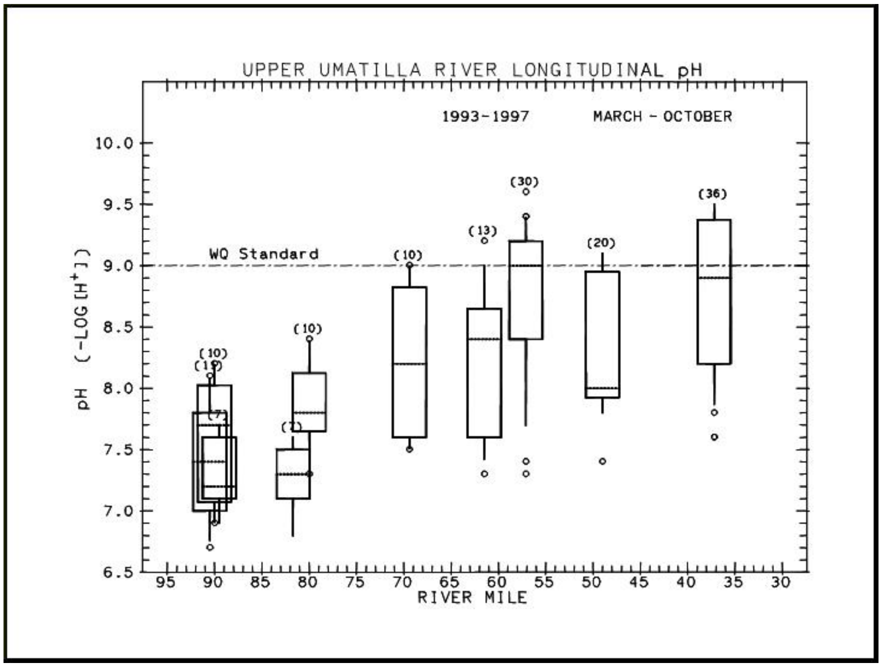


Figure 20. pH of the upper Umatilla River (ODEQ et al. 2001).

Bacteria: The 1998 303(d) listings (Tables 9 and 10) were based on fecal coliform samples exceeding the standard (400 colonies/100ml) in the listed reaches. Fecal coliform bacteria are found in the fecal matter of warm-blooded animals, including humans. In 1996 the State of Oregon revised its bacteria standards to be based on *Escherichia coli* instead of fecal coliform. *E. coli* is the most common type of fecal coliform bacteria and is rarely harmful; however, its presence in water indicates sewage or other fecal contamination, both of which may contain disease-causing organisms (ODEQ et al. 2001). Most reaches and tributaries of the Umatilla River upstream of Pendleton have low levels of *E. coli* bacteria (less than 150 per 100 ml). Areas in the subbasin with high *E. coli* counts include the middle reaches of Wildhorse Creek (450 to 600 per 100 ml), the Umatilla River near and downstream of the city of Pendleton (greater than 600 per 100ml), and the lower and middle reaches of Butter Creek (greater than 600 per 100 ml) (ODEQ 1998). Bacteria levels are also high in the Balm Fork of Willow Creek.

Flow Modification: The Umatilla mainstem has been listed for flow modification from Speare Canyon to the mouth and one of the Umatilla's tributaries, Birch Creek, has also been listed from its headwaters to mouth. The magnitude and cause of flow modification in the Umatilla/Willow subbasin is reviewed in Sections 3.1.1.9 and 3.1.3.2.

Habitat Modification: The mainstem Umatilla River from Wildhorse Creek to the forks and sections of 17 tributaries of the mainstem are 303(d) listed because of habitat (including substrate) problems (see Table 9). Habitat benchmarks developed by ODFW (Oregon Department of Fisheries and Wildlife) were used to 303(d) list stream reaches based upon standardized habitat surveys (Moore et al. 1999). Parameters measured in these surveys include habitat features known to be important to salmonids such as presence and amount of large woody debris, pool frequency, presence of eroding streambanks, type of riparian vegetation, stream channel form and pattern, and the proportion of the substrate composed of fine materials.

Nitrate: The two stations (Spring Hollow Creek, a tributary to Wildhorse Creek, and Wildhorse Creek) for which nitrate standards are in violation have concentrations that violate general criteria set for public water supplies (<10 mg/L). Concentrations at these stations may represent a serious health concern for infants and pregnant or nursing women (Oregon Health Division, Environmental Toxicology Section 1990 cited in ODEQ et al. 2001).

Sediment and Turbidity: The Umatilla River produces large amounts of sediment, much of which originates from weathered basalt and unconsolidated loess deposits -- the dominant geology in the subbasin. The primary sources include both bank and upland erosion of tributaries and tributary watersheds, both of which may be accelerated by land uses (ODEQ et al. 2001). The dominant erosion processes in the subbasin are surface erosion by sheetwash, rills and gullies, and bank erosion (ODEQ et al. 2001). Peak sedimentation usually occurs during rainstorms or snowmelts associated with freeze and thaw periods (CTUIR and ODFW 1990). The entire Umatilla mainstem from the mouth to the forks is listed for either sediment or turbidity.

Neither EPA nor the State of Oregon has established numeric water quality standards for suspended solids or streambed fines. Umatilla Basin fisheries managers, however, determined through basin-specific knowledge and literature review that an instream turbidity standard of 30 nephelometric turbidity units (NTU's), that does not exceed a 48-hour duration, will protect aquatic species (ODEQ et al. 2001). The 30 NTU target was correlated to total suspended solids (TSS) data to derive watershed target concentrations/loading capacities. The 303(d) listings were based on stream surveys, using ODFW Habitat Benchmarks for silt, sand, and organics, in upper watershed areas. The TMDL uses turbidity as the target for reducing the amount of suspended material available for settling.

One of the sediment-impaired stream segments that significantly deviated from the target standard for turbidity was Wildhorse Creek (at its confluence with the Umatilla River), which had a peak turbidity value of over 5,000 NTU measured on April 23, 1997. High levels were also measured in McKay Creek. Wildhorse Creek turbidity mainly results from spring runoff, while McKay's turbidity is mostly a result of bottom withdrawal of water from the reservoir for flow augmentation. Composite samples of turbidity, collected at various stations during the winter of 1997-1998, show that Tutuilla, Birch, and five sites on the Umatilla mainstem exceeded standards on numerous occasions (ODEQ et al. 2001).

Suspended sediment is often deposited on streambeds where it forms an unstable part of the substrate. High levels of substrate sediment often fill the interstitial spaces between gravel and cobble, which can negatively influence the survival of salmon eggs and alevins (Cooper 1965, Mundie and Crabtree 1997). Surveys conducted by ODFW and CTUIR throughout the Umatilla River subbasin found that 19 of 42 stream reaches had fine sediment as the dominant substrate (Boyd et al. 1999). In the Patawa/Tutuilla watershed, fine sediment made up the dominant substrate in 9 of 19 reaches surveyed (Watershed Professionals and Duck Creek Associates 2003). Substrate sediment is less of a problem in the upper Umatilla subbasin; a survey of the upper Umatilla River and Meacham Creek by the Umatilla National Forest (2001) in which substrate embeddedness was measured directly found that only two sub-watersheds of 18 had embeddedness levels greater than 35% (a level of embeddedness considered detrimental to salmon).

Temperature: Water temperature is a concern throughout most of the Umatilla/Willow subbasin during periods of low flow (May until early November). On the 1998 303(d) list, 287 miles of the Umatilla River and its tributaries were listed as impaired for elevated water temperatures including the entire mainstem Umatilla River (ODEQ et al. 2001) (Figure 21). The highest water temperatures have been recorded in late July and early August when ambient air temperatures are high. During this period, the Umatilla River warms rapidly from the headwaters to the mouth, reaching sub-lethal (64-74°F, 20-23°C) and incipient lethal temperatures (70-77°F, 21-25°C) for its entire length (Boyd et al. 1999; Contor and Crump 2003) (Figures 22 and 23). Many of the tributaries also reach sub-lethal and incipient lethal ranges for salmonids (Boyd et al. 1999; CTUIR 2004a).

The Umatilla subbasin's coolest mid-summer recorded temperatures are in the North Fork of the Umatilla River, where maximum summer temperatures usually do not exceed the state standard of 64°F (17.8°C). For example, in the summer of 2002, maximum water temperature in the North Fork did not exceed 60.8°F (16.0°C) (Contor and Crump 2003). The South Fork of the Umatilla River experiences higher summertime temperatures often above 64°F, though rarely above 70°F. Data indicate a significant increase (approximately 5° F) in temperature from the Umatilla River east of the Gibbon site (RM 80.0) to the Umatilla River at Cayuse Bridge (RM 69.4). This increase in temperature is attributed to Meacham Creek which enters the Umatilla Mainstem at RM 79. Summer water temperatures in Meacham Creek are frequently in the high 60s ºF. However, maximum summer temperatures drop further downstream (at RM 50; Figures 22 and 23) as a result of cold water releases from McKay Reservoir for the benefit of irrigation and fish.

One of the warmest tributaries of the Umatilla River is Wildhorse Creek. This drainage regularly experiences excessive summertime stream temperatures throughout the entire stream length. Headwaters often exceed 70˚F for long periods in the summer, while lower Wildhorse Creek can often experience stream temperatures exceeding 85˚F.

The temperature regime in Willow Creek is similar; the entire mainstem can exceed criteria for salmonid rearing (64°F, 17.8° C). In addition, water frequently reaches sublethal and incipient lethal temperatures from the mouth to RM 62 from June through

September (ODEQ et al. 2001). These high temperatures extend into Rhea Creek, one of Willow Creek's main tributaries.

Excessive stream temperatures in the Umatilla/Willow subbasin are influenced primarily by non-point sources including riparian vegetation disturbance (reduced stream surface shade), summertime diminution of flow (reduced assimilative capacities), and channel widening (increased surface area exposed to solar radiation) (ODEQ et al. 2001).

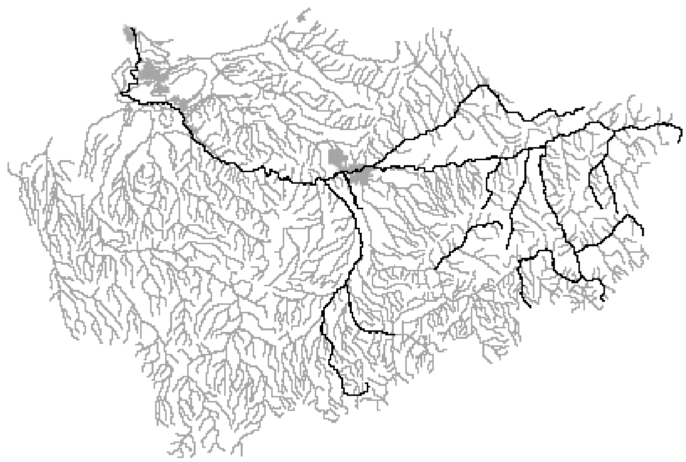


Figure 21. Stream segments listed for temperature on the 1998 303(d) list.

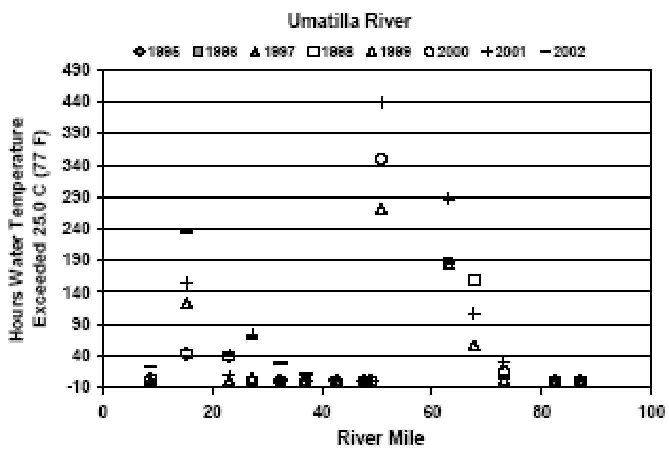


Figure 22. The number of hours water temperatures exceeded 25°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87.

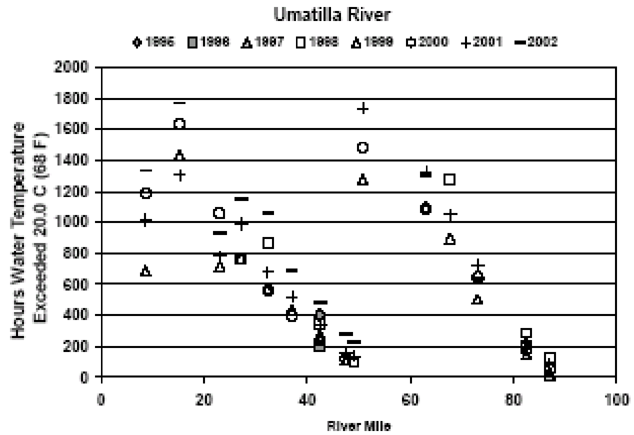


Figure 23. The number of hours water temperatures exceeded 20°C during June-September, 1995-2002, in the Umatilla River at selected sites from RM 8-87.

3.1.2.3 Riparian Resources

The current condition of the riparian vegetation varies considerably throughout the Umatilla/Willow subbasin. The majority of the riparian vegetation in the upper tributaries is composed of narrow bands of hardwood and conifer species. Much of these areas are on National Forest lands. Galleries of large mature cottonwoods exist in some areas of CTUIR land as well as in a few areas along the mainstem Umatilla River below Pendleton (RM 51). Lower mainstem and tributary reaches have riparian vegetation types primarily composed of shrubs and grasses, with some scattered hardwood trees (e.g., ash, cottonwood, and alder). In some cases where crop cultivation extends to the stream banks or where grazing pressure is high, woody or shade-producing riparian vegetation is sparse. Much of the lower mainstem is diked, and trees are actively prevented from growing on the dikes.

Riparian vegetation on the mainstem Umatilla River and many tributaries is in poor condition, with approximately 70% of 422 miles inventoried identified as needing riparian improvements (CTUIR and ODFW 1990). Losses of riparian vegetation are particularly high in the lower subbasin; Kagan et al. (2000) estimated these losses at greater than 95% as compared to pre-settlement conditions (c. 1850).

3.1.2.4 Wetland Resources

An assessment of wetlands along the Umatilla River corridor was conducted by the CTUIR and developed into a Wetland Protection Plan (CTUIR 1997). The assessment was conducted using National Wetlands Inventory maps and found that 10,090 acres of wetlands occur along the mainstem corridor. That acreage can be divided into three different types of wetlands: 4,400 acres of lacustrine wetlands (those associated with ponds and reservoirs), 4,250 acres of palustrine wetlands (those typically referred to as “swamps”, “bogs” or “marshes”), and 1,440 acres of riverine wetlands (riparian areas adjacent to streams and rivers). Based on a limited analysis conducted by the CTUIR (1997), wetland losses in the upper Umatilla River range from 30 to 35%, while wetland losses in the Umatilla/Echo Meadows area are estimated to be as high as 90%. The CTUIR (1997) analysis identified three important wetland areas: Minthorn Springs on the Umatilla Indian Reservation, a braided portion of the Umatilla River downstream of Pendleton, and the Echo/Umatilla Meadows complex.

The Minthorn Springs area (RM 65) represents a riverine and palustrine wetland complex formed by the interface of the springs and the Umatilla River. The area contains approximately 19 acres of palustrine wetlands and 11 acres of riverine wetlands. Historically, the wetland received water inputs from intermittent tributaries. Input from those streams has now been reduced because upland farming has either eliminated or rechanneled the stream channels. Additionally, cottonwood forest riparian areas that once existed along the upland channels have either been reduced or completely removed, resulting in intermittent streams drying up earlier in the year. This area is important for water quality and quantity, and fish and wildlife habitat (CTUIR 1997).

The second focus area is located in the mid- to lower river corridor west of Pendleton (RM 47). This area contains braided river channels and a cottonwood gallery with approximately eight acres of palustrine wetlands and five acres of riverine wetlands. This portion of the Umatilla River has been channelized for transportation routes (roads and railways), agricultural development, and diking. This area serves as a corridor for fish and wildlife and represents a habitat that was once much more common prior to human impacts (CTUIR 1997).

The Echo-Umatilla Meadows wetland complex is located lower in the Umatilla River corridor (between RM 18 and 24). This complex results from the broadening of the river's floodplain to nearly 10 times its upstream width. Examination of aerial photos reveals numerous side channels and oxbows that are now dry. These dry channels are generally within a mile of the existing high water mark. The area historically held palustrine wetlands that abated floods, trapped sediment, stored water, provided recharge to the river, and provided fish and wildlife habitat. The area currently contains an estimated 862 acres of palustrine wetlands and 152 acres of riverine wetlands. Primary impacts to this area include conversion to farmland, channelization for agriculture, roadways, railways, diking, and urbanization (CTUIR 1997).

3.1.3 Hydrological and Ecological Trends in the Subbasin

3.1.3.1 Trends in Climate and Their Effect on Hydrology and Ecology

The entire Umatilla/Willow subbasin falls within Oregon's North Central Climatic Zone (Zone 6), a relatively dry region with peak precipitation occurring in winter and dry summers (Oregon Climate Service 2004). Major influences on the climate are the Cascade Mountains and the Columbia Gorge to the west and the Blue Mountains to the east. The Cascade Mountains form a barrier to the passage of warm moisture-laden storm fronts from the Pacific Ocean into the Columbia basin interior. However, the Columbia Gorge provides a break in this barrier, occasionally allowing moisture laden air to penetrate to the Blue Mountains (Johnson and Clausnitzer 1992).

Mean annual temperature and precipitation records for a hundred year period for Zone 6 indicate that while temperature and precipitation have oscillated over this period, no obvious trends exist (Figures 24 and 25). More detailed information on climate is given in section 3.1.1.4.

Hydrology and ecology are influenced to a great degree by a region's climate. Thus, year-to-year variation in climate can result in year-to-year variability in the hydrologic regime and fish and wildlife populations. However, the lack of any obvious trends in climate through time (Figures 24 and 25) suggests that there should be little climate-induced trends in either hydrology or ecology in the subbasin.

The ecology of the subbasin is likely influenced by trends in climate outside of the subbasin. An important weather pattern in the Pacific Northwest that appears to have a strong influence on salmon survival in the ocean is the Pacific Decadal Oscillation (PDO) (Taylor and Southards 2003). The PDO pattern is of a period of cool, wet years followed by a period of warm, dry years. The impact of the PDO on the abundances of adult salmon and steelhead returning to the Columbia River and to the Umatilla/Willow subbasin is described in more detail in Section 3.3.1.

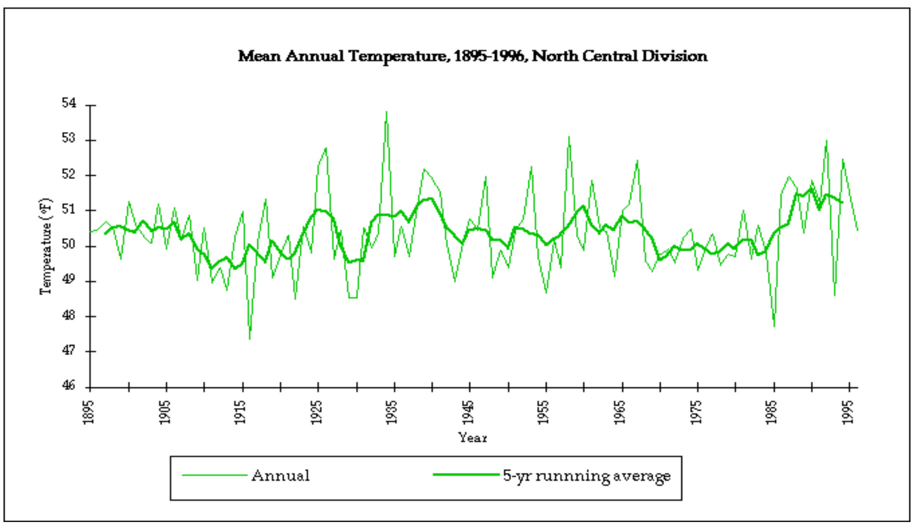


Figure 24. Air temperature in Climate Zone 6 (North Central) of Oregon (1895- 1995) (Oregon Climate Service 1999).

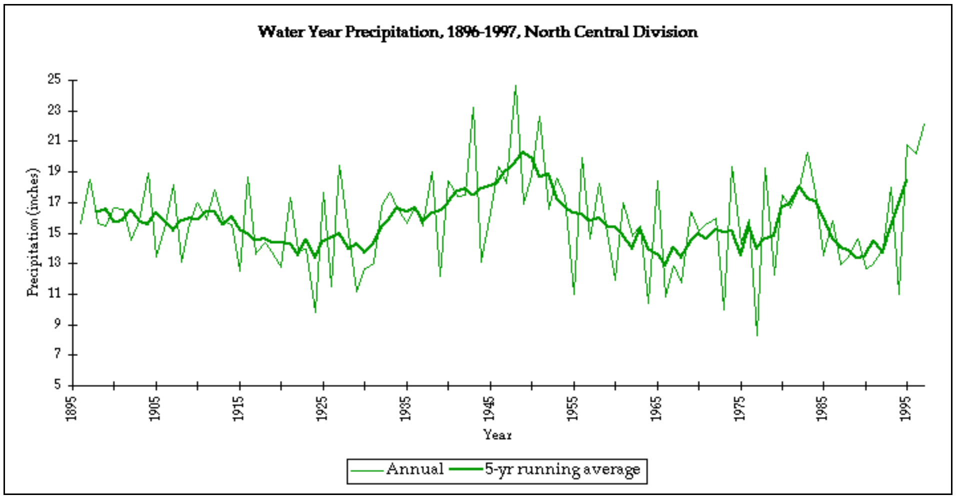


Figure 25. Precipitation in Climate Zone 6 (North Central) of Oregon (1895-1995) (Oregon Climate Service 1999).

Despite the lack of evidence of any obvious climate change in the Region 6 climatic zone, computer simulations of future weather generally agree that the climate is warming and will continue to warm during the next 50 years. TOAST (2004) provided this brief overview of probable impacts of climate change on the Pacific Northwest and the region's salmon:

> Computer models generally agree that the climate in the Pacific Northwest will become, over the next half century, gradually warmer and wetter, with an increase of precipitation in winter and warmer, drier summers (USDA Forest Service 2004). These trends mostly agree with observed changes over the past century. Wetter winters would likely mean more flooding of certain rivers, and landslides on steep coastal bluffs (Mote et al. 1999) with higher levels of wood and grass fuels and increased wildland fire risk compared to previous disturbance regimes (USDA Forest Service 2004). The region's warm, dry summers may see slight increases in rainfall, according to the models, but the gains in rainfall will be more than offset by losses due to increased evaporation. Loss of moderate-elevation snowpack in response to warmer winter temperatures would have enormous and mostly negative impacts on the region's water resources, forests, and salmon (Mote et al. 1999). Among these impacts are a diminished ability to store water in reservoirs for summer use, and spawning and rearing difficulties for salmon.

3.1.3.2 Trends in Anthropogenic Activities and Their Effect on Hydrology and Ecology

The current influence of human activities on aquatic and terrestrial environments is described in 3.1.1.9. The purpose of this section is to briefly describe trends in these activities through time and their corresponding impact on the hydrology and ecology of the Umatilla/Willow subbasin. Activities are presented in alphabetical order.

Agriculture[1]*:* When early settlers arrived in the Umatilla/Willow subbasin between 1843 and 1880, they found mountains covered with forests and plateau lands covered with native grasses. These settlers pursued an agrarian lifestyle, primarily raising livestock with limited crop production. Intensive tillage began during the 1880s, causing large amounts of native grassland to be converted to dry cropland. The completion of several irrigation and Bureau of Reclamation (BOR) projects shortly after the turn of the century (see discussion of water development below in this section) allowed for the conversion of arid areas in the lower basin into irrigated croplands. In the late 1940s and early 1950s, the need for large areas of pasture and hay production declined due to a reduction in the number of horses because of increased mechanization and government policy (e.g., WWII horse slaughter). Since the advent of modern irrigation systems, approximately 480,000 acres of land have been developed for crop production.

Other than water development (which is discussed below) agriculture has had two important impacts on the subbasin's fish and wildlife resources. First is the conversion of native grasslands and shrub-steppe plant communities to croplands. Historically (c. 1850), the Umatilla/Willow subbasin is estimated to have had 2,030,959 acres of grassland and 273,546 acres of shrub-steppe habitat (IBIS 2004). Currently, the subbasin has 528,269 acres of grassland (a reduction of 74%) and 628,795 acres of shrub-steppe (an increase of over 100%) (IBIS 2004). However, it is important to note that the overall increase in shrub-steppe habitat is primarily due to an increase in rabbit brush, as abandoned wheat fields have been enrolled in CRP, and does not reflect trends in specific types of shrub-steppe. For example, in the Umatilla/Willow subbasin, Kagan et al. (2000) estimates that big sagebrush steppe has declined by 86%, with historic coverage estimated at 302,704 acres and current coverage as 43,145 acres. Most of this habitat loss occurred in the northern part of the subbasin, on deeper loess soils, which are now farmed. Bitterbrush shrub-steppe, located primarily in the sandy areas of the northern part of the subbasin, has also experienced significant losses, with only 45% (43,540 acres in 1999) of the original habitat (94,171 acres c. 1850) remaining (Kagan et al. 2000). Bitterbrush shrub-steppe has declined primarily as a result of irrigated agriculture or industrial development. The largest remaining habitats of bitterbrush shrub-steppe are found on the Umatilla Army Depot and the Boeing Lease Lands, both of which face significant threats (Kagan et al. 2000). In addition, bluegrasss/rigid sage scabland has decreased by approximately 54%, from 268,356 acres c. 1850 to 124,022 acres in 1999 (Kagan et al. 2000).

The loss of high quality native shrub-steppe habitat can negatively affect terrestrial wildlife species. Kagan et al. (2000) examined seven birds species (Burrowing Owl, Sage Sparrow, Grasshopper Sparrow, Swainsons Hawk, Ferruginous Hawk, Long-billed Curlew, Loggerhead Shrike), two mammals (white-tailed jackrabbit, Washington ground-squirrel), two reptiles (sagebrush lizard and short-horned lizard), and one amphibian (Great-basin spadefoot), and found that sagebrush-steppe habitats are the most critical and limiting habitat for these species within the lower Umatilla/Willow subbasin (see

[1] The first paragraph of this section was adapted from information presented on pp. 3-4 of the Umatilla River Subbasin Agricultural Water Quality Management Area Plan (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee 1999)

Sections 3.2.4 and 3.5.2 for more discussion of selected focal species and their relationship to shrub-steppe habitat). Fragmentation of remaining shrub-steppe habitat can negatively affect terrestrial wildlife by altering dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale and by increasing certain interspecific interactions, such as parasitism (Altman 2000, Altman and Holmes 2000) (see Section 3.2.4.2 for more discussion of fragmentation of shrub-steppe habitats).

Agricultural impacts on wildlife have not all been negative, however. Agricultural areas support many small birds and mammals, important predators such as coyotes and red-tailed hawks, and game species such as ring-necked pheasants and wild turkey (Csuti et al. 1997; Edge 2001). The number of species inhabiting agricultural areas may be quite large; Edge (2001) estimates that the number of wildlife species supported by agriculture in eastern Oregon and Washington is similar to the number of species supported by eastside grasslands (about 170 species in each habitat type).

The second important impact of agriculture is erosion and sediment input into streams. Efforts to control erosion of topsoil were being made as early as the 1930s. Bennett (1947), discussing wheat production areas, stated that, "fair to good control of erosion can be obtained by plowing down stubble (rather than burning it) in such a way that part of the straw protrudes above the ground, affording considerable surface protection, especially against wind". Currently, sedimentation into streams continues to be a problem in the Umatilla/Willow subbasin with the mainstem and many tributaries 303(d) listed for sediment and turbidity (see section 3.1.2.2). The source of most sediment in streams in the subbasin is thought to be surface erosion (through sheetwash, rills and gullies) and streambank erosion (ODEQ et al. 2001). The relative contribution of each is unclear; however, recent work in the Wildhorse watershed, one of the largest sediment yielding tributaries of the Umatilla River, suggests that the majority of sediment in Wildhorse Creek comes from bank erosion and not from surface erosion as a result of cropping practices (Nagle and Ritchie 2004). Using carbon, nitrogen and Cesium-137 as tracers, Nagle and Ritchie (2004) estimate that bank material contributed from 74-88% of bottom sediments in Wildhorse Creek and surface soils contributed 12-26%. More work like this is needed throughout the subbasin to determine if this is a common pattern in sediment sources. This work suggests that, to control sediment in Wildhorse Creek, a premium should be placed on bank stabilization through riparian vegetation recovery with less effort directed towards changing cropping practices.

Recently, the impact of agriculture on fish and wildlife resources in the subbasin has been mitigated to a degree by conservation incentive programs. A variety of United States Department of Agriculture (USDA) incentive programs are currently available to crop growers through the local NRCS and county Farm Service Agency (FSA) offices. The most significant federal agriculture program in Umatilla County over the past 15 years has been the Conservation Reserve Program (CRP), which includes the Conservation Reserve Enhancement Program (CREP) and Continuous Conservation Reserve Program (CCRP). Under this program, growers get paid on an annual per acre basis to retire and set aside cropland areas. Contracts can be from ten to 15 years depending on specific practices involved. There are two types of sign-ups; a standard sign-up, which is on a bid basis, and during a designated sign-up period; the other option is a special practice sign-up, which can occur at any time. The special practice sign-up is for specific areas and often includes native grasses, trees, and shrubs. The CRP has achieved significant conservation and wildlife habitat benefits. As of 2003, Umatilla County had 108,000 acres in the program, with 347 acres enrolled in CREP, which involves installing riparian forest buffers along streams, and 991 acres enrolled in CCRP. Morrow County has 109,921.1 acres in the program, with 97.7 of those acres enrolled in CCRP. Table 11 summarizes the specific type of CRP practices conducted in Umatilla and Morrow counties from 1986-2001 (USDA 2000).

Other conservation-based programs include the Direct Seeding Program. The program is a partnership between the Umatilla County Soil and Water Conservation District (SWCD), Oregon State University (OSU) – Umatilla County Extension Service, EPA, ODEQ, and Oregon Watershed Enhancement Board (OWEB). The Direct Seeding Program provides growers with an incentive payment of $10 per acre for up to 200 acres per producer, and up to three crop rotations per entity. The program has increased the practice of direct seeding substantially. Before 1997, when the program began, growers rarely employed the practice; in 2003, growers used direct seeding on more than 50,000 acres in the subbasin, often without cost shares (personal communication: T. Straughan, ODA, March 2004).

Another USDA program which provides cost-share for installing conservation practices is the Environmental Quality Incentives Program (EQIP). EQIP funds are currently being used for supporting such practices as reduced tillage systems, direct seeding, nutrient management, cropland conversion to grasslands, and irrigation management. Contracts are for 1 to 10 years and provide up to 75% cost share. Resource concerns are prioritized for funding annually by a Local Working Group (personal communication: T. Straughan, ODA, April 2004).

Exotic Weed Introduction: Introduced exotic weeds are not a new problem in the Umatilla/Willow subbasin; early newspaper accounts from 1902 through 1923 describe wheat farmers in the Adams area of the Wildhorse Creek drainage having difficulties with “Russian thistle”, “tar weeds” and “Jim Hill Mustard” (Adams Ladies Club 1993, 1994). Since that time, both the number of exotic species established in the Umatilla/Willow subbasin and the acreage of lands invaded have increased, although the magnitude of these changes in the last 100 years has not been quantified. As discussed in Section 3.1.1.9, the spread of exotic weeds not only reduces the abundance and diversity of native vegetation, but can also negatively affect fish and terrestrial wildlife and natural ecological processes, such as fire regimes in shrub-steppe habitats.

Table 11. Acreages of specific CRP practices in the Umatilla/Willow subbasin from 1986-2001 (USDA 2000)

County	Conservation Reserve Practice	Activity Acres
Umatilla	established grass	47,536.4
	introduced grasses	32,597.3
	native grasses	14,076.1
	tree planting	853.5
	established trees	870.5
	wildlife habitat	9,971.9
	wildlife food plots	75.2
	grass waterways	44.9
	filter strips	1,071.3
	riparian buffers	185.5
Morrow	established grass	79,666.1
	introduced grasses	33,881.9
	native grasses	63.8
	field windbreaks	39.8
	wildlife food plots	17.5
	contour grasses	10.3
	filter strips	522.4
	riparian buffers	28.8

Forestry Practices: The USFS created the Umatilla National Forest in 1920 (USFS 2004). Shortly thereafter, commercial forestry began in the Umatilla subbasin. However, large amounts of timber were not cut until the 1950s. Data on harvest rates indicate that harvest peaked in the subbasin in the 1970s and declined substantially by the 1990s (Table 12).

However, some extensive logging has occurred in Morrow County recently (2003) on private property in the headwaters of Rhea Creek (personal communication: K. Ramsey, USFS, January 2004). Although Oregon forest practices are being followed, these are less stringent than USFS practices, and the harvest may affect water quality in Rhea Creek (personal communication: K. Ramsey, USFS, January 2004).

Table 12. Timber sales and harvest rate in the Umatilla/Willow subbasin (Umatilla National Forest 2000).

Period of Harvest	Timber Sales (acres)	Harvest Rate (ac/yr)
1990-1994 (5 years)	4,091	818
1980-1989 (10 years)	17,572	1,757
1970-1978 (9 years)	26,374	2,931
1960-1969 (10 years)	6,963	693
1958-1959 (2 years)	983	492

One management practice involved with timber harvesting is fire suppression. This practice has had a significant impact on the ecology of forests in the Umatilla/Willow subbasin. These impacts have been summarized in an ecosystem analysis of the Upper Umatilla River and Meacham Creek watersheds conducted by the Umatilla National Forest (2001):

> Like most areas in the Blue Mountains, fire suppression has strongly influenced the structure and composition of the forest vegetation within the watersheds. Most significantly, early seral species such as ponderosa pine, lodgepole pine and western larch have been replaced by late seral and climax species like Douglas-fir and grand fir. In addition, forest structure has changed from predominantly low density, single story to high density, multi-story. Forests have also colonized grasslands, resulting in an overall decline in herbage production. There has been a substantial loss of hardwood tree species, particularly in riparian areas, resulting in a loss of forest tree diversity. The result of these vegetation changes has been an increase in fuel loads to the extent that forested areas are at significantly higher risk of experiencing stand replacing wildfires as compared to historical conditions.

Another impact of the change in dominant tree species from pines to firs is that firs are not as resistant to insect attacks and disease outbreaks as pines, and thus, areas where fire has been suppressed are more susceptible to timber loss from these sources than they were historically (Langston 1995).

The impact that forestry practices have had on wildlife in the Umatilla/Willow subbasin has not received extensive study. However, several wildlife species are dependent upon large structure ponderosa pine forests, which, while historically abundant in the subbasin, have become scarce because of forestry practices including fire suppression. These wildlife species include White-headed Woodpeckers, which have become scarce in the subbasin presumably because of destruction of appropriate habitat (Gilligan et al. 1994), and Flammulated Owls. Historical timber harvests in steep headwater portions of the Umatilla subbasin have likely also affected aquatic systems; deforestation can reduce riparian and water storage capacities, and increase runoff rates, increasing sedimentation in streams (Shaw and Sexton 2000).

Livestock Grazing: Livestock grazing in the subbasin dates back to pre-European settlement times. The local tribes, particularly the Cayuse, owned large numbers of horses. Around 1870, according to early reports, one Indian chief owned a band of 5,000 horses (Harper et al. 1948). As early as 1811, Wilson Price Hunt noted that there were 2,000 horses for 34 Indian families at just one winter encampment adjacent to the Umatilla River (Langston 1995). Accounts from tribal elders agree that the number of horses in the subbasin was quite large (CTUIR 2004b):

> Tribal elders tell us that in those days the Indians had thousands and thousands of horses and that they needed areas for them to graze. There wasn't enough grazing area so they had to spread the horses out. The Cayuse used to graze horses all through the Umatilla Basin, across the Columbia River on the Horse Heaven Hills all the way to

> Hanford to the north, on the east side of the Blue Mountains from the Grande Ronde country all the way to Huntington, to the John Day River country in the south and all the way to the Cascades in the west

These large tribal horse herds likely impacted the native grasses of the region; however, this impact has not received study.

Livestock raising was the first important agricultural practice in the subbasin for white settlers. Horses, cattle and sheep have all been raised over the past 100 years, but their relative importance has changed. Sheep were the predominant livestock at the beginning of the 20th century; however, by the late 1950s, sheep numbers greatly decreased and cattle became the predominant livestock (Figures 26 and 27). The total number of livestock in Umatilla and Morrow counties was quite large in the early 1900s, often totaling over 250,000 head of sheep (Figures 26 and 27). However, in the early 1930s the numbers began to decline and currently there is approximately 90,000 head of livestock in each county.

While the number of livestock has decreased greatly over the last 70 years in the subbasin, it still is a primary or secondary land use in some watersheds. These watersheds include Spring Hollow Creek, Mission Creek, Buckaroo Creek, Squaw Creek, McKay Creek, Moonshine Creek and Cottonwood Creek (Shaw and Sexton 2000).

The impact of livestock grazing on native vegetation is quite extensive and has a long history. Brown (1947) reported that by the 1890s, native grasses, though naturally recuperative under conservative use, were partially destroyed by unregulated grazing by sheep and cattle. Problems associated with overgrazing include 1) reduction of the total amount of native vegetation, 2) replacement of native vegetation with plants of low forage value and/or exotic species and 3) reduction of surface cover, resulting in increased surface and wind erosion (Shelford and Hanson 1947). Exotic vegetation that has been introduced into the subbasin as a possible result of livestock grazing includes cheatgrass and yellow starthistle.

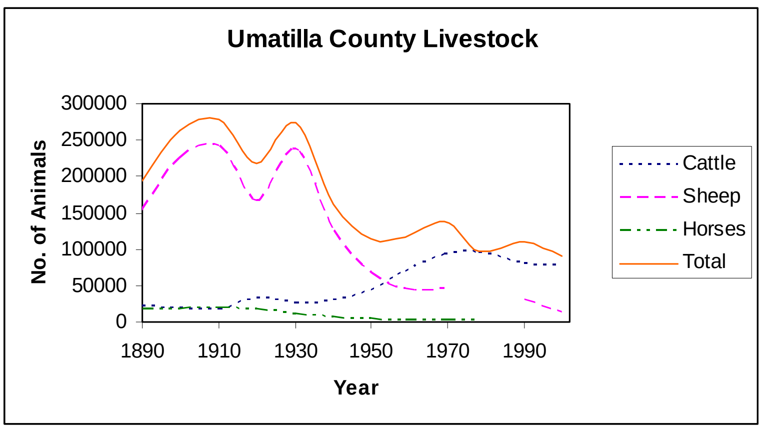


Figure 26. The number of livestock over the past century in Umatilla County (Umatilla National Forest 2004; USDA NASS 2004).

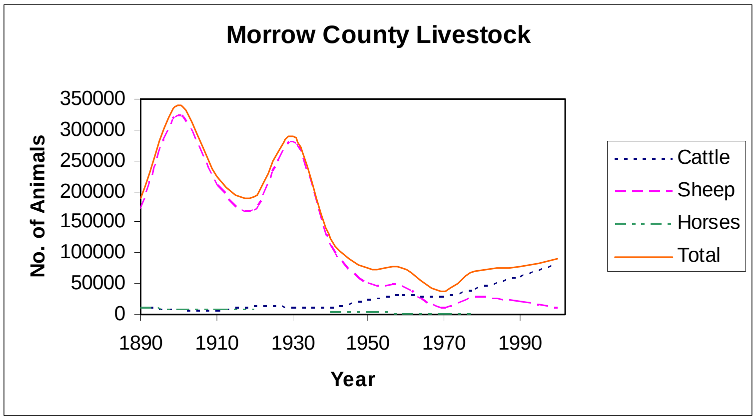


Figure 27. The number of livestock over the past century in Morrow County (Umatilla National Forest 2004; USDA NASS 2004).

Livestock grazing can also have significant impacts on rivers and streams and their biota. This impact comes largely from the loss of riparian vegetation in areas in which livestock have access to riparian areas. With loss of riparian vegetation come increased stream temperatures from lack of shade, loss of input of organic matter from the riparian vegetation to the stream (an important energy source for aquatic food webs), and unstable streambanks which are vulnerable to erosion and increase the input of fine sediment into the stream (Waters 1995; NRC 2002). In the Umatilla/Willow subbasin livestock grazing has been identified as having important impacts on bull trout habitat in the Umatilla River mainstem from the city of Pendleton to the forks, within the Meacham Creek drainage, and within the North Fork of the Umatilla River (associated with livestock trespasses) (USFWS 2004). In addition, livestock grazing in the Wildhorse Creek watershed has contributed to poor water quality and loss of floodplain function (Shaw and Sexton 2000).

Livestock grazing can also affect terrestrial wildlife. The extirpation of the Rocky Mountain bighorn sheep from the Umatilla/Willow subbasin and the rest of the Oregon by the 1940s may have been partially due to unregulated domestic livestock grazing and the spread of parasites and disease carried by domestic livestock to bighorn sheep (ODFW 2003b). Excessive livestock grazing in riparian areas can eliminate vegetative structure that are important habitat features for birds such as the Red-Eyed Vireo (Altman 2000, Altman and Holmes 2000). Livestock grazing may also contribute to increased rates of brood parasitism by Cowbirds, which often forage near livestock (Goguen and Matthews 2001). Brood parasitism occurs when Cowbirds lay their eggs in the nests of other bird species. The Cowbird offspring is then raised by its “adopted” bird mother, often to the detriment of her own offspring. Parasitism by Cowbirds has been found to significantly decrease the reproductive output of some bird species, particularly in fragmented landscapes (Robinson et al. 1995).

Settlement/Urbanization: The first human inhabitants of the Umatilla/Willow subbasin were Native Americans. The Umatilla/Willow subbasin is part of the historic homelands of the Walla Walla, Cayuse, and Umatilla Indian Tribes. Historically, Native-Americans relied heavily on hunting, fishing, and gathering. This lifestyle changed as large numbers of white settlers moved into the Umatilla/Willow subbasin in the mid 1800s. Conflict arose when the federal government gave Native American lands in the Oregon Territory to settlers. This conflict ended, for the most part, with the Treaty of 1855. Under the Treaty, the Tribes ceded 6.4 million acres of their lands in northeast Oregon and southeast Washington to the United States and reserved rights for fishing, hunting, gathering foods and medicines, and pasturing livestock (CTUIR 2004). The Tribes also reserved 510,000 acres on which to live. The Treaty was subsequently ratified by Congress on March 8, 1859. The Umatilla Indian Reservation is located within the Umatilla/Willow subbasin, including the CTUIR government headquarters at Mission, Oregon. Today, there are over 2,400 tribal members, and the lands of the CTUIR encompass 172,000 acres (158,000 acres just east of Pendleton, Oregon plus 14,000 acres in the McKay, Johnson, and McCoy Creek areas southeast of Pilot Rock, Oregon) (CTUIR 2004). Approximately 75,500 acres of the reservation are privately owned.

The three largest cities in the Umatilla/Willow subbasin were all established before 1910. The city of Umatilla was incorporated in 1864, Pendleton was incorporated in 1880, and Hermiston was incorporated in 1907. In 2000, approximately half of Umatilla County's population lived in these three cities, with 16,354 people in Pendleton, 13,154 in Hermiston, and 4,978 in Umatilla. Boardman, the largest city in Morrow County, with 2,855 people in 2000, was incorporated in 1927. Population in the subbasin is expected to grow by about 10,000 people in the next 10 years (Umatilla River Subbasin Local Agricultural Water Quality Advisory Committee 1999). Urbanization has affected about 1% of the land in the Umatilla/Willow subbasin, and the impacts of urbanization, including effects on water flow and water quality, and the construction of dikes, levees, and rip-rapped banks, are described in 3.1.1.9.

Several efforts are underway in the Umatilla/Willow subbasin to reduce negative impacts of urbanization on stream water quality and water flow conditions. For example, Pendleton has a program on hazardous materials training for public works employees that will enhance and protect riparian areas and streams by preventing runoff from hazardous chemical spills that could convey pollutants into these systems (see Section 4.3.1 for more details). Pendleton is also working on a water supply development program that will not only improve and stabilize drinking water supplies for residents of the city and ensure that drinking water meets federal Safe Drinking Water Act standards, but will also improve the quantity and quality of in-stream flows of the Umatilla River, protect groundwater from over drafting, and lead to the development of a surface water supply for future economic development. The projects that make up this program include building a new, membrane filtration water treatment plant; building a new intake/pump station on the Umatilla River; transferring City water rights from current locations to the new intake/pump station location; and modifying city wells for storing and recovering the filtered water from the new water treatment plant in a process known as "aquifer storage and recovery." More details of this project are described in Section 4.3.1.

Transportation: The earliest routes of transportation in northeastern Oregon were formed by Native Americans of the Columbia Plateau, as they traded goods with tribes west of the Cascades and east of the Bitteroot Mountains. Later, early white settlers established major transportation routes in the Umatilla/Willow subbasin as they moved to the western United States in wagon trains. The most extensive and famous of these routes was the Oregon Trail, which extended through the Blue Mountains, down to the banks of the Umatilla River where Pendleton now stands, and through the lower basin of the Umatilla/Willow subbasin. The first wagon train rolled onto the Trail in 1841 and emigrants eventually wore the road into a great highway, in some places a hundred feet wide and ten feet deep. Ruts of the Oregon Trail are still visible today at some locations in the subbasin. Estimates from 1842 to 1849 indicate a total of 12,287 immigrants moved through CTUIR tribal homelands (CTUIR 2004). The movement of large numbers of settlers into the area had a devastating effect on Native Americans. Diseases introduced by settlers killed up to 50% of area Native Americans; resources, including fish and wildlife, were degraded and depleted; and, eventually, most tribal lands were lost (CTUIR 2004).

Further development of transportation corridors in the Umatilla/Willow subbasin continued with the coming of the railroad in 1881, which opened the area to the development of dryland wheat farming. Many past and current railroad routes follow the Umatilla River and its tributaries and Willow Creek. For example, the Union Pacific Railroad runs almost the entire length of Willow Creek from near the mouth to Heppner and nearly the entire length of the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79). Abandoned railroads of [0]Union Pacific and Northern Pacific, which ran out of Pendleton to Adams/Athena and Helix /East Juniper Canyon respectively until 1978, still exert a major influence on Wildhorse Creek and its tributaries (personal communication: J. Williams, USDA-ARS, January 2004), as described in Section 3.1.1.9.

Roads and highways have also continued to increase in the Umatilla/Willow subbasin. Although first used by horse drawn vehicles, roads became more common with the widespread use of the automobile, and with the development of urban areas, such as the cities of Pendleton, Umatilla, and Hermiston. In addition, the timbering industry resulted in a high density of roads in many of the forested areas in the subbasin (Umatilla National Forest 2001). Both paved and gravel roads are often constructed along waterways in the Umatilla and Willow Creek subbasin. For example, State Highway 74 runs along most of Willow Creek from near the mouth to Heppner and asphalt county roads run adjacent to the Umatilla River mainstem from near its mouth to Meacham Creek (RM 79).

Transportation corridors can significantly impact hydrology and ecology by increasing 1) the loss of riparian vegetation, 2) stream water temperatures, 3) surface water run-off into stream channels, and 4) flashiness in stream flow. These effects are described in more detail in Section 3.1.1.9.

Water Development: Water development for irrigation has had a large impact on both the hydrology and ecology of the Umatilla/Willow subbasin. Irrigated agriculture is served by six diversion dams found in the lower Umatilla River (from RM 4.1 to RM 32.4) and two reservoirs, Cold Springs and McKay Creek.

In Umatilla County, irrigation began in 1870 but only in limited areas near river and stream bottoms. Livestock, horses, cattle, and sheep, were the main agricultural practice at this time. In 1876 some area agriculturalists began growing grains. The first large irrigation canal, the Hinkle Ditch, was not constructed until 1903 in Umatilla County. During this time the United States Reclamation Service (now the Bureau of Reclamation, BOR) engineers began investigating the development of the "Umatilla Basin Project" and their early plans called for the irrigation of 60,000 acres of land and the construction of a reservoir (Stene 1993). In addition, two other private irrigation ventures took shape, the Furnish Ditch Company and the Western Land and Irrigation Company (BOR 2003). In 1905 the Secretary of the Interior authorized the Umatilla Basin Project and provided the United States Reclamation Service with one million dollars to begin construction on an irrigation system (Stene 1993). The first steps involved constructing the Feed Canal system and Cold Springs Dam, which would produce the reservoir filled by the Feed Canal. Construction on this system began in 1906 and finished in 1908. Cold Springs Dam is 100 feet high with a crest length of 3450 feet and the reservoir holds 50,000 acre-feet of water. Cold Springs reservoir was used as an irrigation supply in the summer by local farmers. However, it did not meet the demand for water and subsequently two other diversion systems were completed by the U.S. Reclamation Service, Three Mile Falls Diversion Dam and West Extension Canal system in 1914 and Maxwell Diversion Dam and canals in 1916. Irrigation was further augmented by the Reclamation Service with the construction of McKay Dam on McKay Creek. Construction on the dam began in 1923 and the project was finished in 1927. McKay Dam is 165 feet high with a crest length of 2700 feet and the reservoir holds 73,800 acre-feet of water.

The private irrigation ventures included the Furnish Ditch Company, which was started in 1903. By 1907 the company had built a diversion dam east of the town of Echo, and two years later finished a small offstream storage reservoir to provide additional summer water (BOR 2003). By 1925 the reservoir had filled with silt and was later destroyed in 1934 (Swanson 1950). The diversion however, remained and is currently operated by the Stanfield Irrigation District. The other private venture, Western Land Irrigation Company, was started in the 1890s. It is currently the Westland Irrigation District and operates the Westland Diversion Dam.

These irrigation diversion projects and McKay Reservoir have had important impacts on the hydrology of the Umatilla subbasin. During the summer months, discharge in the lower Umatilla River decreases with water withdrawals and shows slight increases with irrigation return water (Figure 28). Water is released from McKay Reservoir at RM 50.5 during peak irrigation periods. The impact of storage of water in McKay Reservoir and releases of water during the summer months is to lower mean monthly instream flows during the winter when water is stored and increase flows during the summer when stored water is used for irrigation (Figure 29).

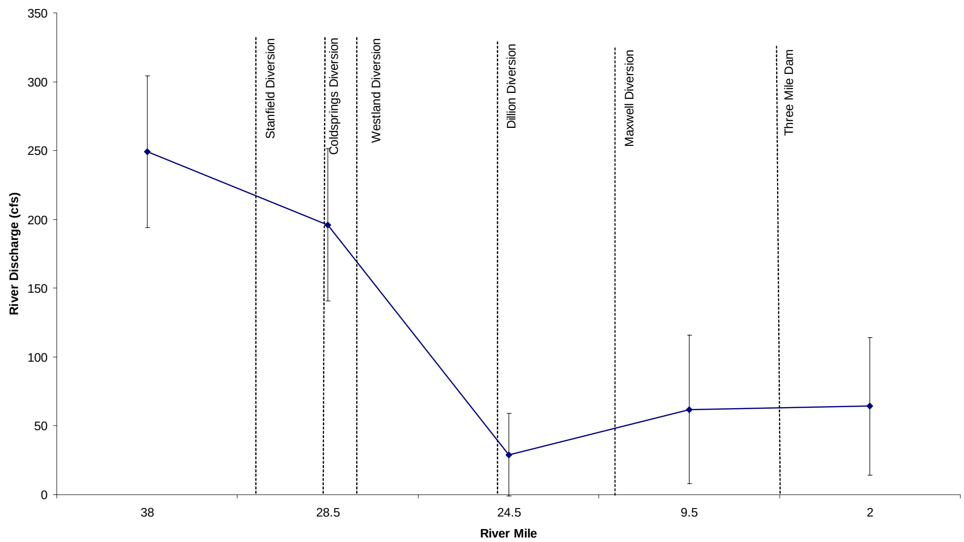


Figure 28. Discharge at 5 USGS gauging stations. Data are summer averages for the months of July, August, and September for the years 1994-2000 (USGS 2004).

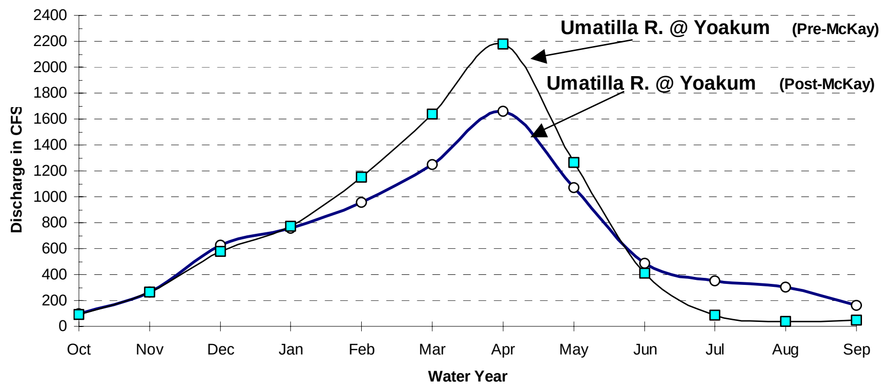


Figure 29. The impact of McKay Reservoir releases on the Umatilla River at Yoakum (RM 37.7).

The hydrology of Willow Creek is also greatly influenced by irrigated agriculture as well as the construction of the Willow Creek Dam. Irrigated agriculture began in the late part of the 19th century; the earliest water rights date back to 1870 (personal communication: M. Ladd, OWRD, April 2004). Currently, total annual flows are reduced by approximately 23% (from 30,000 acre feet to 23,000 acre feet) due to extensive irrigation withdrawals (Willow Creek Local Advisory Committee et al. 2003). Willow Creek Dam was constructed on Willow Creek upstream of Heppner (at RM 55.5) in 1983. It is 160 feet high and has a maximum storage capacity of 14,000 acre feet (Willow Creek Local Advisory Committee et al. 2003). The Willow Creek Dam was constructed mainly as a flood control structure, and not for irrigation. However, a permit issued by OWRD does allow the storage of 3,500 acre-feet for irrigation purposes (personal communication: M. Ladd, OWRD, April 2004). As such its influence on downstream hydrology is different than diversions built for irrigation purposes. During late winter and spring, when reservoir waters rise above the maximum pool elevation, water is released at a maximum rate of 500 cfs. During the dry season, discharge is generally less than 10 cfs. In the summer the reservoir is maintained above the flood control level to accommodate recreational activities. However, in mid-October the reservoir is reduced to the winter flood control level and maintained at that level during the winter by releasing larger amounts of water as needed (Willow Creek Local Advisory Committee et al. 2003). Therefore, the hydrology in the lower sections of Willow Creek below the dam is characterized by no natural floods, a regular fall peak in flow during reservoir draw-down, and constant high winter and spring flows.

In the Umatilla River, the dewatering of reaches and the creation of passage barriers that were necessary for irrigation activities resulted in the extirpation of Chinook and coho salmon stocks and the endangerment of the steelhead stock in the 1920s (Phillips et al. 2000). In response to the need for continued irrigation and the desire to restore steelhead and salmon populations a unique coalition formed in the 1980s between the CTUIR and local irrigators. With the help of the BOR, Bonneville Power Administration (BPA), Oregon Water Resources Department (OWRD), and ODFW, this coalition has made substantial progress in recovering salmon populations in the subbasin without harming irrigated agriculture. The coalition led to the development of the Umatilla Basin Project Act (102 Stat. 2791, Public Law 100-557), which was passed by Congress on October 28, 1988.

The Act allows irrigators to exchange Umatilla River water for Columbia River water. This allows water historically appropriated for irrigation to remain in the Umatilla River during times when flows are critical for steelhead and salmon. Water exchanges are made possible by the construction of exchange facilities, which include pumping plants that take water out of the Columbia River and a series of pipelines that deliver that water to the irrigation districts. Two phases of the Act have been completed and a third phase has been proposed. Phase I involves exchange of water with the West Extension Irrigation District, which withdraws water at Three Mile Falls Dam. The purpose of this exchange is to provide target instream flows in the lower 3 miles of the Umatilla River. Construction of the Phase I exchange facilities began in 1991 and the first exchange occurred in 1993. The primary operational months for this exchange are critical months for salmon and steelhead adult returns and juvenile outmigration: May, June, September, and October. An average annual exchange of 9700 acre-feet is made under this Phase.

Phase II involves exchanges of water with the Hermiston and Stanfield Irrigation Districts. Historically, Hermiston Irrigation District diverted water from the Umatilla River off season (November-May) to fill Cold Springs Reservoir. The purpose of the exchange with the Hermiston District is to provide additional instream flow during critical months of adult returns and juvenile outmigration below the Feed Canal Diversion (RM 28). This exchange began in 1995 and involves on average an annual exchange of 11,200 acre-feet of water. Stanfield Irrigation District historically diverted both live flow and McKay irrigation releases at the Stanfield diversion (RM 32). The purpose of this exchange is to provide additional instream flow during the irrigation season and to cool water temperatures through cold water releases from McKay Reservoir. A partial exchange with Stanfield Irrigation District began in 1996 and full exchange started in 1999. Annually, an average of 18,600 acre-feet of water is exchanged with Stanfield Irrigation District under full operation[1].

While these phases have helped the recovery of the steelhead population and assisted the reintroduction of Chinook and coho populations in the Umatilla River, irrigation still removes approximately half of the instream flows during the summer months (June – September) (ODEQ et al. 2001). The proposed Phase III of the Umatilla Basin Project would involve a complete exchange of water in the Umatilla River used by Westland Irrigation District with Columbia River water and would allow nearly all of the Umatilla River surface water to remain instream.

As stated above, water development for irrigation was one of the main influences on the extirpation of Chinook and coho salmon and the endangerment of steelhead. Further water development has had more positive impacts on these fish. Habitat surveys have shown that that hypolimnetic releases of cool water from McKay Reservoir during early summer months keep water temperatures suitable for salmonids in areas between the McKay Creek confluence (RM 50.5) and Westland dam (RM 27) (Contor et al. 1997). This discharge, however, is not continuous during the summer, and water temperatures can become extreme when releases are stopped. In addition, warmer epilimnetic waters can be discharged upon the depletion of the hypolimnion, further contributing to unsuitable habitat conditions (Contor et al. 1997).

In addition, the early construction of diversion dams led to problems with passage, entrainment, and injuries to fish at points of diversion. In an effort to address this problem, outdated juvenile and adult fish passage facilities were reconstructed between 1988 and 1994 at five major irrigation dams on the lower Umatilla River. Reconstructions followed design standards set by the National Marine Fisheries Service (NMFS). ODFW conducted studies to evaluate screen efficiency and migration survival of juvenile salmonids between 1988 and 1994 (Knapp and Ward 1990, Hayes et al. 1992, Cameron and Knapp 1993, Cameron et al. 1994, 1995, 1997). From 1991 – 1995, most test fish passed through the updated bypass facilities and fish ladders with negligible injury (Knapp et al. 2000).

In addition, water development might also have had an important impact on non-salmonid fish species in the subbasin. Summer fish communities in the lower Umatilla mainstem include exotics whose abundance in the river may be aided by low discharge and high temperatures. These species include smallmouth bass, largemouth bass, carp, bluegill, yellow crappie, black crappie, channel catfish, and mosquitofish. It is unclear what impact these exotic fish have on the ecology of the river system including the abundance of native species.

Finally, while little work exists on the impacts of water development on wildlife, waterfowl numbers have increased recently in the subbasin. While this has been

[1] Information in this and the preceding paragraph is from BOR 1998.

attributed to the construction of the John Day and McNary dams and their reservoirs (Lloyd et al. 1983), the Cold Springs and McKay Reservoirs most likely contribute to the increase in these species within the Umatilla/Willow subbasin as well.

3.1.4 Regional Context

3.1.4.1 Relation to the Columbia Basin

The Umatilla/Willow subbasin is located near the center of the Columbia basin, in northeastern Oregon (Figure 30). It is of intermediate size compared to the other 61 subbasins delineated by the NWPCC, and has a total area of 3,714 square miles, which accounts for approximately 1.7% of the total area of the Columbia basin in the United States. The Umatilla River flows into the Columbia River at RM 289 and Willow Creek enters at RM 253. Three major Columbia River dams (the John Day, The Dalles, and Bonneville dams) are downstream of these confluences.

3.1.4.2 Relation to the Ecological Province

The NWPCC has divided the subbasins of the Columbia Basin into 11 ecological provinces based on similarities in climate and geology (NWPCC 2000). The Umatilla/Willow subbasin is one of ten subbasins grouped in the Columbian Plateau ecological province (Figures 30 and 31). The Columbia Plateau province is the largest of the 11 ecological provinces and is defined as the Columbia River and associated watersheds between The Dalles and Wanapum dams on the Columbia River and Ice Harbor Dam on the Snake River. Within the Columbia Plateau province, the Umatilla/Willow subbasin is bordered to the north by the Walla Walla subbasin, to the south by the John Day subbasin, and to the west by Columbia Lower Middle subbasin (Figure 31). The Grande Ronde, a subbasin in the Blue Mountain province, lies to the east of the Umatilla/Willow subbasin.

3.1.4.3 Relation to Other Subbasins in the Province

Because subbasins in the Columbia Plateau province are grouped together based on similarities in climate and geology (see Sections 3.1.1.3 and 3.1.1.4 for description), almost all of the subbasins in the province (with the exception of the John Day) were historically dominated by interior grasslands and/or shrub-steppe habitats (IBIS 2004). Currently, the Umatilla/Willow subbasin is dominated by agricultural lands, as are all other subbasins in the province with the exception of the Deschutes, John Day, and Yakima subbasins (IBIS 2004). Thus, like most other subbasins in the province, agriculture plays a key role in the economy and culture of the Umatilla/Willow subbasin, and, as is typical of many agricultural areas, human population densities are generally low. The majority of land in the Umatilla/Willow subbasin (>85%) is privately owned (Table 2), as is the case with other subbasins in the province (e.g., the Walla Walla, John Day, and Deschutes subbasins). The importance of agriculture and the arid nature of the area also results in a problem common in most other subbasins in the province: water is over-appropriated and is required for multiple, sometimes competing purposes. Like most other subbasins in the province wildland recreation, including fishing, hunting, boating, and hiking, is also an important component of the economy and culture of the Umatilla/Willow subbasin.

The fish and wildlife of the Umatilla/Willow subbasin are also related to other subbasins in the province. For example, bull trout of the Walla Walla, John Day, and Umatilla/Willow subbasins belong to the same gene conservation group. In addition, the Umatilla/Willow, John Day, Yakima, and Walla Walla subbasins share the same Middle Columbia River Steelhead evolutionarily significant unit (ESU). Many of the terrestrial wildlife species found in the Umatilla/Willow subbasin are also found in other subbasins in the province (IBIS 2004), with mobile species often moving between subbasins in the province. Like some of the other subbasins in the province, the Umatilla/Willow subbasin also has significant remnants of high quality shrub-steppe wildlife habitat. Fish and wildlife in the Umatilla/Willow subbasin face many of the same problems that threaten species in other subbasins of the province, both from within and outside of the subbasin (see Sections 3.1.1.9, 3.3, and 3.5).

3.1.4.4 Unique Qualities of the Subbasin

Although the Umatilla/Willow subbasin is similar in many ways with the other subbasins in the province, it is also unique in other ways. Perhaps most notable is the way in which stakeholders in the Umatilla/Willow subbasin with different interests have worked together to improve fish habitat in the Umatilla River through the Umatilla Basin Project. The project itself is unique, in that it allows managers to artificially regulate hydrographs with stored and exchanged water to mitigate water quality and quantity issues limiting fish habitat (see Section 3.1.3.2 for thorough description). Historically, the subbasin’s political, economic and ecological challenges often arose in the classic “fish versus agriculture” paradigm. This situation was exacerbated by the federal government, which “twice promised” waters of the river: first to local Native American Tribes by treaty and later to pioneer farmers by contract. However, substantial progress was made in efforts to recover salmon populations and improve salmon habitat on the Umatilla River because of an informal alliance between CTUIR and growers in the Umatilla River irrigation districts in the 1980s. Through this alliance, and with the help of the BOR, BPA, OWRD, and ODFW, the first two phases of the Umatilla Basin Project were implemented, a process that brought water from the Columbia River to be used for irrigation, and thus allowed an equal amount of Umatilla River water to remain in-stream to aid fish migration. Although a third phase has yet to be completed, the alliance continues and has the long-term goals of 1) restoring native salmonid populations, 2) creating a river habitat that allows for sustainable natural reproduction with adequate adult returns to serve tribal needs and provide a sport fishery, and 3) provide water needed for agriculture.

The Umatilla/Willow subbasin is also unique in other ways related to water resources and the presence of salmonid species. Extirpated Chinook and coho salmon have been reintroduced to the subbasin, and their production, as well as steelhead production, has been increased through hatchery supplementation. Natural production of steelhead is increasing as well; returns of Middle Columbia River ESU natural summer steelhead adults are increasing more rapidly in the Umatilla River than in the Walla Walla or John Day subbasins (Contor 2003). The Umatilla/Willow subbasin also provides important habitat for many salmonids. Although the subbasin contains only about 1.5% of all the river miles in the U.S. portion of the Columbia basin and 6% of all the river miles in the Columbia Plateau province (Streamnet 2004), it provides a disproportionate amount of salmonid habitat (Table 13).

The terrestrial environment in the Umatilla/Willow subbasin is also unique in that it contains some of the largest remaining tracts of shrub-steppe habitat in the Columbia Plateau in Oregon (see Section 3.2.4.2).

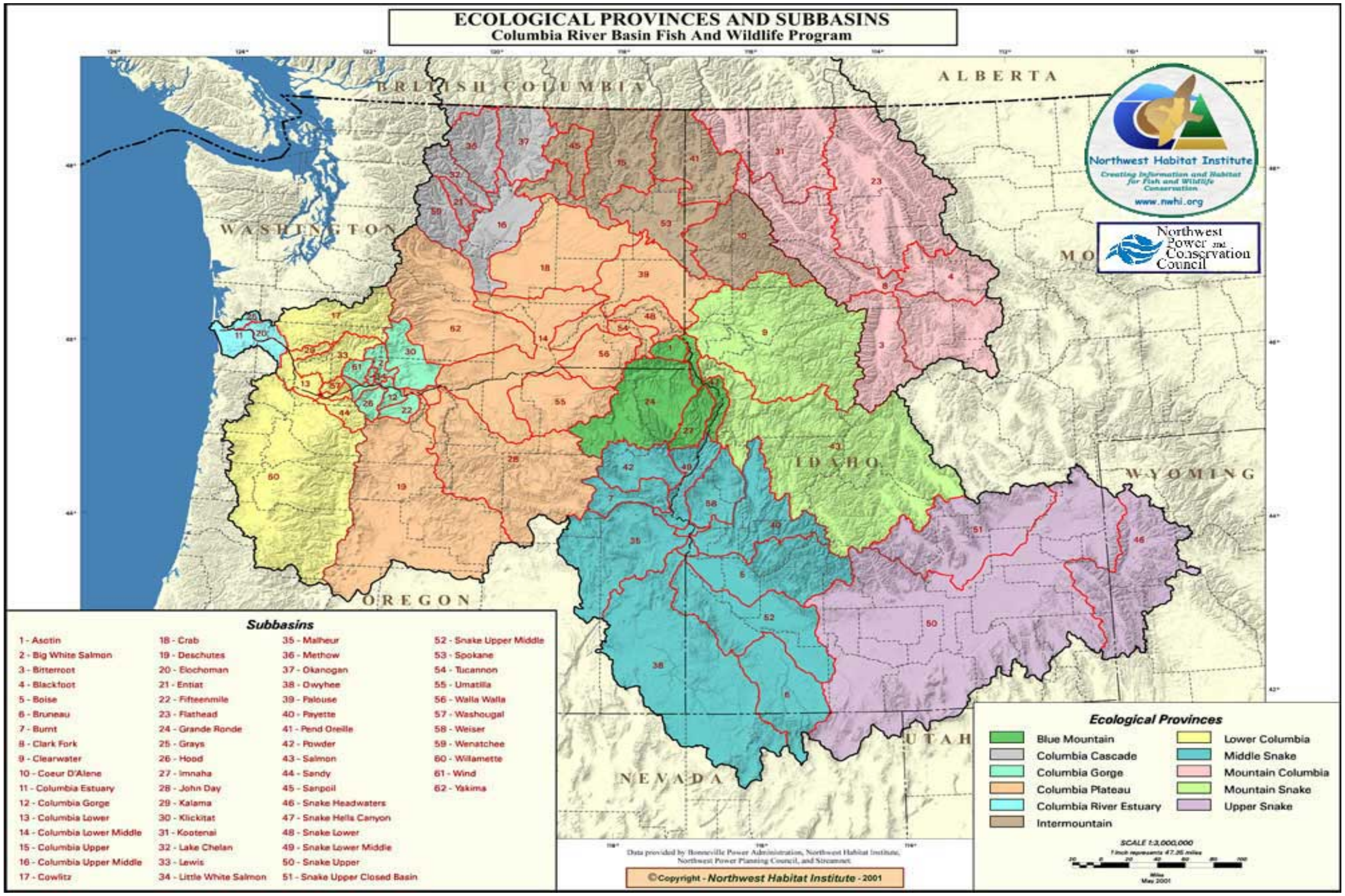


Figure 30. The 62 subbasins and 11 provinces of the Columbia basin as delineated by NWPCC (NWHI 2003).

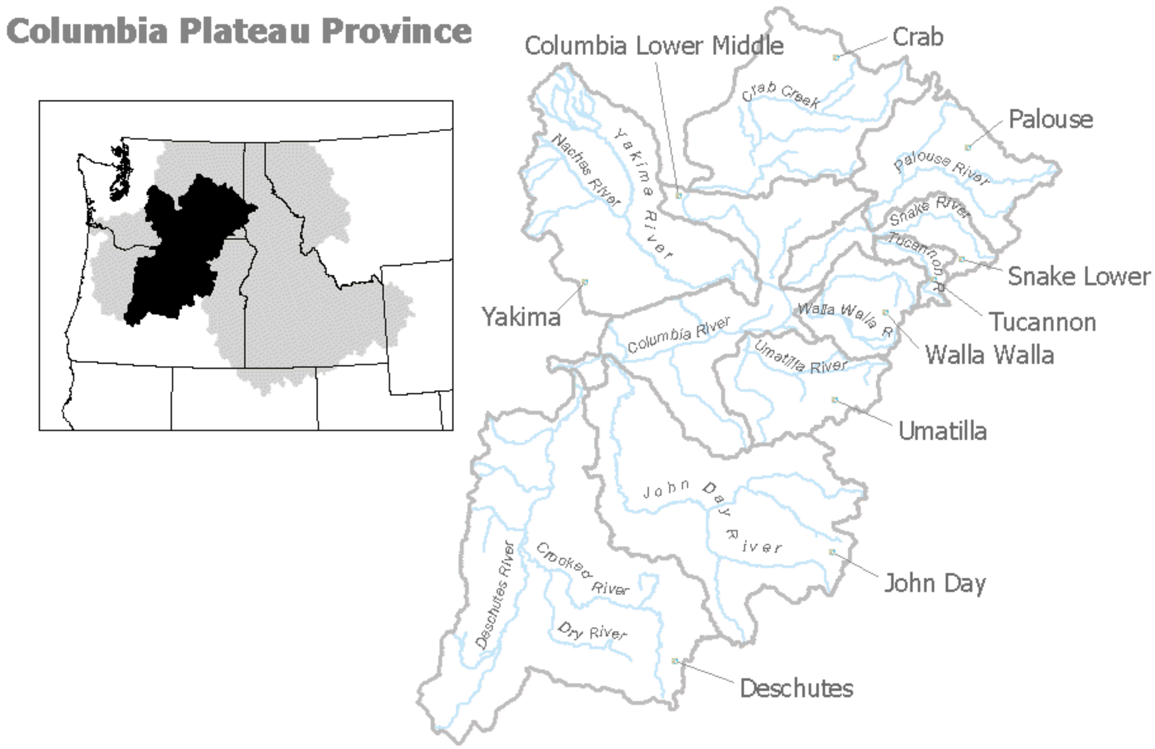


Figure 31. The ten subbasins forming the Columbia Plateau Province.

3.1.4.5 NOAA Fisheries Evolutionarily Significant Units[1]

More than 50 different ESUs of West Coast salmon and steelhead have been identified in Washington, Oregon, California and Idaho. An ESU is a geographic delineation of fish used to distinguish individual populations of salmon or steelhead that share common genetic, ecological and life history traits. Within an ESU there may be multiple populations of demographically independent groups of fish that spawn during specific seasons and within specific waterbodies, but do not interbreed with fish from another group.

The interior Columbia River basin is currently home to 12 different anadromous salmonid ESUs, belonging to three different species: Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), and steelhead trout (*O. mykiss*). Since 1991, seven of these 12 ESUs have been listed as threatened under the Endangered Species Act (ESA) because of dramatic declines in abundance and loss of habitat.

The Umatilla/Willow subbasin is located within the Middle Columbia River (MCR) Steelhead ESU. Other subbasins within the Middle Columbia River Steelhead ESU are the John Day, Upper Yakima, Lower Yakima, Naches, Klickitat, Lower Deschutes, Trout, Willow, and the Walla Walla subbasins. The MCR Steelhead ESU is the only

[1] Large portions of the text in this section were written by N. Berwick of NOAA Fisheries and are used with permission to D. Wooster and J. Phelps from the author.

NOAA Fisheries ESU in the subbasin. The Middle Columbia River steelhead was listed as threatened on March 25, 1999 (64 FR 14517), critical habitat was designated on February 16, 2000 (65 FR 7764), and protective regulations were adopted on July 10, 2000 (65 FR 42422). The Middle Columbia River ESU includes all naturally spawned populations of steelhead in streams from above Wind River, Washington, and Hood River, Oregon, upstream to, and including, Yakima River, Washington.

3.1.4.6 USFWS Designated Bull Trout Recovery Units

The Umatilla-Walla Walla Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River Basin (USFWS 2004). The two subbasins were combined into one recovery unit based on the conclusion that their bull trout are genetically similar, or fall within the same gene conservation group, as defined by ODFW (Kostow 1995; Spruell and Allendorf 1997). Although John Day River bull trout also fall within the same gene conservation group, they have been separated into their own recovery unit for logistical and administrative reasons (USFWS 2004). In the Umatilla-Walla Walla Recovery Unit, two local populations have been identified in the Umatilla Subbasin – the Upper Umatilla population and the Meacham Creek population. The Upper Umatilla population includes bull trout in both the North Fork and South Fork Umatilla Rivers. The viability of the Meacham Creek population is undetermined because of the low number of redds and fish observed in recent years.

3.1.4.7 Summary of Out-of-Subbasin Environmental Conditions on Fish and Wildlife

Environmental conditions external to the Umatilla/Willow subbasin impact both fish and wildlife species in the subbasin. Anadromous fish leaving the subbasin as juveniles and returning as adults are affected by multiple aspects of the aquatic environments they encounter in that journey, including three major dams on the Columbia River, and variable estuary and ocean conditions. Passage barriers, poor water quality, flow issues, and predation are some of the obstacles facing these fish outside the subbasin. In addition, salmon and steelhead abundances are influenced strongly by ocean conditions including the PDO. Likewise, highly mobile terrestrial wildlife species are also affected by out-of-subbasin conditions. These may range from problems such as loss of habitat connectivity in adjacent subbasins to deforestation of wintering habitat in South America. A detailed and quantitative discussion of out-of-subbasin effects on aquatic focal species and terrestrial focal species and their habitats can be found in Section 3.3.

Table 13. Comparison of amount of habitat used by selected fish species in the U.S. portion of the Columbia basin, in the Columbia Plateau province, and in the Umatilla/Willow subbasin (Streamnet 2004). Highlighted percents in the last two columns of the table show instances in which the percent of habitat used by fish is twice or greater than predicted based on river miles alone (see text for further explanation).

Fish Species Use Type	**Habitat in US portion of Columbia Basin** (in stream miles)	**Habitat in Columbia Plateau Province** (in stream miles)	**Habitat in Umatilla/Willow Subbasin** (in stream miles)	**Percent of Columbia Basin Habitat Found in Umatilla/Willow Subbasin**	**Percent of Columbian Plateau Province Habitat Found in Umatilla/Willow Subbasin**
Spring Chinook					
Primarily spawning and rearing	4,191.9	543.1	44.1	1%	8%
Primarily rearing and migration	2,728.6	843.9	93.4	3%	11%
Primarily migration	1,897.0	573.9	0	0%	0%
Total use*	8,839.5	1,976.8	137.5	2%	7%
Fall Chinook					
Primarily spawning and rearing	1,269.7	415.2	87.0	7%	21%
Primarily rearing and migration	284.2	27.1	0.3	<1%	<1%
Primarily migration	1,090.0	428.7	0	0%	0%
Total use*	2,643.9	871.1	87.3	3%	10%
Coho					
Primarily spawning and rearing	1,527.3	146.1	103.5	7%	71%
Primarily rearing and migration	770.2	39.7	37.5	5%	94%
Primarily migration	1,376.3	345.3	0	0%	0%
Total use*	3,675.5	531.0	141.0	4%	27%
Steelhead					
Primarily spawning and rearing	12,060.1	4,018.5	241.6	2%	6%
Primarily rearing and migration	1,455.2	494.5	169.2	12%	34%
Primarily migration	2,954.6	1,250.9	0	0%	0%
Total use*	16,599.4	5,888.6	413.5	2%	7%
Bull Trout					
Primarily spawning and rearing	1,618.4	428.1	11.1	<1%	3%
Primarily rearing and migration	736.3	313.2	64.5	9%	21%
Primarily migration	1,326.4	122.2	22.0	2%	18%
Total use*	6,633.6	882.4	97.6	1%	11%

* may include stream miles that are used by fish, but the nature of the use is unknown; thus, “total use” may not reflect the sum of the primary uses listed

3.2 Focal Species Characterization and Status

3.2.1 Fish, Wildlife, Plants, and Invertebrates of Ecological Importance

3.2.1.1 Species Designated as Threatened, Endangered, or Sensitive

Two fish species and five terrestrial wildlife species found in the Umatilla/Willow subbasin are currently listed as threatened or endangered by Oregon and/or the federal government (Table 14). No threatened or endangered plant or invertebrate species are known to occur in the Umatilla/Willow subbasin. Three wildlife species in the subbasin are federal candidate species, meaning that there is sufficient information on the biological vulnerability of and threats to these species to support proposals to list them as endangered or threatened (Table 15). In addition, three plant species in the subbasin are listed by the Oregon Department of Agriculture as candidate species for threatened and endangered status under the Oregon Endangered Species Act (Table 16).

Table 14. Fish and wildlife species of the Umatilla/Willow subbasin listed as threatened or endangered at the state or federal level (ODFW 2003a, USFWS 2003).

Common Name	Scientific Name	Status
Fish:		
bull trout [1]	*Salvelins confluentus*	US: Threatened
summer steelhead [2]	*Oncorhyncus mykiss*	US: Threatened
Wildlife:		
Bald Eagle	*Haliaeetus leucocephalus*	OR and US: Threatened
Canada lynx	*Lynx canadensis*	US: Threatened
Peregrine Falcon	*Falco peregrinus*	OR: Endangered
Washington ground squirrel	*Spermophilus washingtoni*	OR: Endangered
wolverine	*Gulo gulo*	OR: Threatened

[1] listing unit is the Columbia River Distinct Population Segment
[2] listing unit is the Middle Columbia River ESU

Table 15. Wildlife species of the Umatilla/Willow subbasin that are candidates for federal listing (USFWS 2003).

Common Name	Scientific Name
Columbia spotted frog	*Rana luteiventris*
Washington ground squirrel	*Spermophilus washingtoni*
Yellow-billed Cuckoo	*Coccyzus americanus*

Table 16. Plant species of the Umatilla Willow subbasin that are candidates for state listing (ONHP 2001).

Common Name	Scientific Name
Columbia yellow-cress	*Rorippa columbiae*
dwarf evening-primrose	*Camissonia pygmaea*
hepatic monkeyflower	*Mimulus jungermannioides*

The USFWS also classifies “species of concern.” These are species that might be in need of conservation actions, however, they receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species. Three fish species, 22 wildlife species, and five plant species occurring in the subbasin fall into the USFWS “species of concern” category (Table 17). The USFS has a similar category of “sensitive species”, which are any species for which the Regional Forester has determined that there is a concern for population viability within the state, as evidenced by a significant current or predicted downward trend in populations or habitat. Two fish species and 10 wildlife species in the Umatilla/Willow subbasin are listed as sensitive species by the USFS (Table 18). USFS has also established a list of 30 sensitive plant species found in the Umatilla National Forest; this list was developed by the USFS jointly with other land management agencies and the Heritage Programs of Washington and Oregon, and is based primarily on the rarity of the plant and perceived threats to its well being (Table 19).

Table 17. Fish, wildlife, and plant species of the Umatilla/Willow subbasin that are classified as species of concern by the federal government (USFWS 2002).

Common Name	Scientific Name
Fish:	
margined sculpin	*Cottus marginatus*
Pacific lamprey	*Lampetra tridentate*
redband trout	*Oncorhyncus mykiss*
Birds:	
Black Tern	*Chlidonias niger*
Ferruginous Hawk	*Buteo regalis*
Harlequin Duck	*Histrionicus histrionicus*
Lewis' Woodpecker	*Melanerpes lewis*
Long-billed Curlew	*Numenius americanus*
Mountain Quail	*Oreortyx pictus*
Northern Goshawk	*Accipter gentiles*
Olive-sided Flycatcher	*Contopus borealis*
Tricolored Blackbird	*Agelaius tricolor*
White-headed Woodpecker	*Picoides albolarvatus*
Willow Flycatcher	*Empidonax traillii adastus*
Yellow-breasted Chat	*Icteria virens*
Mammals:	
fringed myotis	*Myotis thysanodes*
long-eared myotis	*Myotis evotis*
long-legged myotis	*Myotis volans*
Preble's shrew	*Sorex preblei*
silver-haired bat	*Lasionycteris noctivagans*
western small-footed myotis	*Myotis ciliolabrum*
wolverine	*Gulo gulo*
Yuma myotis	*Myotis yumanensis*
Amphibians:	
tailed frog	*Ascaphus truei*
Reptiles:	
northern sagebrush lizard	*Sceloporus graciosus graciosus*
Plants:	
Columbia yellow-cress	*Rorippa columbiae*
Douglas clover	*Trifolium douglasii*
hepatic monkeyflower	*Mimulus jungermannioides*
Laurence's milk-vetch	*Astragalus collinuse* var. *laurentii*
long-haired star-tulip	*Calochortus longebarbatus* var. *longebarbatu*s

Table 18. Fish and wildlife species of the Umatilla/Willow subbasin that are listed as sensitive species by the USFS (USFS 2000).

Common Name	Scientific Name
Fish:	
margined sculpin	*Cottus marginatus*
redband trout	*Oncorhyncus mykiss*
Birds:	
American Peregrine Falcon	*Falco peregrinus anatum*
Gray Flycatcher	*Empidonax wrightii*
Harlequin Duck	*Histrionicus histrionicus*
Red-necked Grebe	*Podiceps grisegena*
Tricolored Blackbird	*Agelaius tricolor*
Mammals:	
Townsend's big-eared bat	*Corynorhinus townsendii*
wolverine	*Gulo gulo*
Amphibians:	
Columbia spotted frog	*Rana luteiventris*
northern leopard frog	*Rana pipiens*
Reptiles:	
painted turtle	*Chrysemys picta*

Table 19. Sensitive plant species on the Umatilla National Forest as of July 2002 (Umatilla National Forest 2002).

Common Name	Scientific Name
arrow-leaved thelypody	*Thelypodium eucosmum*
Arthur's milkvetch	*Astragalus arthuri*
Back's sedge	*Carex backii*
Blue Mountain onion	*Allium diction*
branching montia	*Montia diffusa*
clustered lady slipper	*Cypripedium fasciculatum*
crenulate moonwort	*Botrychium crenulatum*
Cusick's milkvetch	*Astragalus cusickii cusickii*
Douglas clover	*Trifolium douglasii*
Farr willow	*Salix farriae*
granite phlox/prickly phlox	*Leptodactylon pungens*
inland sedge	*Carex interior*
lance-leaf grapfern	*Botrychium lanceolatum*
longbearded sego lily	*Calochortus longebarbatus longebarbatus*
Mingan grapefern	*Botrychium minganense*
moonwort grapefern	*Botrychium lunaria*
mountain buttercup	*Ranunculus populago*
mountain grapefern	*Botrychium montanum*
Nez Perce mariposa lily	*Calochortus macrocarpus maculosus*
Oregon bolandra	*Bolandra oregano*
pinnate grapefern	*Botrychium pinnatum*
porcupine sedge	*Carex hystericina*
pussy clover	*Trifolium plumosum plumosum*
Sabin's lupine	*Lupinus sabinianus*
Sierra onion	*Allium campanulatum*
Snake River daisy	*Erigeron disparipilus*
Spalding's silene	*Silene spaldingii*
stalked moonwort	*Botrychium pedunculosum*
two-spiked moonwort	*Botrychium paradoxum*
windowleaf moonwort	*Botrychium fenestratum*

At the state level, Oregon has a multi-tiered classification of sensitive species for fish and wildlife. Oregon classifies "critical sensitive species" as those species whose listing as threatened or endangered status is pending, or for which immediate conservation actions are needed to prevent their listing. In addition to the critical category, Oregon also recognizes sensitive wildlife species that are vulnerable, peripheral or naturally rare, or have an undetermined status. Vulnerable sensitive species are those whose listing as threatened or endangered is not imminent and may be avoided by continued or expanded use of adequate protective measures and monitoring. Peripheral or naturally rare species are sensitive because they are species whose Oregon populations are at the edge of their range, or because they have had historically low population numbers in Oregon because of naturally limiting factors. Species with an undetermined status may also be susceptible to population decline, but need more study to determine their status. The Umatilla/Willow subbasin has three fish species and 43 wildlife species found on Oregon's sensitive species list; this list includes 15 wildlife species that are considered "critical sensitive species" (Table 20).

Table 20. Oregon sensitive fish and wildlife species of the Umatilla/Willow subbasin that fall into one of four categories: critical, vulnerable, peripheral or naturally rare, or of undetermined status (ODFW 1997). See text for an explanation of each category.

Common Name	**Scientific Name**	**Oregon Sensitive Status**
Fish:		
margined sculpin	*Cottus marginatus*	Vulnerable
Pacific lamprey	*Lampetra tridentate*	Vulnerable
redband trout	*Oncorhyncus mykiss*	Vulnerable
Amphibians:		
northern leopard frog	*Rana pipiens*	Critical
tailed frog	*Ascaphus truei*	Vulnerable
western toad	*Bufo boreas*	Vulnerable
Columbia spotted frog	*Rana luteiventris*	Undetermined Status
Woodhouse toad	*Bufo woodhousii*	Peripheral or Naturally Rare
Birds:		
Black-backed Woodpecker	*Picoides arcticus*	Critical
Burrowing Owl	*Athene cunicularia*	Critical
Ferruginous Hawk	*Buteo regalis*	Critical
Flammulated Owl	*Otus flammeolus*	Critical
Lewis' Woodpecker	*Melanerpes lewis*	Critical
Northern Goshawk	*Accipiter gentiles*	Critical
Northern Pygmy-owl	*Glaucidium gnoma*	Critical
Sage Sparrow	*Amphispiza belli*	Critical
Three-toed Woodpecker	*Picoides tridactylus*	Critical
White-headed Woodpecker	*Picoides albolarvatus*	Critical
Yellow-billed Cuckoo	*Coccyzus americanus*	Critical
Yellow-breasted Chat	*Icteria virens*	Critical
Grasshopper Sparrow	*Ammodramus savannarum*	Vulnerable
Great Gray Owl	*Strix nebulosa*	Vulnerable
Loggerhead Shrike	*Lanius ludovicianus*	Vulnerable
Long-billed Curlew	*Numenius americanus*	Vulnerable
Olive-sided Flycatcher	*Contopus cooperi*	Vulnerable
Pileated Woodpecker	*Dryocopus pileatus*	Vulnerable
Sandhill Crane	*Grus canadensis*	Vulnerable
Swainson's Hawk	*Buteo swainsoni*	Vulnerable
Bank Swallow	*Riparia riparia*	Undetermined Status
Mountain Quail	*Oreortyx pictus*	Undetermined Status
Williamson's Sapsucker	*Sphyrapicus thyroideus*	Undetermined Status
Willow Flycatcher	*Empidonax traillii*	Undetermined Status
Black-throated Sparrow	*Amphispiza bilineata*	Peripheral or Naturally Rare
Tricolored Blackbird	*Agelaius tricolor*	Peripheral or Naturally Rare
Mammals:		
Townsend's big-eared bat	*Corynorhinus townsendii*	Critical
American marten	*Martes americana*	Vulnerable
fringed myotis	*Myotis thysanodes*	Vulnerable
pallid bat	*Antrozous pallidus*	Vulnerable
long-eared myotis	*Myotis evotis*	Undetermined Status
long-legged myotis	*Myotis volans*	Undetermined Status
silver-haired bat	*Lasionycteris noctivagans*	Undetermined Status
western small-footed myotis	*Myotis ciliolabrum*	Undetermined Status
white-tailed jackrabbit	*Lepus townsendii*	Undetermined Status

Table 20 (continued). Sensitive wildlife species of the Umatilla/Willow subbasin that fall into one of four categories: critical, vulnerable, peripheral or naturally rare, or of undetermined status (ODFW 1997). See text for an explanation of each category.

Common Name	Scientific Name	Oregon Sensitive Status
Reptiles:		
painted turtle	*Chrysemys picta*	Critical
sagebrush lizard	*Sceloporus graciosus*	Vulnerable
longnose leopard lizard	*Gambelia wislizenii*	Undetermined Status

3.2.1.2 Species Recognized as Rare or Significant to the Local Area

Fish:

The only fish species in the Umatilla/Willow subbasin that is notably rare due to its limited distribution is the margined sculpin. This species' distribution is limited to the northern portion of the Blue Mountains, specifically within the Tuccannon, Walla Walla and Umatilla subbasins. As shown in Table 20, the ODFW has listed the margined sculpin as a state sensitive species due to its limited distribution and human impacts on its habitat.

Several species of Pacific salmon are significant to the local area from the perspective of their use by humans. The Pacific salmon species present in the subbasin, Chinook salmon, coho salmon, and steelhead trout, provide opportunities for recreational and consumptive harvest that is important to the local area from both a cultural/social and an economic standpoint. Both coho and Chinook salmon runs were driven to extinction in the Umatilla/Willow subbasin by impacts from agricultural activities, and reintroduction of both species is underway in the subbasin. Runs of both are now adequate to support annual consumptive sport fisheries.

Wildlife:

As discussed in the previous section (Section 3.2.1.1), many wildlife species found in the Umatilla/Willow subbasin are rare, primarily because of negative impacts associated with human activities. However, in addition to these species, there are several other components of the terrestrial wildlife diversity in the Umatilla/Willow subbasin that are locally significant, including the presence of an unusually large maternity colony of Townsend's big-eared bats, significant strongholds of shrub-steppe-associated species, and a relatively large representation of landbirds.

The Umatilla/Willow subbasin is home to a regionally significant maternity colony of Townsend's big-eared bats (personal communication: C. Scheeler, CTUIR, February 2004), which is both a USFS sensitive species (Table 18) and a state critical sensitive species (Table 20). This is the only known maternity colony of Townsend's big-eared bats in the subbasin and may be one of the largest in the state (personal communication: K. Kroner, April 2004). Because this colony is found in a structure located on private property, its continued protection presents a greater challenge than if it was found on public property.

Other wildlife species that are significant to the local area are wildlife species strongly associated with shrub-steppe habitats. Compared with many other subbasins in the

Columbia Basin, the Umatilla/Willow subbasin has a high proportion of shrub-steppe habitat. As such, it serves as a stronghold for many species associated with high quality shrub-steppe habitat, such as Loggerhead Shrikes, Sage Sparrows, Sage Thrashers, Ferruginous Hawks, Black-Throated Sparrows, sagebrush lizards, black-tailed jackrabbits, and Washington ground squirrels.

Landbirds are also significant in the local area because they account for a majority of the vertebrate diversity in the Umatilla/Willow subbasin. Over 200 species of landbirds occur in the subbasin, making up more than 50% of the terrestrial vertebrate species (Appendix A). The distribution and abundance of many of these birds has been affected by habitat conversion, fire suppression, timber management, and resulting changes in the structure and distribution of plant communities (Marcot et al. 1997). Landbirds found in the Umatilla/Willow subbasin that have declined in abundance regionally are shown in Table 21.

Table 21. Landbird species inhabiting the Umatilla/Willow subbasin with declining population trends.

Species	**Primary Habitat for Breeding**
American Goldfinch[1]	riparian
American Kestrel[1]	coniferous forest, grassland
Barn Swallow[1]	riparian
Belted Kingfisher[1]	riparian
Chipping Sparrow[1]	coniferous forest
Dark-eyed Junco[1]	coniferous forest, riparian
Lewis' Woodpecker[2]	coniferous forest, riparian
Mourning Dove[1]	coniferous forest, riparian
Olive-sided Flycatcher[1,2]	coniferous forest
Orange-crowned Warbler[1]	riparian
Pine Siskin[2]	coniferous forest
Rock Wren[1]	grassland, cliff, rock, talus
Rufous Hummingbird[1]	coniferous forest, riparian
Swainson's Thrush[1]	coniferous forest, riparian
Varied Thrush[1]	coniferous forest
Vaux's Swift[1]	coniferous forest, riparian
Violet-green Swallow[1]	coniferous forest, riparian
Western Meadow Lark[1,2]	grassland
Western Tanager[1]	coniferous forest, riparian
Western Wood-pewee[1]	coniferous forest, riparian
White-crowned Sparrow[1]	riparian
Williamson's Sapsucker[1]	coniferous forest, riparian
Wilson's Warbler[1]	riparian

[1]Species identified as having a significant declining population trend by Andelman and Stock 1994
[2]Species identified as a high concern to management by Saab and Rich 1997

Plants, Fungi, and Invertebrates:
The Umatilla/Willow subbasin is home to many species of rare or otherwise significant plants, fungi, and invertebrates. Because plants, fungi, and invertebrates are generally considered to be less charismatic than fish and wildlife, they have received relatively little study. Because of this, they are often absent or underrepresented in lists of threatened, endangered, sensitive, and managed species. Information on invertebrates is particularly lacking, despite the fact that they are the most abundant and diverse of all animal groups and fulfill vital roles in ecosystem functioning, including pollination, decomposition, and soil conditioning (Wilson 1987). Like plants, invertebrates also form a major component of both aquatic and terrestrial food webs. Although very little is known about the status and distribution of many of the important plant, fungus, and invertebrate species in the Umatilla/Willow subbasin, data from the Oregon Natural Heritage Program (ONHP) do provide some information about species in these groups that are rare or may be facing significant threats in the subbasin. Table 22 lists 32 plant species, two fungus species, and six invertebrate species that are known to exist in the Umatilla/Willow subbasin and have been recognized by the OHNP as rare or of conservation interest. The status of these species is described by their presence on ONHP lists and their Natural Heritage Network Rank, which is based on an international system for ranking rare, threatened and endangered species throughout the world (see the footnotes associated with Table 22 for more detail). Species are ranked at both a global and state level. Some species may be globally abundant, but rare in Oregon (e.g., Back’s sedge), while others may be rare both globally and locally (e.g., Laurence’s milk-vetch).

More detailed information is known about three of the species that appear in Table 22. Laurence’s milk vetch, a federal species of concern (Table 17), is entirely restricted to 14 small (<20 acres) unprotected sites in the lower subbasin (Kagan et al. 2000). These sites occur either on private lands or on highway right-of-ways. Hepatic monkeyflower, another federal species of concern (Table 17) and a candidate for listing in Oregon (Table 16), is found at one site in the lower subbasin, in the Umatilla River Canyon. This species, which occurs on moist vertical cliffs along major rivers, is only known to occur at 19 sites globally (Kagan et al. 2000). The only known population of rosy balsamroot in the subbasin is found in Juniper Canyon (Kagan et al. 2000).

While not classified as rare by the ONHP, mussels are declining in the Umatilla/Willow subbasin and some have been extirpated from the subbasin. Mussels were historically an important food resource for Native Americans throughout the Columbia basin including within the Umatilla/Willow subbasin (Ray 1942, Lyman 1984). In addition to their cultural importance, mussels are important ecologically. They are primary consumers, detritivores and act as nutrient sinks (McMahon and Bogan 2001). In addition, freshwater mussels filter and clarify large amounts of waters and therefore contribute to maintaining water clarity (McMahon and Bogan 2001). Freshwater mussels can also be important food items for fish, mink, otters and raccoon (Dillon 2000).

Table 22. Plant, fungus, and invertebrate species listed in the Oregon Natural Heritage Program database known to occur currently or historically in the Umatilla/Willow subbasin (ONHP 2001). The heritage list on which the species occurs, and its global and state Natural Heritage Network ranking, are shown.

Common Name	Scientific Name	Heritage List[1]	Global Heritage Rank[2]	State Heritage Rank[2]
Vascular Plants:				
aristulate lipocarpha	*Lipocarpha aristulata*	List 2	5	1
Back's sedge	*Carex backii*	List 2	5	1
Columbia milk-vetch	*Astragalus succumbens*	List 4	4	4
Columbia yellow-cress	*Rorippa columbiae*	List 1	3	3
Douglas clover	*Trifolium douglasii*	List 1	3?	1
Douglas' milk-vetch	*Astragalus kentrophyta* var. *douglassii*	List 1-X	X	X
dwarf evening-primrose	*Camissonia pygmaea*	List 1	3	1
flat-leaved Tolmie's onion	*Allium tolmiei* var. *platyphyllum*	List 3	3	3
gray moonwort	*Botrychium minganense*	List 2	4	2
hepatic monkeyflower	*Mimulus jungermannioides*	List 1	2	2
Kruckeberg's holly fern	*Polystichum kruckebergii*	List 4	4	4
Laurence's milk-vetch	*Astragalus collinuse* var. *laurentii*	List 1	1	1
long-haired star-tulip	*Calochortus longebarbatus* var. *longebarbatus*	List 4	3	3
male fern	*Dryopteris filix-mas*	List 4	5	3
many-flowered onion	*Allium pleianthum*	List 3	3	3
meadow sedge	*Carex praticola*	List 2	5?	2
mountain lady's slipper	*Cypripedium montanum*	List 4	4-5	4
pinnate grape-fern	*Botrychium pinnatum*	List 2	5	2-3
retrorse sedge	*Carex retrorsa*	List 2	5	1
Robinson's onion	*Allium robinsonii*	List 2 - ex	3	H
rosy balsamroot	*Balsamorhiza rosea*	List 2	4	H
rush-like skeletonweed	*Lygodesmia juncea*	List 3	4?	?
Sabine's lupine	*Lupinus sabinianus*	List 4	4	4
salt helitrope	*Heliotropium curassavicum*	List 3	5	?
shining cyperus	*Cyperus bipartitus*	List 3	5	?
stalked-pod milk-vetch	*Astragalus sclerocarpus*	List 4	4	4
Torrey's rush	*Juncus torreyi*	List 4	5	3
variable hot-rock penstemon	*Penstemon deustus* var. *variabilis*	List 3	2	?
western moonwort	*Botrychium hesperium*	List 3	3?	1
Mosses:				
No common name	*Aloina bifrons*	List 2	4	1
No common name	*Bryoerythrophyllum columbianum*	List 2	3	2
No common name	*Helodium blandowii*	List 2	4	2
Fungi:				
No common name	*Gamundia leucophylla*	List 3	3?	1
No common name	*Sclerotinia veratri*	List 3	2?	1

Table 22 (continued). Plant, fungus, and invertebrate species listed in the Oregon Natural Heritage Program database known to occur currently or historically in the Umatilla/Willow subbasin (ONHP 2001). The heritage list on which the species occurs, and its global and state Natural Heritage Network ranking, are shown.

Common Name	Scientific Name	Heritage List[1]	Global Heritage Rank[2]	State Heritage Rank[2]
Invertebrates:				
Columbia River tiger beetle	*Cicindela columbica*	List 1-ex	2	H
Columbia springsnail	*Pyrgulopsis* sp. nov	List 1	2	1
eastern meadow fritillary (butterfly)	*Boloria bellona toddi*	List 2	4-5	1
humped coin (snail)	*Polygyrella polygyrella*	List 3	U	H
southern tightcoil (snail)	*Ogaridiscus subrupicola*	List 1	2-3	H
Umatilla megomphix (snail)	*Megomphix lutarius*	List 3	1	H

[1]List 1 contains taxa that are threatened with extirpation or presumed to be extinct throughout their entire range; List 2 contains taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon.; List 3 contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range; List 4 contains taxa which are of conservation concern but are not currently threatened or endangered. "ex" indicates the species is extirpated from Oregon and "X" indicates the species is thought to be extinct throughout its range.

[2] Rank 1 indicates the species is critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; Rank 2 indicates the species is imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6-20 occurrences; Rank 3 indicates the species is rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; Rank 4 indicates the species is not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; and Rank 5 indicates the species is demonstrably widespread, abundant, and secure. "H" indicates "historical occurrence", i.e., the species was formerly part of the native biota with the implied expectation that it may be rediscovered; "X" means the species is presumed extirpated or extinct; "U" means the rank of the species is unknown; and "?" means the assigned rank is uncertain.

3.2.1.3 Species with Special Ecological Importance to the Subbasin

Fish:

The Pacific salmon species that spawn and rear in the subbasin are very important ecologically. While the impact of increasing salmon numbers on terrestrial wildlife in the subbasin as a result of the reintroduction of coho and Chinook salmon has not been quantified, it is likely substantial. Salmon carcasses, particularly in the lower Umatilla River and the North Fork Umatilla River, are once again abundant. Although the effect of increases in salmon carcasses has not been quantified in the Umatilla/Willow subbasin, a variety of studies in other regions of the Northwest and Alaska support the hypothesis that salmon carcasses play key roles in both aquatic and terrestrial food webs and nutrient cycling. Salmon carcasses provide an important source of marine-derived nutrients to streams and their adjacent riparian zones. Nutrients leached from carcasses stimulate primary productivity in streams (Kline et al. 1993). These nutrients are also directly taken up by macroinvertebrates that feed on the carcasses (Minakawa et al. 2002), and these macroinvertebrates are, in turn, consumed by juvenile salmon (Piorkwoski 1995). In addition, evidence exists that marine-derived nutrients found in salmon carcasses make their way into riparian vegetation from the excretion of these nutrients by scavengers, such as black bears (Bilby et al. 1996). Although the magnitude of the impact of salmon carcasses on nutrient cycling and food webs within the Umatilla/Willow subbasin has not been studied, observations of dramatic increases in the number of black bears gathering at the North Fork of the Umatilla River during spring Chinook spawning over the past five years suggests the importance of carcasses in the subbasin (personal communication: T. Bailey, ODFW, April 2004).

Wildlife:
Several groups of wildlife species have special ecological importance to the Umatilla/Willow subbasin, including: 1) functional specialists, 2) critical functional link species, 3) species with an association with salmonids, 4) Partners in Flight (PIF) species, 5) managed game species, and 6) species identified in the Habitat Evaluation Procedure (HEP) loss assessment. Each group is discussed briefly below.

Functional Specialists: Functional specialists are those wildlife species that perform very few and very specific ecological roles (IBIS 2004). As such, the persistence of these species depends on the continued existence of the required habitat or resource. One example of a functional specialist in the Umatilla/Willow subbasin is the Turkey Vulture, which feeds on carrion and little else. Accordingly, a decrease in the availability of carrion will negatively impact this species. Vertebrate species occurring in the Umatilla/Willow subbasin that have been identified as functional specialists by IBIS are listed in Table 23.

Table 23. Functional specialists occurring in the Umatilla/Willow subbasin (IBIS 2004).

Common Name	Scientific Name
Birds:	
Black Swift	*Cypseloides niger*
Common Nighthawk	*Chordeiles minor*
Gyrfalcon	*Falco rusticolus*
Harlequin Duck	*Histrionicus histrionicus*
Merlin	*Falco columbarius*
Northern Pygmy-owl	*Glaucidium gnoma*
Peregrine Falcon	*Falco peregrinus*
Snowy Owl	*Nyctea scandiaca*
Turkey Vulture	*Cathartes aura*
Mammals:	
Canada lynx	*Lynx canadensis*
wolverine	*Gulo gulo*

Critical Functional Link Species: A terrestrial species is characterized as a critical functional link species if it is the only species, or one of just a few species, in a particular wildlife habitat type that performs a particular key ecological function (IBIS 2004). The loss of these species may mean the loss of this function in the wildlife habitat type. Critical functional link species identified by IBIS that occur in the Umatilla/Willow subbasin are listed in Table 24. One example of a critical functional link species in the Umatilla/Willow subbasin is the American beaver, which plays a unique role in every habitat in which it occurs by impounding water as it creates diversions or dams. Several species play multiple unique roles; for example the black bear eats the bark, cambium, and bole of trees, excavates cavities in snags or live trees, and physically fragments standing wood (IBIS 2004).

Table 24. List of critical functional link terrestrial wildlife species in the Umatilla/Willow subbasin (IBIS 2004).

Common Name	Scientific Name
Amphibians:	
Great Basin spadefoot	*Scaphiopus intermontanus*
long-toed salamander	*Ambystoma macrodactylum*
Birds:	
Black-chinned Hummingbird	*Archilochus alexandri*
Brown-headed Cowbird	*Molothrus ater*
Canada Goose	*Branta canadensis*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Great Horned Owl	*Bubo virginianus*
Greater Scaup	*Aythya marila*
Redhead	*Aythya americana*
Rufous Hummingbird	*Selasphorus rufus*
Williamson's Sapsucker	*Sphyrapicus thyroideus*
Mammals:	
American beaver	*Castor canadensis*
black bear	*Ursus americanus*
bushy-tailed woodrat	*Neotoma cinerea*
common porcupine	*Erethizon dorsatum*
deer mouse	*Peromyscus maniculatus*
golden-mantled ground squirrel	*Spermophilus lateralis*
mink	*Mustela vison*
mountain lion	*Puma concolor*
northern pocket gopher	*Thomomys talpoides*
mountain cottontail	*Sylvilagus nuttallii*
red squirrel	*Tamiasciurus hudsonicus*
Rocky Mountain elk	*Cervus elaphus nelsoni*
snowshoe hare	*Lepus americanus*

Species Associated with Salmonids: The Umatilla/Willow subbasin also has numerous species that are linked, in some manner, to salmonids. The wildlife species of the subbasin that have been identified by IBIS as species that eat salmonid eggs, fry, fingerlings, parr, smolts, adults, or carcasses are listed in Table 25.

Table 25. List of wildlife species in the Umatilla/Willow subbasin that eat different stages of salmonids (IBIS 2004).

Common Name		
Birds:	**Birds:**	**Birds:**
American Crow	Great Egret	Varied Thrush
American Dipper	Greater Scaup	Violet-green Swallow
American Robin	Greater Yellowlegs	Western Grebe
American White Pelican	Green Heron	Willow Flycatcher
Bald Eagle	Green-Winged teal	Winter Wren
Bank Swallow	Harlequin Duck	**Mammals:**
Barn Swallow	Herring Gull	American marten
Barrow's Goldeneye	Hooded Merganser	black bear
Belted Kingfisher	Horned Grebe	bobcat
Black-billed Magpie	Killdeer	coyote
Black-crowned Night-heron	Mallard	deer mouse
California Gull	Northern Rough-winged Swallow	long-tailed weasel
Canvasback	Osprey	mink
Caspian Tern	Peregrine Falcon	mountain lion
Clark's Grebe	Pied-billed Grebe	northern flying squirrel
Cliff Swallow	Red-breasted Merganser	northern raccoon
Common Goldeneye	Red-necked Grebe	northern river otter
Common Loon	Red-tailed Hawk	red fox
Common Merganser	Ring-billed Gull	striped skunk
Common Raven	Snowy Owl	vagrant shrew
Common Tern	Song Sparrow	Virginia opossum
Double-crested Cormorant	Spotted Sandpiper	water shrew
Forster's Tern	Spotted Towhee	white-tailed deer
Golden Eagle	Tree Swallow	**Reptiles:**
Gray Jay	Trumpeter Swan	common garter snake
Great Blue Heron	Turkey Vulture	

PIF Species: Other species with special ecological importance to the subbasin are Partner in Flight species. Partners in Flight (PIF) is "a cooperative effort involving partnerships among federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals" (PIF 2002). Founded in 1990, the original purpose of PIF was to aid neotropical migratory birds that breed in the Nearctic and winter in the Neotropics. However, the organization now works to conserve most landbirds. PIF produces both national and state lists of species they believe should be considered in land use plans, project planning, impact assessments, research, monitoring, outreach and other activities. A total of 74 species found in the Umatilla/Willow subbasin are on the Oregon PIF list (Table 26).

Table 26. Common names of the 74 birds species found in the Umatilla/Willow subbasin that are on the Oregon PIF list (IBIS 2004).

Common Name		
American Dipper	Gray Flycatcher	Swainson's Hawk
American Kestrel	Great Gray Owl	Swainson's Thrush
American Pipit	Green-tailed Towhee	Townsend's Solitaire
Ash-throated Flycatcher	Hammond's Flycatcher	Townsend's Warbler
Bank Swallow	Hermit Thrush	Varied Thrush
Black Swift	Horned Lark	Vaux's Swift
Black-backed Woodpecker	House Wren	Veery
Black-headed Grosbeak	Lark Sparrow	Vesper Sparrow
Black-throated Gray Warbler	Lewis' Woodpecker	Warbling Vireo
Black-throated Sparrow	Lincoln's Sparrow	Western Bluebird
Brewer's Sparrow	Loggerhead Shrike	Western Meadowlark
Brown Creeper	MacGillivray's Warbler	Western Tanager
Bullock's Oriole	Nashville Warbler	Western Wood-pewee
Burrowing Owl	Northern Harrier	White-breasted Nuthatch
Bushtit	Olive-sided Flycatcher	White-headed Woodpecker
Calliope Hummingbird	Orange-crowned Warbler	White-throated Swift
Chipping Sparrow	Pileated Woodpecker	Williamson's Sapsucker
Clark's Nutcracker	Purple Finch	Willow Flycatcher
Common Poorwill	Red Crossbill	Wilson's Warbler
Downy Woodpecker	Red-eyed Vireo	Winter Wren
Dusky Flycatcher	Red-naped Sapsucker	Yellow Warbler
Ferruginous Hawk	Rufous Hummingbird	Yellow-billed Cuckoo
Flammulated Owl	Sage Sparrow	Yellow-breasted Chat
Fox Sparrow	Sage Thrasher	Yellow-rumped Warbler
Grasshopper Sparrow	Short-eared Owl	

Managed Game Species: The Umatilla/Willow subbasin is also home to many game species. A total of 53 species in the subbasin are classified as managed game species or fur-bearing animals in Oregon (IBIS 2004; personal communication: D. Brunings, ODFW, May 2004; Table 27). In addition to the species listed in Table 27, other hunted or trapped species in the subbasin include coyote, American badger, striped and Western spotted skunk, Virginia opossum, long-tailed weasel, and ermine. Several ODFW management plans provide guidance for managing these species in the subbasin,

Table 27. Managed game species and fur-bearing animals in the Umatilla/Willow subbasin.

Common Name	Scientific Name
Amphibians:	
bullfrog	*Rana catesbeiana*
Birds:	
American Coot	*Fulica americana*
American Crow	*Corvus brachyrhynchos*
American Widgeon	*Anas americana*
Barrow's Goldeneye	*Bucephala islandica*
Blue Grouse	*Dendragapus obscurus*
Blue-winged Teal	*Anas discors*
Bufflehead	*Bucephala albeola*
California Quail	*Callipepla californica*
Canada Goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Chukar	*Alectoris chukar*
Cinnamon Teal	*Anas cyanoptera*
Common Goldeneye	*Bucephala clangula*
Common Merganser	*Mergus merganser*
Eurasian Widgeon	*Anas penelope*
Gadwall	*Anas strepera*
Gray Partridge	*Perdix perdix*
Greater Scaup	*Aythya marila*
Greater White-fronted Goose	*Anser albifrons*
Green-winged Teal	*Anas crecca*
Harlequin Duck	*Histrionicus histrionicus*
Hooded Merganser	*Lophodytes cucullatus*
Lesser Scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Mountain Quail	*Oreortyx pictus*
Mourning Dove	*Zenaida macroura*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Anas clypeata*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Ring-necked Pheasant	*Phasianus colchicus*
Ross' Goose	*Chen rossii*
Ruddy Duck	*Oxyura jamaicensis*
Ruffed Grouse	*Bonasa umbellus*
Snow Goose	*Chen caerulescens*
White-winged Scoter	*Melanitta fusca*
Wild Turkey	*Meleagris gallopavo*
Wood Duck	*Aix sponsa*
Mammals:	
American beaver	*Castor canadensis*
American marten	*Martes americana*
black bear	*Ursus americanus*
bobcat	*Lynx rufus*
mink	*Mustela vison*
mountain lion	*Puma concolor*
mule deer	*Odocoileus hemionus*
muskrat	*Ondatra zibethicus*

Table 27 (continued). Managed game species and fur-bearing animals in the Umatilla/Willow subbasin.

Common Name	Scientific Name
Mammals (continued):	
northern raccoon	*Procyon lotor*
northern river otter	*Lutra canadensis*
pronghorn	*Antilocapra americana*
red fox	*Vulpes vulpes*
Rocky Mountain elk	*Cervus elaphus nelsoni*
white-tailed deer	*Odocoileus virginianus*

including *Oregon's Elk Management Plan*, *Oregon's Mule Deer Management Plan*, *Oregon's Black Bear Management Plan*, *Oregon's Cougar Management Plan*, *Oregon's Western Canada Mallard Management Plan*, and *Oregon's Taverner/Lesser Canada Goose Management Plan*.

HEP Species: Certain species in the Columbia River basin were selected during the USFWS Habitat Evaluation Procedure (HEP) loss assessment process, and used to model impacts from adjacent hydro-development. HEP species relevant to the Umatilla/Willow subbasin are those selected for the John Day and McNary dams (Table 28).

Table 28. HEP species selected for the John Day and McNary dams (IBIS 2004).

Common Name	Scientific Name
Birds:	
Spotted Sandpiper	*Actitis macularia*
Mallard	*Anas platyrhynchos*
Great Blue Heron	*Ardea herodia*
Lesser Scaup	*Aytha affinis*
Canada Goose	*Branta canadensis*
Blue Grouse	*Dendragapus obscurus*
Yellow Warbler	*Dendraica petechia*
California Quail	*Lophortyx californicus*
Black-capped Chickadee	*Parus atricopillus*
Downy Woodpecker	*Picoides pubescens*
Western Meadowlark	*Sturnella neglecta*
Mammals:	
mink	*Mustela vison*
mule deer	*Odocoileus hemionus*

3.2.1.4 Species Recognized by Columbia Plateau Tribes as Having Cultural or Religious Value

All living things are valued by the Tribes of the Columbia Plateau. In general, tribal religious beliefs are that the Creator created and gave foods and medicines in the form of plants and animals to the Natityat (i.e., Indian people) to survive. In return the Natityat made a promise to the Creator to always protect these gifts. As such, each species is believed to fulfill important roles in the ecosystem. Some examples of these roles in tribal tradition and culture are shown in Table 29.

Table 29. Some examples of the importance of plants and animals in the cultural and spiritual lives of the Natityat.

Traditional or Cultural Role	Examples of Animals Involved
regalia	eagle feathers and otter, deer, and elk pelts
instruments/drums	eagle whistle, deer hide drum, dew claw rattles
housing	tule, lodgepole
subsistence	salmon, whitefish, mule deer, elk, grouse, chokecherry, lamprey, fresh water mussel, huckleberry, various root food plants, mushrooms
medicinal	various plants
burial/religious ceremonies	tule
stories/oral histories	coyote, owl
tools	elk/deer antler tools, fish bones, willow, mock orange, oceanspray, dogbane hemp

3.2.1.5 Locally Extirpated and Introduced Species

Fish:

Currently more than 31 species of fish inhabit the Umatilla River and its tributaries. Eleven species are introduced exotics, 17 are native to the subbasin, and three are reintroduced endemic species (Table 34). The species composition and distribution of fish in the Willow Creek subbasin are not well known. However, it is assumed that fish species in the Willow Creek subbasin are generally the same as those found in the Umatilla subbasin, with the exception of anadromous salmon and steelhead. Sixteen Mile Canyon, Sand Hollow and Juniper Canyon are known to be intermittent streams in many locations; however extensive surveys have not been conducted and there may be some perennial reaches that support fish.

The Umatilla/Willow subbasin historically supported large populations of spring and fall Chinook and coho salmon. These populations were extirpated from the subbasin in the early 20th century (Boyce 1986). Extirpation of these populations occurred primarily as a result of habitat degradation, compromised fish passage resulting from diversion dams, and prolonged irrigation water withdrawals (Boyce 1986, Phillips et al. 2000). Hatchery reared coho salmon were introduced into the subbasin from 1966 to 1969 and then from 1987 until the present. Hatchery reared fall Chinook were introduced into the subbasin in 1982, and spring Chinook in 1986. More information on the release of hatchery reared salmon into the subbasin is given in Section 3.2.3.3.

Historically, non-endemic rainbow trout were stocked throughout the Umatilla and Willow Creek subbasins to augment sport fisheries. This widespread stocking occurred from the 1940s through the 1970s and has been gradually reduced due to reduced funding and conservation concerns. See Section 3.2.3.3 for more details about the history of rainbow trout stocking in the subbasin.

One introduction of an exotic fish species in the Umatilla subbasin was accidental. Mosquito fish, which were introduced into standing waters of the subbasin to reduce mosquito abundance for public health issues, inadvertently spread into the Umatilla River. All other exotic species found in the subbasin have generally been intentionally introduced for the purposes of creating sport fisheries. These introductions have been made either by ODFW or illegally by the public. These species have been primarily introduced into standing water bodies, including McKay and Willow Creek reservoirs, and have dispersed volitionally into streams in the subbasin, primarily downstream of these reservoirs. Introductions into McKay Reservoir include largemouth bass, smallmouth bass, black crappie, white crappie, bluegill, pumpkinseed sunfish, yellow perch, brown bullhead, and channel catfish. These introductions occurred prior to 1970 and the reservoir is currently managed to optimize warmwater fisheries. Introductions into Willow Creek Reservoir have been done so illegally by the public after the reservoir was constructed in 1981. The most significant dispersal of these species is that of

Table 30. Fish species present in the Umatilla subbasin.

Species	Origin[1]	Location[2]	Status[3]	Comments
bull trout (*Salvelinus confluentus*)	N	R, T	C	
spring Chinook (*Oncorhynchus tshawytscha*)	H	R, T	C	
fall Chinook (*Oncorhynchus tshawytscha*)	H	R, T	C	
coho salmon (*Oncorhynchus kisutch*)	H	R, T	C	
redband trout/summer steelhead (*Oncorhynchus mykiss*)	N/E	R, T	A	exotic hatchery trout introduced for fisheries
mountain whitefish (*Prosopium williamsoni*)	N	R, T	U	
Pacific lamprey (*Lampetra tridentata*)	N	R, T	U	
western brook lamprey (*Lampetra richardsoni*)	N	R, T	U	
longnose dace (*Rhinichthys cataractae*)	N	R, T	I	
speckled dace (*Rhinichthys osculus*)	N	R, T	A	
Umatilla dace (*Rhinichthys umatilla*)	N	R, T	I	
leopard dace (*Rhinichthys falcatus*)	N	R, T	I	
chiselmouth (*Acrocheilus alutaceus*)	N	R, T	C	
peamouth (*Mylocheilus caurinus*)	N	R, T	U	
redside shiner (*Richardsonius balteatus*)	N	R, T	A	
northern pikeminnow (*Ptychocheilus oregonensis*)	N	R, T	C	
sucker (Catostomidae)	N	R, T	C	Bridgelip, largescale
carp (*Cyprinus carpio*)	E	R, T	U	
pumpkinseed (*Lepomis gibbosus*)	E	R, T	R	
bluegill (*Lepomis macrochirus*)	E	R, T	R	
white crappie (*Pomoxis annularis*)	E	R, T	R	
black crappie (*Pomoxis nigromaculatus*)	E	R, T	R	
yellow perch (*Perca flavescens*)	E	R, T	R	
large mouth bass (*Micropterus salmoides*)	E	R	U	
small mouth bass (*Micropterus dolomieu*)	E	R	C	
brown bullhead (*Ameiurus nebulosus*)	E	R	U	
channel catfish (*Ictalurus punctatus*)	E	R	U	
mosquitofish (*Gambusia*)	E	R	U	Seasonal
Paiute sculpin (*Cottus beldingi*)	N	R, T	C	
margined sculpin (*Cottus marginatus*)	N	R, T	C	
torrent sculpin (*Cottus rhotheus*)	N	R, T	R	

[1] Origin: N=native stock, E=exotic, H=hatchery reintroduction with a naturalized sub-population
[2] Location: R= mainstem rivers T= tributaries
[3] Fish species abundance based on average number of fish per $100m^2$: A=abundant, R=rare, U=uncommon, C=common, and I=insufficient data

smallmouth bass into the lower Umatilla River. Although sampling has not been conducted to determine abundance, reports from anglers indicate that significant numbers of smallmouth bass now exist in the lower Umatilla River.

Wildlife:

A number of terrestrial wildlife species have been extirpated from the Umatilla/Willow subbasin, including the Columbia Sharp-tailed Grouse, the Sage Grouse, the gray wolf, the grizzly bear, and the Rocky Mountain bighorn sheep. Columbia sharp-tailed Grouse were extirpated from Oregon in the 1960s due to a combination of factors, including over-hunting in the mid- to late 19th century, the conversion of native habitats to crop production, and habitat degradation from livestock grazing (Hays et al. 1998, Crawford and Coggins 2000). Sage Grouse, a species dependent on shrub-steppe habitat, were extirpated from the Umatilla/Willow subbasin by 1955 because of habitat conversion, overgrazing, and over-hunting (Stinson et al. 2003). The gray wolf and grizzly bear were both extirpated from the subbasin by the 1940s, primarily due to predator control efforts. Rocky Mountain bighorn sheep were extirpated from Oregon in the 1940s due to over-hunting, unregulated domestic livestock grazing, and parasites and diseases carried by domestic livestock (ODFW 2003b).

A large number of terrestrial wildlife species have been introduced to the Umatilla/Willow subbasin, both intentionally and accidentally. Exotic gamebirds introduced into the subbasin to provide recreational activities include the Red Leg Partridge, Ring-necked Pheasant, Wild Turkey, California Quail, Chukar, and Hungarian Partridge. Because these species are popular game species in the Umatilla/Willow subbasin, wildlife managers in the subbasin work to maintain their populations. However, populations of many of these species have been declining in the last 20-30 years for a variety of reasons, including changes in agricultural practices, exotic weed invasions, and weather variability (ODFW 1999).

Other species intentionally introduced as game animals in the Umatilla/Willow subbasin include the bullfrog, the Virginia opossum, the eastern fox squirrel, and the European red fox. Bullfrogs are particularly problematic in the area due to their negative effects on native amphibian species; their introduction is considered a major factor in the decline of many of these species (Csuti et al. 1997). As a result of their aggressive behavior and rapid growth rate, bullfrogs out-compete native amphibians (Corkran and Thoms 1996; personal communications: C. Corkran, February 2001; M. Hayes, WDFW, February 2001). In addition, they are voracious predators, often eating the eggs, tadpoles, and adults of native frog species. In the Umatilla/Willow subbasin, the bullfrog's preferred habitat is similar to that of many other amphibians native to the Umatilla/Willow subbasin, especially to that of the Columbia spotted frog (personal communications: C. Corkran, February 2001; M. Hayes, WDFW, February 2001). The Virginia opossum can also negatively impact native wildlife. As opportunistic feeders, they often consume a variety of small birds, mammals, and reptiles (Csuti et al. 1997). Opossum predation on bird eggs may be limiting native bird populations and is a concern for wildlife managers in the subbasin. The eastern red fox may also exert negative effects on indigenous wildlife species, such as the red tree squirrel, through competition (personal communication: M. Kirsch, ODFW, April 2004).

Two exotic bird species common in the Umatilla/Willow subbasin and virtually everywhere else in the United States are the European Starling and the House Sparrow. Intentionally introduced in the 1800s from Europe, these birds are aggressive competitors for nesting cavities. They commonly out-compete native cavity-nesting birds, and are known to destroy nests and eggs and kill nestlings and adults while taking over nest sites.

Two exotic mammalian species closely associated with humans globally also occur in the Umatilla/Willow subbasin. The Norway rat and house mouse are found in cities and towns of the subbasin, but their prevalence and their effect on native wildlife in the subbasin are not known.

Other exotic animals common in the Umatilla/Willow subbasin are pet animals that escape or are intentionally released. Common feral animals in the subbasin include cats, dogs, and red eared slider turtles. Cats, in particular, are known to have large, negative impacts on terrestrial wildlife, such as birds, rodents, and lizards, an effect that can be magnified in fragmented landscapes (Crooks and Soulé 1999).

Plants and Invertebrates:
The presence of exotic invasive plants is a major problem in the subbasin, and the magnitude of the effect and the most damaging species are described in Section 3.1.1.9. Unfortunately, little is known about the number of plant species that have been extirpated from the Umatilla/Willow subbasin because of a lack of study. However, two plants known to have historically occurred in the Umatilla/Willow subbasin, Douglas' milk-vetch and Robinson's onion, are extirpated from Oregon (OHNP 2001).

Several exotic invertebrate species are also known to occur in the Umatilla/Willow subbasin and are suspected to have negatively affected the native fauna in the area. An example of one common exotic invertebrate in the subbasin is the European earwig, which was found at 90% of 20 riparian sites sampled in the Patawa/Tutuilla watershed in the Umatilla subbasin (Wooster and DeBano 2003). Although the effect of invasive exotic invertebrate species like the European earwig has not been quantified in the subbasin, these species undoubtedly compete with native invertebrate species for a variety of resources. The European honeybee is also common in the Umatilla/Willow subbasin, and is an example of an exotic species that was intentionally introduced by humans to the detriment of native invertebrate pollinators (Kearns et al. 1998). However, European honeybees are highly valued by humans because of two important services they provide: honey production and crop pollination. The annual value of pollination for crop systems in the Unites States, provided primarily by honeybees, is estimated to be between $20-40 billion (Kearns et al. 1998). Other introduced invertebrates that provide beneficial services to humans in the subbasin are a variety of exotic insect species that are used in attempts to control exotic weeds. For example, several species of snout beetles (*Larinus curtus*, *Eustenopus villosus,* and *Bangasternus orientalis*) are used by the BIA to help control yellow starthistle in the subbasin.

Very little is known about how many invertebrate species have been extirpated from the Umatilla/Willow subbasin; only one terrestrial and one aquatic taxon are known or suspected to be extinct. The terrestrial species is the Columbia River tiger beetle, which occurred historically in the subbasin and is now extirpated from Oregon (ONHP 2001). The aquatic taxon is a genus of mussels, *Margaritifera*, which occurred historically in the Umatilla River but was not found in a recent survey of mussels by the CTUIR and is suspected to be locally extinct (personal communication J. Brim Box, CTUIR, April 2004).

3.2.2 Focal Species Selection

3.2.2.1 List of Species Selected

Aquatic:

The following aquatic species were chosen as focal species for the Umatilla/Willow subbasin: summer steelhead/redband trout (*Oncorhyncus mykiss*), coho salmon (*Oncorhyncus kisutch*), spring and fall Chinook salmon (*Oncorhyncus tshawytscha*), and bull trout (*Salvelinus confluentus*). In addition, two other taxa were identified as “taxa of interest;” these are Pacific lamprey (*Lampetra tridentata*) and mussels. Models have not been developed to examine the population dynamics of these taxa under current conditions or under different scenarios of future conditions (i.e., the Ecosystem Diagnosis Treatment Model (EDT) and the Qualitative Habitat Assessment Model (QHA) will not work for the life-histories of lampreys and mussels). However, these taxa are of cultural and ecological interest in the subbasin and are therefore given consideration in this plan.

This list of aquatic focal species was presented to the public and stakeholders on August 6, 2003 in Pendleton, Oregon and the list was finalized on that date.

Terrestrial Wildlife:

Terrestrial wildlife focal species and their associated habitats for the Umatilla/Willow subbasin are listed in Table 31. The rationale for their selection is provided in Section 3.2.2.2. This list of proposed focal species was presented to stakeholders and the public for final consideration and was approved on November 12, 2003.

3.2.2.2 Methodology for Selection

Aquatic:

Aquatic focal species were selected based on three criteria: 1) the degree to which they have special ecological, cultural or legal status, 2) the extent to which they “represent” certain habitat types and the aquatic communities found in those habitats and 3) the availability of adequate knowledge of the species’ biology in the subbasin for use in EDT and QHA. While assessment of all fish species present within the Umatilla/Willow subbasin would best insure the needs of each species for habitat protection and restoration, this kind of endeavor is not feasible at this time. Because time and resources for completing this planning process are limited, and because data regarding the biology, distribution, abundance and productivity of all fish species in the subbasin are not

Table 31. Terrestrial focal species selected for the Umatilla/Willow subbasin.

Common Name ***(Scientific Name)***	**Focal Habitat**	**Status**[1]		**Critically Linked**	**Functional Specialist**	**Salmon Associated**	**HEP**	**PIF**	**Managed Game Species**
		Federal	OR						
Pileated Woodpecker *(Dryocopus pileatus)*	montane & eastside mixed conifer forest	n/a	SS-V	No	No	No	No	Yes	No
White-headed Woodpecker *(Picoides albolarvatus)*	ponderosa pine	SC	SS-C	No	No	No	No	Yes	No
Red-naped Sapsucker *(Sphyrapicus nuchalis)*	aspen forest	n/a	n/a	No	No	No	No	Yes	No
Ferruginous Hawk *(Buteo regalis)*	western juniper woodlands	SC	SS-C	No	No	No	No	Yes	No
Grasshopper Sparrow *(Ammodramus savannarum)*	eastside interior grasslands	n/a	SS-V/PNR	No	No	No	No	Yes	No
Sage Sparrow *(Amphispiza nevadensis)*	shrub-steppe	n/a	SS-C	No	No	No	No	Yes	No
Columbia spotted frog *(Rana luteiventris)*	herbaceous wetlands	C, FS	SS-U	No	No	No	No	No	No
Yellow Warbler *(Dendroica petechia)*	eastside interior riparian-wetlands	n/a	n/a	No	No	No	Yes	Yes	No
American beaver *(Castor canadensis)*		n/a	n/a	No	No	No	No	No	Yes
Great Blue Heron *(Ardea herodias)*		n/a	n/a	Yes	No	Yes	Yes	No	No

[1] Status: C=candidate species; SC=species of concern; FS- Forest Service sensitive species; SS-C=sensitive species-critical; SS-V=sensitive species-vulnerable; SS-V/PNR=sensitive species-vulnerable/peripheral or naturally rare; SS-U=sensitive species-undetermined

available, an approach that selects key indicator species to represent all species and habitats in the ecosystem is prudent and necessary.

For the first criterion, consideration was first given to species that specifically require assessment due to ecological, cultural or legal importance. Species listed under the federal ESA were adopted as focal species. Consideration was also given to species that are of significant interest to the cultures represented in the subbasin, both Native American and non-Native American. Finally, consideration was given as to whether or not there are species in the subbasin that require assessment with regard to their critical role in the ecology of the ecosystem.

For the second criterion, an emphasis was placed on those species and associated habitats that are the focus of restoration actions under the Columbia Basin Fish & Wildlife Program. In addition, aquatic species were considered based on their habitat use (both spatially and temporally) relative to the habitat conditions that exist throughout the subbasin. Special consideration was given to species that have the most stringent habitat requirements; focusing development of restoration plans around these key species will ensure that habitat requirements of all species of management concern will be addressed to the extent possible.

Bull trout were first selected as a focal species based on their threatened status under the federal ESA. However, the ecological merits for selecting this species are strong as well. Bull trout have the most stringent habitat requirements of any fish species inhabiting the Umatilla subbasin. They require cold water of the highest quality and stable, complex habitat. Their distribution in the subbasin is limited, but encompasses areas not occupied significantly by other species. Bull trout serve as good indicators of high quality habitat and of degradation where distribution has decreased.

Like bull trout, summer steelhead were first selected as a focal species because of their threatened status under the federal ESA as a population of the Middle Columbia River ESU. While the anadromous from of steelhead is listed, the resident form (redband trout) is not. However, as the knowledge base on this species grows, so does our understanding of the interaction of the anadromous and resident life history forms. Because it cannot be assumed that the resident and anadromous forms are reproductively isolated, we chose to consider both forms as the focal species. In addition to their legal status, summer steelhead inhabit a large portion of the subbasin, more than the other salmonid species, yet require cold and clean water and high quality instream habitat. For rearing, in particular, steelhead require higher quality freshwater habitat than do the other anadromous species. Finally, the life history of steelhead is unique in that they have a relatively long freshwater residency of one to four years as juveniles.

Spring Chinook were selected as a focal species because their habitat requirements and life history characteristics are intermediate between summer steelhead and bull trout, and thus more strongly represent habitat that is transitional in quality. In addition, spring Chinook have some unique life history requirements. Adults immigrate into the subbasin from April through July as flows decrease and water temperatures increase. This exposes adults during the later part of the return to high risks of pre-spawning mortality. Adults then hold for approximately two months (June and July) in the upper Umatilla River prior to spawning, which requires high quality summertime holding habitat.

Coho were selected because their spawning and rearing distribution is mainly in the mainstem of the Umatilla River downstream of Pendleton, an area not used significantly for spawning or rearing by summer steelhead or spring Chinook.

Fall Chinook were selected as a focal species based primarily on their cultural, social, and political importance in the subbasin. Not only are fall Chinook culturally significant to the Tribes in the subbasin, but they are also socially and politically important because a large investment of public resources has been made in an on-going fall chinook reintroduction effort in the Umatilla subbasin through artificial production. Because the investment in the artificial program is expected to continue and program goals include natural production in the subbasin, managers believe it is important to complete a detailed habitat assessment through EDT for fall Chinook. An EDT analysis is needed to aid future management decisions including a possible reexamination of fall Chinook production goals for the subbasin.

All aquatic focal species selected have sufficient data for modeling using EDT or QHA. However, it was felt that limiting the aquatic species chosen to those suitable for use in EDT and QHA was too restrictive and eliminated species that have cultural and ecological importance in the subbasin, but for which detailed biological data are limited. Therefore, a category called “taxa of interest” was developed that allowed the inclusion of important aquatic species that, while their status cannot be assessed using the modeling approaches, hold great interest in the subbasin in terms of developing management strategies.

Lamprey and mussels were selected as “taxa of interest” as a result of both their cultural and ecological importance. Historically, Pacific lamprey were used both as food and for medicinal purposes by Native Americans throughout the Columbia basin (Close et al. 2002). Lamprey numbers have declined dramatically in the subbasin over the past century and there is no longer a tribal harvest of these animals. Pacific lamprey are currently the focus of a restoration initiative by the CTUIR (Close 1999).

Two genera of mussels are found in the lower Umatilla subbasin, *Anodonta* and *Gonidea*, and a third, *Margaritifera*, was found historically in the subbasin, but now appears to be locally extinct (personal communication: J. Brim Box, CTUIR, April 2004). Mussels were historically an important food resource for Native Americans throughout the Columbia basin including within the Umatilla/Willow subbasin (Ray 1942, Lyman 1984). Native American use of freshwater mussels decreased during the last 200 years, probably due to declines in native populations and assimilation following Euro-American settlement (Chatters 1995). A Umatilla tribal elder, however, remembered his parents trading fish for dried mussels as late as the 1930s (personal communication: E. Quaempts, CTUIR tribal member, 1996). In addition to their cultural importance, mussels are important ecologically; they are important detritivores and act as nutrient sinks (McMahon and Bogan 2001). In addition, freshwater mussels filter and clarify large amounts of water and therefore contribute to maintaining water clarity (McMahon and Bogan 2001). Freshwater mussels are also important food items for fish, mink, otters and raccoon (Dillon 2000).

Terrestrial[1]:

In contrast to the selection of aquatic focal species, terrestrial focal species for the Umatilla/Willow subbasin were selected using a more holistic approach that emphasizes ecosystem management through the use of focal habitat types while including components of single-species, guild, or indicator species assemblages. This approach is more appropriate for terrestrial systems than aquatic ones, and is based on the assumption that conservation strategies for terrestrial systems that emphasize focal habitats are more desirable than those that emphasize individual species.

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

The rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a properly functioning ecosystem. These focal species can serve as "poster" species for a given habitat type, helping stakeholders and the public to better relate to the somewhat abstract notion that habitats are often the primary target of management actions, not species.

Umatilla/Willow subbasin planners selected ten focal species (Table 31) from a list of focal candidates that met one or more of the categories indicating ecological importance, as presented in Section 3.2.1. Planners selected species that had life requirements representative of habitat conditions or features that are important within the properly functioning focal habitat types identified in the IBIS database. These habitat types are described in Section 3.2.4.2, and relationship of the focal species and the focal habitat type are described in Section 3.4.2. Planners also looked for species to provide a focus for describing desired habitat conditions, attributes, and needed management strategies and/or actions. While consideration was given to the value of using focal species for monitoring and evaluation of management strategies, this was not an obligatory

[1] Large portions of the text in this section originate from a 2004 draft of the *Southeast Washington Subbasin Planning Ecoregion Wildlife Assessment*, and are used with permission to C. Scheeler from the authors, P. Ashley and S. Stovall. The text has been slightly modified to fit into the context of the Umatilla/Willow subbasin.

consideration, as monitoring and evaluation is likely to be tiered to a more regionally consistent strategy.

It is important to note that non-focal species, including managed species and federal and state listed species for which species specific management and recovery plans have been developed, may also dictate habitat management considerations in ways that do not conform to the habitat/focal species framework. Therefore, as needed, management and habitat requirements of non-focal species will be included in the assessment and management plan and referenced by appended management plans for those species.

3.2.3 Aquatic Focal Species and Taxa of Interest: Population Delineation and Characterization

3.2.3.1 Focal Species Population Data, Life History, and Distribution

Bull Trout

Abundance and Population Trends

In 1998 bull trout in the Columbia River basin were listed as threatened by the USFWS (2002). In the Umatilla/Willow subbasin they occur in only a limited area in the upper Umatilla River, the North and South Forks, and in North Fork Meacham Creek (Figure 32). The USFWS Draft Bull Trout Recovery Plan (DBTRP) establishes recovery criteria of 500 to 1000 spawning adults per population. The information presented below suggests that the bull trout populations in the Umatilla subbasin are well below the level necessary for recovery under the DBTRP. The DBTRP identifies two local populations in the Umatilla core area: the upper Umatilla population and the Meacham Creek population (Figure 32).

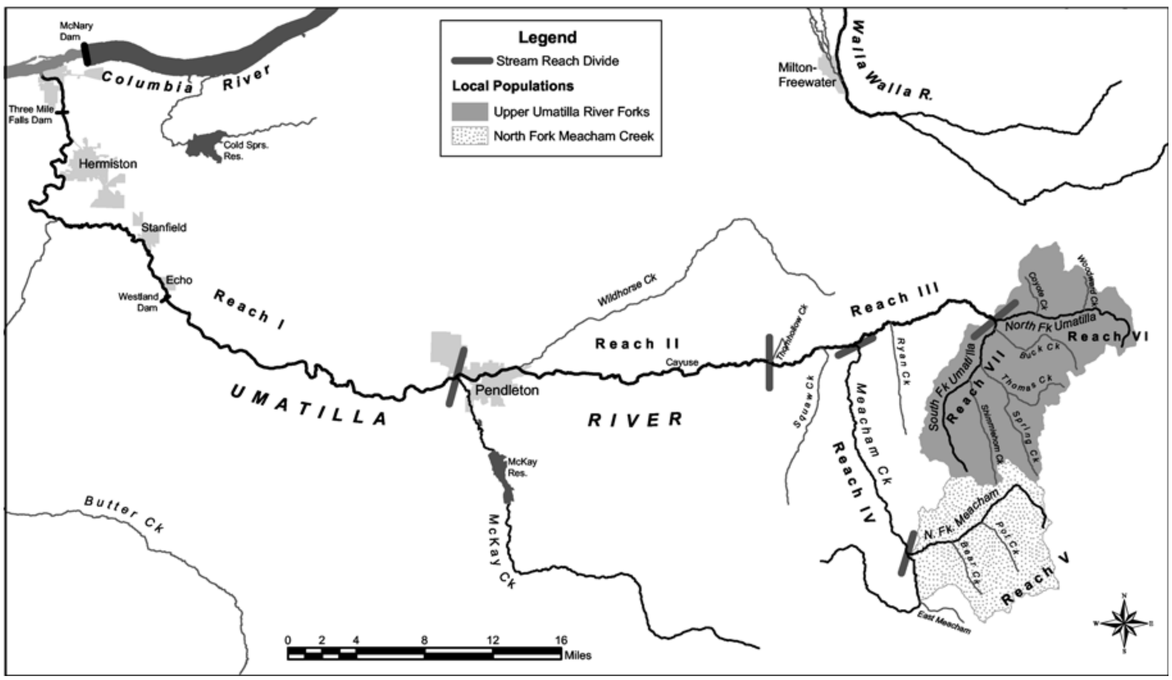


Figure 32. Locations of the two local bull trout populations in the Umatilla/Willow subbasin. Figure provided by John Stephenson, USFWS, April, 2004.

Spawner abundance has been tracked since 1994 in the North and South Forks of the Umatilla and North Fork of Meacham Creek through redd counts (Figure 33). While redd counts are best used as indicators of trends in abundance, they are the only long term data set currently available to gain an understanding of bull trout abundance in the Umatilla subbasin. Between 1994 and 1999 the number of redds counted within the North Fork Umatilla Index Reach (from the confluence of Coyote Creek to the confluence of Woodward Creek) increased substantially from 29 to 144, respectively (Figure 33). However, the number of redds counted declined substantially from 1999 to 2003 with the lowest count of this period being 48 redds in 2002. While it is understood that redd data is best interpreted at the scale of decades, the pattern in redd abundance over the past decade is probably of great enough magnitude to be real rather than an artifact of sampling bias or variability. Even with the decline in redd number over the past four years, the trend over the past decade is positive (Figure 33).

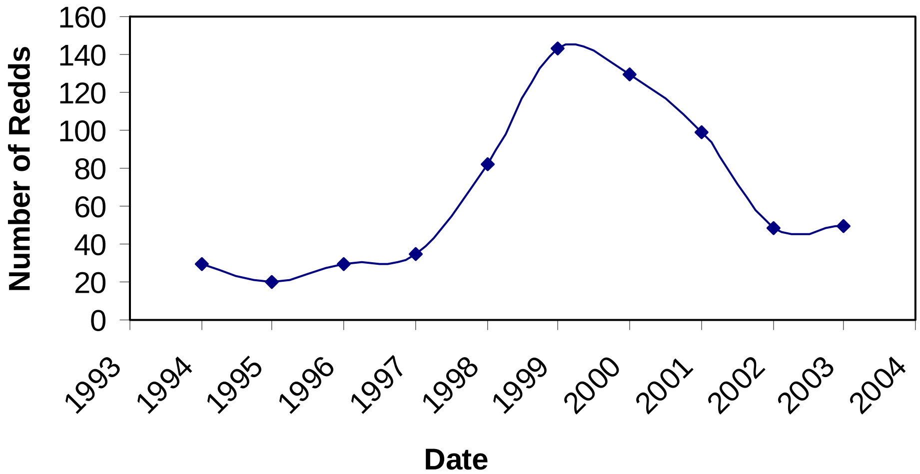


Figure 33. Bull trout redd counts in the North Fork Umatilla River from the confluence of Coyote Creek to the confluence of Woodward Creek. Data from ODFW, unpublished.

Bull trout redd counts are the only data available to monitor trends in abundance of bull trout in the Umatilla/Willow subbasin. There are statistical problems with using redd counts for detecting increasing or declining trends in bull trout populations (Maxwell 1999). Despite these problems it was determined by the Umatilla Bull Trout Working Group that redd surveys provided the most feasible method of estimating abundance available over the past decade. However, in 2003 the USGS Cooperative Fish & Wildlife Research Unit at Utah State University began a project to determine the abundance of bull trout in the North Fork Umatilla River (Budy et al. 2004). Preliminary data are available from this study and will be strengthened with planned continuation of the study over several years.

Preliminary work by Budy et al. (2004) provides a measure of confidence in using redd surveys to estimate bull trout populations. In 2003 Budy et al. (2004) used a mark-resight methodology to estimate population size in the North Fork Umatilla in 2003 and concluded that approximately 100 bull trout over 220 mm (i.e., sexually mature adults) exist there. Redd count data in 2003 provided an estimate that was similar. The number of spawners can be estimated using redd counts by assuming 2.5 spawners per redd. In 2003, 49 redds were counted in the North Fork which leads to an estimate of 123 adult spawners. The similarity in these two estimates of adult population size suggests that the adult bull trout population in the North Fork Umatilla in 2003 was approximately 100-123 individuals. The ten year average in the North Fork based on 2.5 spawners per redd is 165.

While bull trout have been documented in other streams within the subbasin such as the North Fork of Meacham Creek, South Fork Umatilla River, Iskuulpa Creek and Ryan Creek, no abundance data exist for these streams. However, abundance in these streams is anticipated to be quite low, much lower than in the North Fork Umatilla River. This assumption is based on the facts that few bull trout have been observed in these streams during fish surveys and the quality of habitat in these areas is poor relative to the habitat requirements of bull trout.

Life History

Bull trout are known to exhibit several different life history patterns including resident (life cycle is completed within the natal drainage), fluvial (spawning and 1 to 4 years of rearing occur in a tributary before migrating to a larger river), adfluvial (spawning and 1 to 4 years of rearing occur in a tributary before migrating to a lake) and anadromous (Hemmingsen et al. 2002). Both resident and fluvial life history patterns are known to exist in the Umatilla subbasin, but the relative abundance of each type is not well known. Radio telemetry was used in 1998-2000 (Germond 2000) and 2002-2003 (Sankovich et al. 2003) to learn about the movement patterns and life history characteristics of bull trout found in the upper mainstem Umatilla River during spring and early summer. Nineteen fish were tagged during the 1998-2000 study and 15 fish were tagged during the 2002-2003 study. Size of the fish averaged 480 mm (range 280 – 600 mm). In general two patterns were observed, a resident type and a fluvial type. Resident fish spent the summer and spawned in the North Fork Umatilla River and then over-wintered in an approximately five mile reach of the mainstem Umatilla River. The fluvial type spent the summer and spawned in the North Fork and then over-wintered in the mainstem Umatilla River, generally from RM 67 to RM 79. One fish was tracked as far downstream as RM 40.

This radio telemetry work, however, leaves the understanding of life history diversity incomplete due the limitations of the equipment. In order to have a radio tag of sufficient battery life to determine annual movement patterns, the tag must be relatively large, and therefore, fish of smaller size cannot be tagged. Thus a significant data gap exists regarding the life histories of smaller sized fish in the North Fork. It is possible that there are smaller resident fish that spend their entire lives in the North Fork Umatilla or other streams such as the North Fork Meacham, South Fork Umatilla, Ryan Creek or Iskuulpa Creek.

Additional information on the movement of juvenile and adult bull trout in the mainstem Umatilla River and Meacham Creek comes from the results of screw trapping conducted by the CTUIR fisheries program (Contor et al. 1995). A screw trap was operated in the mainstem Umatilla River 0.5 miles upstream from the confluence of Meacham Creek (RM 79) for 145 days from October 15, 1993 to July 19, 1994. One hundred forty-two bull trout were captured in the Umatilla River trap, with the majority trapped in April, May and October. Most bull trout trapped in the spring ranged in size from 100mm and 200 mm (juveniles) while those trapped in the fall ranged in size from 200 mm to 300mm (subadults and adults). The second trap was operated at RM 1 on Meacham Creek for 183 days from December 15, 1993 to June 22, 1994. During this time only two bull trout were captured in the trap. In addition to this information, a small number of juvenile and subadult bull trout have been observed at the Westland Diversion Dam juvenile fish trap (RM 27) and the Three Mile Falls Dam adult trap (RM 4).

The above information documents downstream migration of significant numbers of juvenile and subadult bull trout in the mainstem Umatilla River, presumably originating from the North Fork. And while there is some documentation of bull trout in the lower Umatilla River, the extent of migration by juvenile and subadult bull trout downstream of the screw traps discussed above is a significant data gap.

Almost all spawning activity documented occurs in the North Fork Umatilla River between the confluence of Coyote and Woodward Creeks, a three-mile reach of stream. Since 1994, three redds have been documented in the South Fork Umatilla upstream of Thomas Creek, four in the North Fork Meacham Creek, and two in Pot Creek (a tributary of the North Fork Meacham). Spawning occurs from early September through October.

Current and Historic Distribution

Because of poor water quality conditions in much of the Umatilla subbasin, bull trout are isolated in the headwaters of the Umatilla River and Meacham Creek (Figure 34). Currently, bull trout have been found from the headwaters of the Umatilla River to Three Mile Falls Dam (RM 4). It is presumed that these animals are simply migrating. It appears that spawning and rearing is restricted to the North and South Forks of the Umatilla River and the North Fork Meacham Creek. Annual comprehensive spawning surveys conducted between 1994 and 1996 by ODFW, USFS and CTUIR in known or suspected areas of spawning indicate that the majority (81 to 92 percent) of redds are in the North Fork Umatilla River between the confluences of Coyote and Woodward Creeks (Northrup 1997). Radio telemetry studies indicate that the majority of migratory fish move downstream to the reach of the Umatilla mainstem between Cayuse (RM 67) and the confluence of Meacham Creek (RM 79) in the winter months. Resident life history fish use the reach of the mainstem upstream of Meacham Creek in the winter months. Summertime rearing occurs in the mainstem from the confluence of Meacham Creek upstream to the forks. Year-round use also occurs in Iskuulpa Creek, Ryan Creek, North Fork Umatilla River, Coyote Creek, Shimmiehorn Creek and Meacham Creek (Germond et al. 1996).

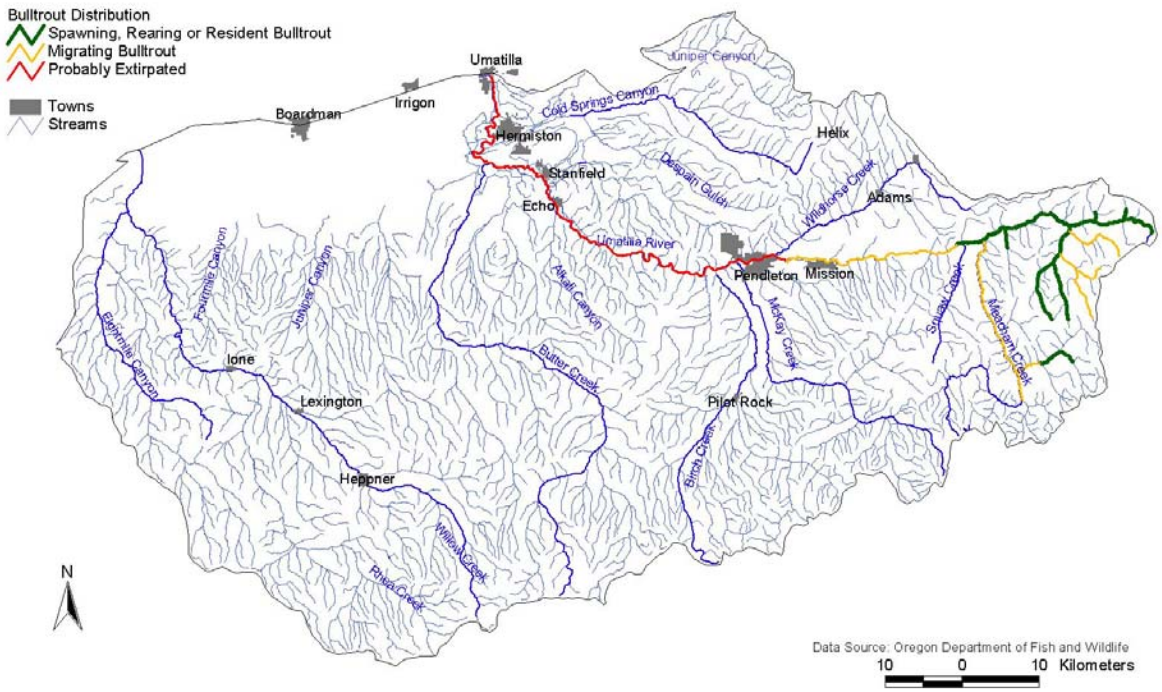


Figure 34. Bull trout distribution, spawning and rearing areas in the Umatilla/Willow subbasin.

Little information exists regarding the historical distribution of bull trout in the subbasin. Recent sightings of bull trout in the mid- and lower Umatilla River and in lower McKay Creek suggest that, in addition to the current distribution, these reaches might have had important historical use and are used only infrequently now and are not considered viable bull trout habitat as a result of degraded stream conditions (Figure 34).

Bull trout require substrate with little sediment, complex habitat, and cold water. As a result of anthropogenic activities much of the Umatilla River mainstem and many of its tributaries have lost suitable habitat for bull trout. This loss has come about through a variety of means. Some of the most important include: the removal of riparian vegetation resulting in a loss of large woody debris into the streams; increased sediment input into the streams which decreases the suitability of the substrate for spawning and rearing, and increased channelization of reaches of streams which leads to a loss of habitat (e.g., slack water areas by meanders) and a decrease in an exchange of cold groundwater. These factors are covered in greater detail in sections 3.1.1.9, 3.1.3.2 and 3.5.1.

Population Risk Assessment

The DBTRP identifies two local populations of bull trout in the Umatilla/Willow subbasin, the Upper Umatilla River including the North and South forks, and Meacham

Creek including the mainstem from the mouth to the confluence of the North Fork and the North Fork including Pot Creek (Figure 32). Buchanan et al. (1997) identified three bull trout populations within the Umatilla subbasin: the North Fork Umatilla, South Fork Umatilla and Meacham Creek Populations. The Recovery Unit Team (a local team established to write the recovery plan) decided to lump the populations in the North and South forks due to the low number of bull trout found in the South Fork and the marginal nature of the habitat for supporting bull trout. The Meacham Creek population has declined from the 1991 status report (Buchanan et al. 1997) and the persistence of bull trout in the Umatilla was considered tenuous by biologists from USFS, CTUIR and ODFW (Northrop 1997).

A five category classification scheme developed by ODFW regarding a population's risk of extinction is shown in Table 32. This scheme was used to describe the Umatilla/Willow subbasin's bull trout populations in 1991 and 1996 (Table 33). Over this period of time the status of the North Fork population declined from "Low Risk" to "Of Special Concern" and the Meacham Creek population was considered to be at high risk of extinction because of relatively poor habitat, warm water temperatures, and low abundance (Buchanan et al. 1997).

In response to perceived population declines, protective angling regulations have been in place since 1989 and harvest of bull trout closed in 1994. A prohibition on angling for bull trout has been in place since 2002. Tribal angling accounts for some harvest, but most tribal members release bull trout (Buchanan et al. 1997).

Table 32. The five category classification system for bull trout populations. Table modified from Buchanan et al. (1997).

<table>
<tr><th>Category</th><th>Life History Stage[a]</th><th>Abundance</th><th>Distribution</th><th>Habitat</th><th>Contact with Non-native Trout</th><th>Recovery Potential</th></tr>
<tr><td>Low Risk</td><td>Large size</td><td>High</td><td>Dipersed</td><td>Excellent</td><td>None</td><td>Not required</td></tr>
<tr><td>Of Special Concern</td><td rowspan="2">↕</td><td rowspan="2">↕</td><td rowspan="2">↕</td><td rowspan="2">↕</td><td rowspan="2">↕</td><td rowspan="2">↕</td></tr>
<tr><td>Moderate Risk</td></tr>
<tr><td>High Risk</td><td>Small size</td><td>Very low</td><td>Isolated and Fragmented</td><td>Poor</td><td>High</td><td>Major effort required</td></tr>
<tr><td>Probably Extinct</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

[a] Large fish size assumes migratory fluvial or adfluvial bull trout while small fish size assumes resident bull trout

Table 33. Status of bull trout populations in the Umatilla subbasin (1991 status: Ratliff and Howell 1992; 1996 status: Buchanan et al. 1997).

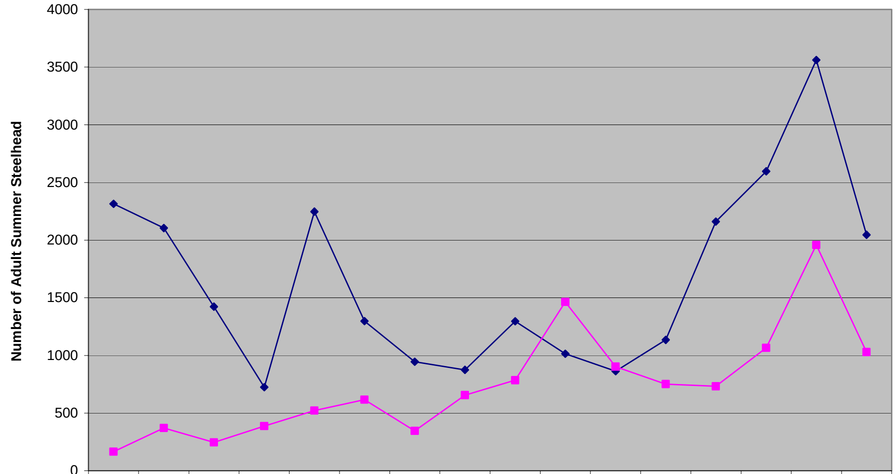
Population	1991 Status	1996 Status
North Fork Umatilla River	Low Risk	Of Special Concern
Meacham Creek	Not Identified	High risk

Summer Steelhead

Abundance and Population Trends

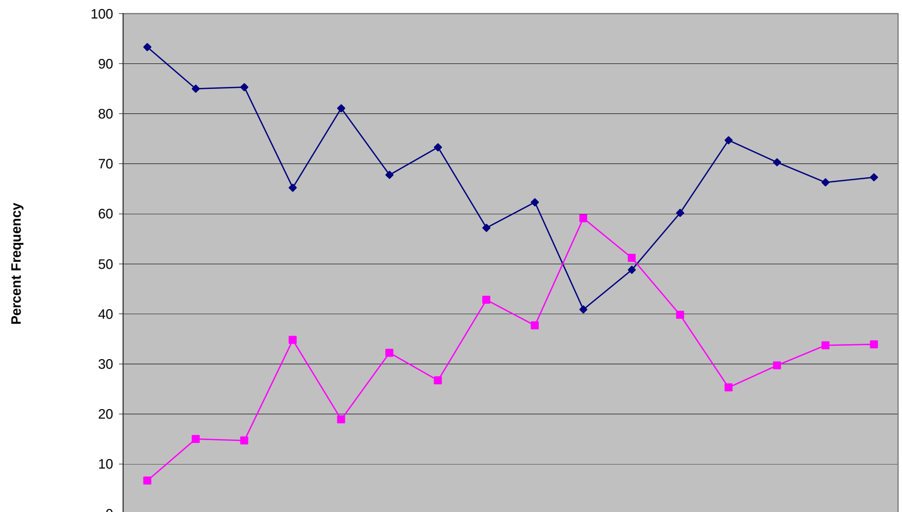
The total return of adult natural and hatchery summer steelhead has been recorded at Three Mile Falls Dam (TMFD) since 1988. The run has varied between a minimum of 1,111 (in 1991) and a maximum of 5,520 (in 2002) adults, with an average 2,412 adults (Figure 35). The natural component of the return to TMFD has varied between 724 (in 1991) and 3,562 (in 2002) adults, and has averaged 1,663 adults. The return of hatchery summer steelhead to TMFD has varied between 165 (in 1988) and 1,958 (in 2002) and averaged 749 adults. From 1988-2003 the naturally reared component of the return ranged from 40.9% to 93.3% (mean 68.9%) of the total steelhead return to TMFD (Figure 36). From 1999 to 2002 there has been an increase in the number of adult steelhead returns to TMFD (Figure 35). However, only in 2002 did these numbers approach the Umatilla/Willow Subbasin Plan objective of 4,000 natural fish and 1,500 hatchery fish.

It is difficult to determine the exact mechanism behind the increase in returns starting in 1999. However, in 1999 there was an apparent phase shift, from positive to negative, in the Pacific Decadal Oscillation (TOAST 2004). Since the negative phase creates favorable ocean conditions for Columbia basin anadromous fish, it is possible that the high returns in 2001-2002 reflect good marine conditions and that when another phase shift occurs, a downward trend in numbers of returning adults will be observed.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Natural	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562	2045
Hatchery	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958	1029

Figure 35. Natural and hatchery summer steelhead adult returns to TMFD between 1988 and 2003. Data provided by CTUIR, DNR Fisheries Program.



	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Natural	93.3	85	85.3	65.2	81.1	67.8	73.3	57.2	62.3	40.9	48.8	60.2	74.7	70.3	66.3	67.30
Hatchery	6.7	15	14.7	34.8	18.9	32.2	26.7	42.8	37.7	59.1	51.2	39.8	25.3	29.7	33.7	33.90

Figure 36. Percent natural and hatchery summer steelhead adults returning to TMFD, 1988-2003. Data provided by CTUIR, DNR Fisheries Program.

Juvenile abundances of steelhead have been estimated at 25 index sites in the upper Umatilla River and its tributaries by the CTUIR (Contor and Sexton 2003). Index sites ranged from 100-300 meters long and abundances were estimated using block nets and multiple electrofishing passes (up to three). Figure 37 shows the catch-per-unit effort averaged across the 25 index sites and reveals a declining trend in juvenile abundance over the surveyed years. However, enough variability among sites exists that it is difficult to determine whether this trend is significant and whether it will continue in the future.

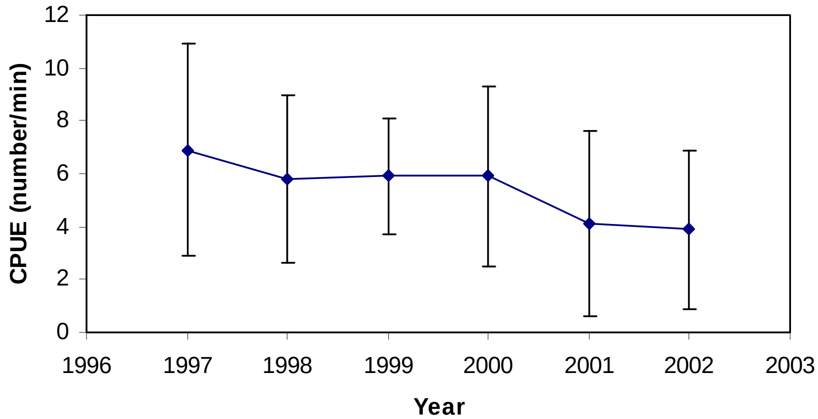


Figure 37. Average annual catch-per-unit effort (CPUE) and standard deviations from 25 index sites in the upper Umatilla River and its tributaries. Data from Contor and Sexton (2003).

Additional data on numbers of steelhead adults counted at TMFD, disposition, escapement, and harvest for run years 1987/1988 to 2001/2002 can be found in Table 1 of Appendix B.

Productivity

Data collected on summer steelhead in the Umatilla/Willow subbasin allow three measures to be made that examine trends in productivity at different life stages. The first measure is an estimate of the number of redds and the relationship between this number and spawning escapement (i.e., the total number available for spawning measured as the number counted at TMFD minus the number taken for broodstock and the estimated number harvested upstream). This measure of productivity provides an estimate of the number of fry produced within the subbasin. The second measure is an estimate of the total number of smolts produced and the number of smolts per spawner. This provides an estimate for a given brood year of the number of salmon leaving the subbasin both in total and per spawner. Finally, productivity can be estimated as the number of returning adults produced per spawning adult. A value of 1 for this ratio indicates that the population is “replacing” itself; in other words, for every reproducing adult, one adult returns to the subbasin. Values greater than 1 suggest that the population is growing and values less than 1 indicate a declining population.

<u>Spawning escapement and redd numbers</u>: Female escapement increased dramatically from 1999 to 2001 (Figure 38). During the same time, redd surveys conducted by the CTUIR indicate that the number of redds per mile also increased (Figure 39). These two values, female escapement and redd density, are tightly correlated (Figure 40).

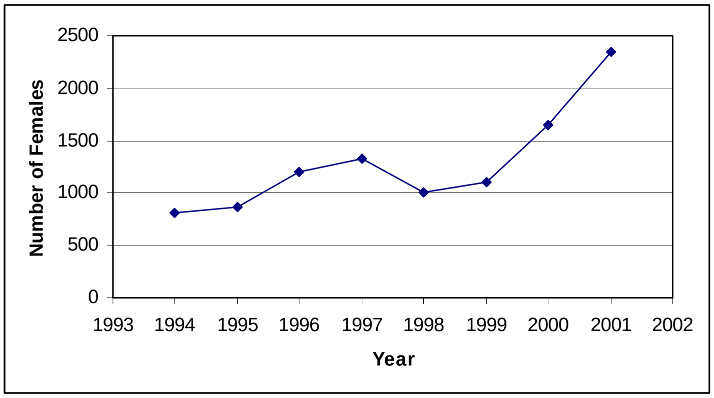


Figure 38. Female spawning escapement in the Umatilla River. Data from Kissner (2003).

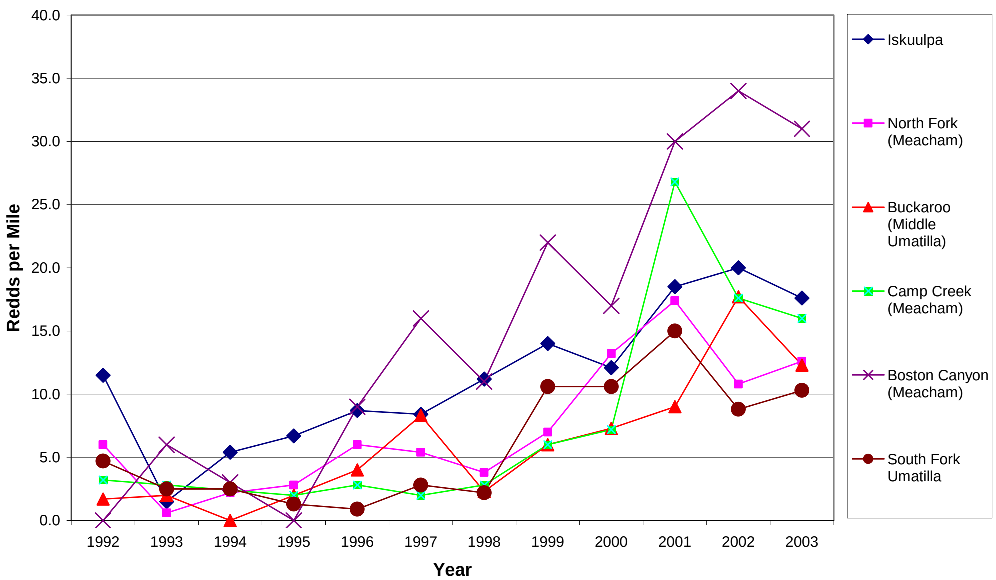


Figure 39. Average redds per mile at six index sites (all are Umatilla River tributaries). Data provided by CTUIR, DNR Fisheries Program.

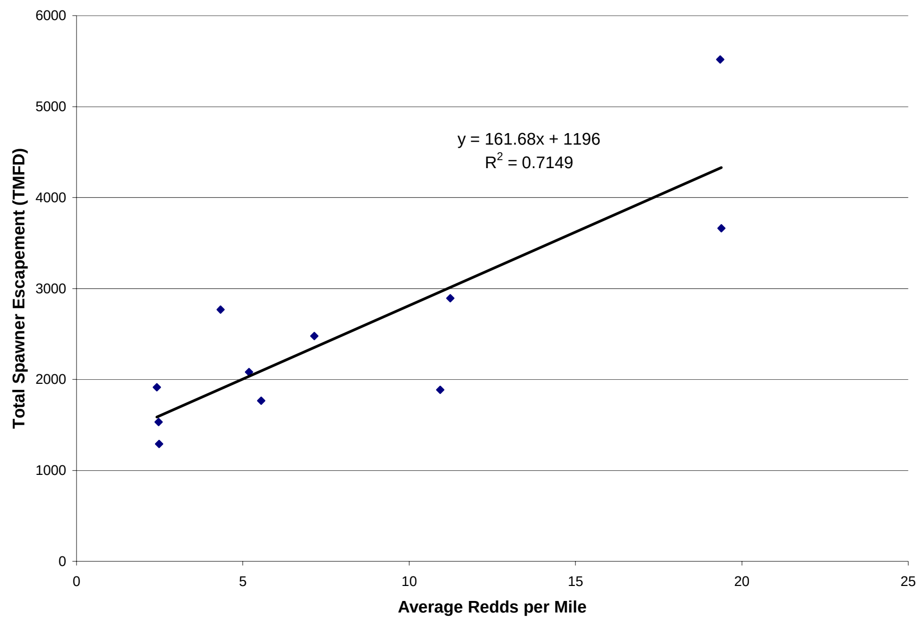


Figure 40. Regression between average redds per mile at six index sites and total spawner escapement to TMFD. Data provided by CTUIR, DNR Fisheries Program.

The increasing number of steelhead redds in the subbasin and the relationship between spawning escapement and number of redds suggest that steelhead productivity is increasing in the subbasin. However, the other measures of productivity do not necessarily support this conclusion.

Number of smolts: The number of smolts leaving the subbasin was estimated from 1995 to 1999. During this time the number of smolts peaked in 1998, but showed no obvious trend over time (Figure 41). Similarly, the ratio of the number of smolts to spawning escapement (an estimate of the number of smolts produced per spawner) peaked in 1998, but also showed no trend over time (Figure 42).

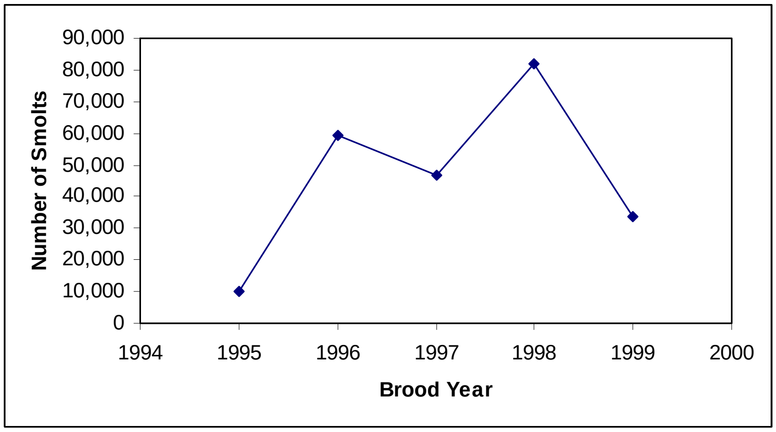


Figure 41. An estimate of the number of steelhead smolts leaving the Umatilla River based on captures of smolts near the Umatilla River's mouth. Data from Chess et al. (2003).

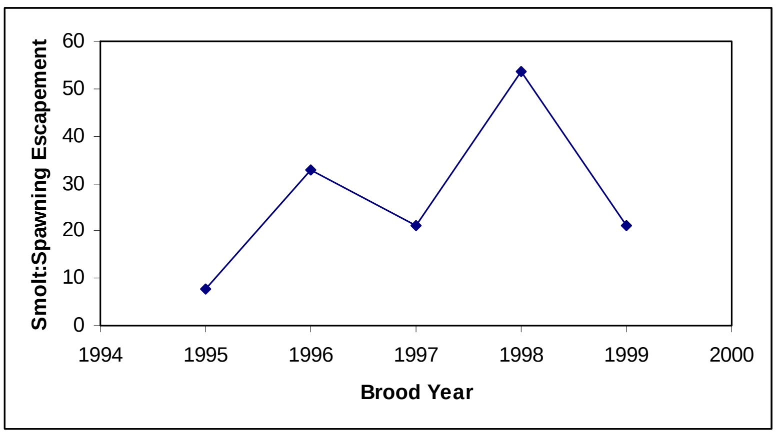


Figure 42. The smolt to spawner escapement ratio for a given brood year. Data from Chess et al. (2003).

No obvious trends in the number of smolts or smolts per spawner exist during the dates when data are available. Because data do not exist for the number of smolts after 1999, it cannot be determined whether the number of smolts increased during the same period that the number of redds increased (1999-2003, Figure 39).

<u>Number or returning adults per spawner</u>: Perhaps the most important measure of productivity is the number of adults that come back to the subbasin per spawning adult. This is the most direct measure of whether, through natural production, a population is growing, replacing itself, or declining. The ratio of progeny (number of returning adults) to spawning escapement for brood years from 1988 to 1997 is shown in Figure 43. In only two years, 1988 and 1996, has the progeny to adult ratio exceeded 1. However, unpublished data indicate that 1998 brood will also produce returns greater than 1.0, but information on 5 year olds is currently not available (personal communication: J.

Schwartz, CTUIR, April, 2004). In two years, 1994 and 1995, returns were almost at replacement; however, in all other years, returns were below replacement (Figure 43). These data reveal that with natural production alone the population would decline (because for six of ten years the ratios are below 1).

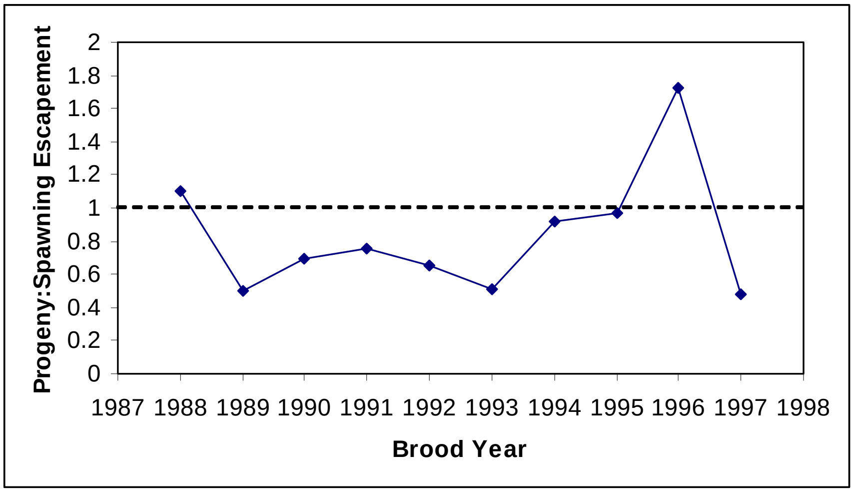


Figure 43. Natural productivity of steelhead in the Umatilla/Willow subbasin as estimated by the number of progeny (adult returns) to the total spawning escapement. A value of 1 indicates that the population is replacing itself (i.e., one returning adult for each spawning adult). Data from Chess et al. (2003).

Productivity associated with hatchery vs. natural adults: An important question regarding productivity of steelhead and salmon populations that are supplemented by hatchery-reared fish is whether hatchery-reared fish contribute to natural production and how that compares to production by naturally-reared fish. Observations at steelhead spawning grounds suggest that hatchery-reared fish contribute to natural production to a similar level as naturally-reared fish. In 2001, 23 observations were made of spawning individuals in which the identity (natural vs. hatchery) could be determined. Hatchery-reared fish made up 26.1% of the spawners and naturally-reared fish made up the other 73.9%. In the same year, the fish available to spawn were 26.6% hatchery-reared and 73.4% naturally-reared. In 2002 a similar trend was found. Hatchery-reared fish made up 45.2% of the observed spawners and naturally-reared fish made up the other 54.8% (from a total of 42 observations), and the fish available to spawn were 34.7% hatchery-reared and 65.3% naturally-reared (Kissner 2003).

Life History

Steelhead display two broad life history patterns often called “summer” and “winter”. General life history traits of these two types are summarized in a report by WDFW and ODFW (2002). Summer steelhead adults return to the Columbia River from March through October after having spent from one to three years in the ocean. Adults spawn from January to June in the year following their entry into freshwater. Juvenile summer steelhead will smolt and migrate to the ocean in May and June. Most wild summer steelhead migrate to the ocean at age 2, while most hatchery smolts migrate at age 1. In contrast, winter steelhead return to the Columbia River from November through April after having spent two years in the ocean. Adults spawn from December through June. Juvenile winter steelhead smolt and migrate to the ocean in May and June. Wild winter steelhead juveniles spend two or three years rearing in freshwater, while hatchery juveniles spend only one year rearing in freshwater.

Only summer steelhead are found in the Umatilla/Willow subbasin. Umatilla River summer steelhead adults typically enter the Columbia River from the Pacific Ocean in June through August of the year before spawning. Entry into the Umatilla River begins in August, peaks in March and is mostly complete by May 1 (Figure 44) (Kissner 2003). On average, 67.2% of the natural and 67.5% of the hatchery adult return is enumerated at Three Mile Falls Dam in a four mouth period between December and March.

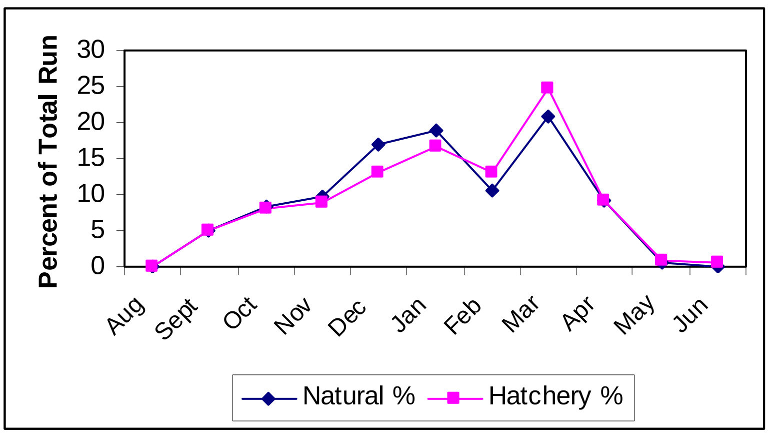


Figure 44. Adult summer steelhead time of entry into the Umatilla River (as measured at TMFD), averaged over the run years of 1994-2000. Data from Kissner (2003).

Spawning has been observed as early as mid-February, peaks in early to mid-April, and is mostly complete by June 1 (Kissner 2003). Redd surveys indicate the same timing of spawning, with redds first observed in index reaches in early March and the number peaking in early April and declining by mid- to late May (Figure 45) (Kissner 2003).

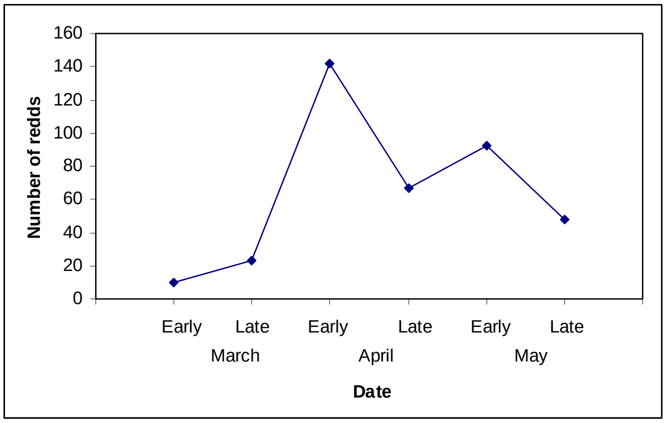


Figure 45. 2001 summer steelhead redd timing in index reaches in Umatilla River tributaries (Camp Creek, Iskuulpa Creek, Buckaroo Creek, South Fork Umatilla, North Fork Umatilla, Meacham Creek, and Boston Canyon Creek). Data from Kissner (2003).

Juveniles emerge from the gravel in late April through early July and most rear for two winters before migrating from the Umatilla River. Based on collections from rotary screw traps near the mouth of the Umatilla River, downstream migration of presmolt and/or smolt begins in October (Chess et al. 2003). However, large numbers are not observed until the following spring when outmigrating smolt numbers peak from early April to late May depending upon the year (Figure 46).

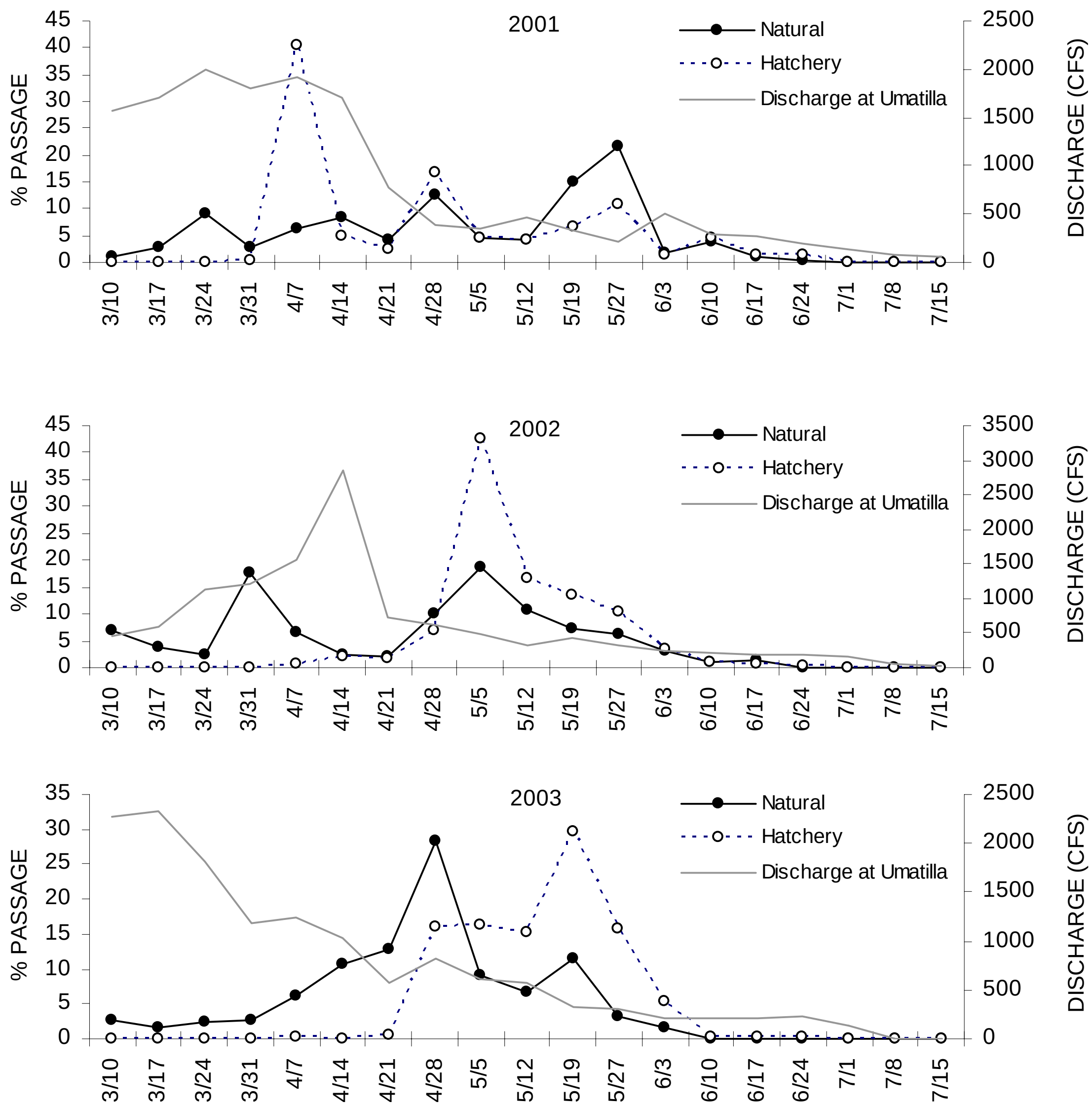
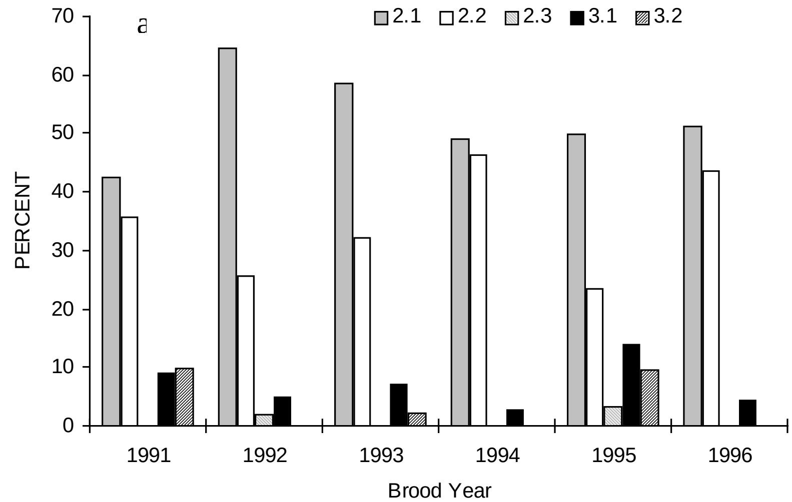


Figure 46. Migration timing of natural and hatchery summer steelhead smolts counted at TMFD during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily flow data at the lower Umatilla River gauge (RM 2.1) were averaged on a weekly interval. Figure provided by ODFW, April, 2004.

One important source of life history diversity within the population is variation in the amount of time spent rearing in the subbasin and the amount of time spent in the ocean. Adults spawn after one (66.9% of the population) or two (33.1%) years of ocean residency. No differences exist between hatchery and natural fish in the duration of ocean residency (Chess et al. 2003). Freshwater residency lasts two or three years, with a very few males staying in freshwater for four years. Figure 47 summarizes these life history patterns for the Umatilla/Willow subbasin population.

While steelhead are known for being iteroparous (individuals spawn multiple times), repeat spawners in the Umatilla/Willow subbasin are rare; repeat spawners account for less than 5% of the return (personal communication: P. Kissner, CTUIR, March, 2004).



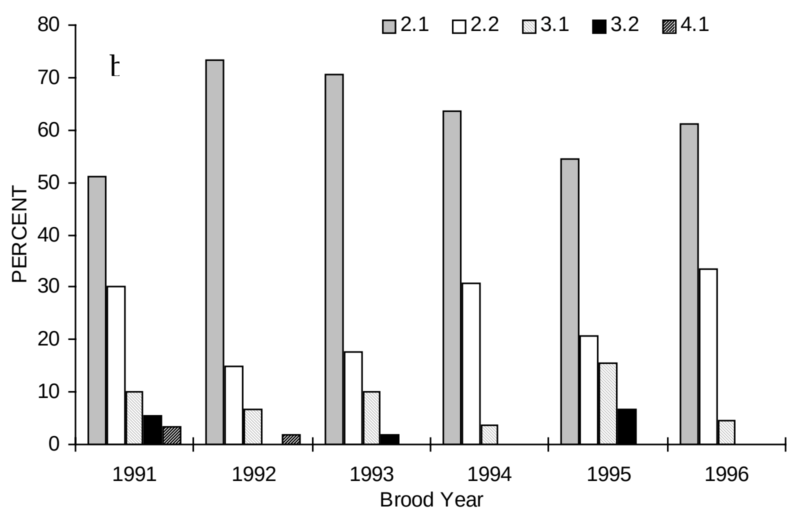


Figure 47. Proportion of natural a) females and b) males returning to TMFD that display a specific life history pattern. Numbers refer to the number of years spent in freshwater (the first number) and in the ocean (the decimal or second number). Age was determined by scale analysis. Figure from Chess et al. (2003).

Within the subbasin there is a fair amount of life history diversity in terms of use of areas within the subbasin. Most spawning occurs in the upper Umatilla mainstem and upper and middle tributaries with some spawning occurring in the middle mainstem. Movement of juveniles is mostly downstream; however, there is a fair amount of movement between the mainstem and tributaries. This movement and the timing of outmigration are summarized in Figure 48.

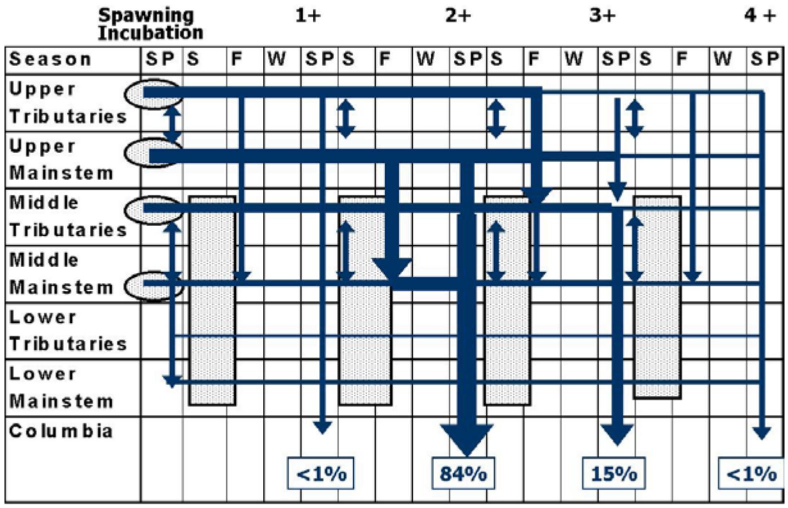


Figure 48. Life history of summer steelhead within the Umatilla/Willow subbasin. Shaded ovals represent areas and times when redds are at risk from scouring and/or sedimentation during high flows. Shaded rectangles represent times and areas where high water temperatures may be limiting Figure from Contor et al. (1998).

Genetic Diversity

Hatchery releases of non-native steelhead commenced in the Umatilla River in 1967 with the introduction of Skamania steelhead. Skamania steelhead were a mixture of coastal steelhead from the Klickitat and Washougal rivers. Since 1980 adults for broodstock have mostly been natural returns collected at TMFD. Usually about 10 hatchery returning males (from natural brood in the previous generation) are also taken and used when necessary.

Results of genetic sampling in 1992 and 1994 indicated that so much genetic variation existed in juvenile redband/steelhead from within a sampling location that it was difficult to detect geographic patterns among fish from different tributaries within the subbasin or to differentiate redband trout from steelhead (Currens and Schreck, 1995).

Current and Historic Distribution

Umatilla River summer steelhead spawning tributaries have been divided into major, medium, and minor producers based on observed escapements and estimated production potential. Major producers are drainages with an estimated natural production potential of over 500 adults annually, medium producers are drainages with production potential of 100-500 adults annually, and minor producers have production potential of less than 100 adults. Major producers, ranked in order of importance, are Meacham Creek and its tributaries and Birch Creek and its tributaries. Medium producers, also ranked in order of estimated importance, are Upper Mainstem Umatilla, South Fork and its tributaries and Iskuulpa Creek. Minor tributaries are the North Fork Umatilla, Buckaroo Creek, Ryan Creek, Minthorn Springs, Bear Creek, Coonskin Creek, McKay Creek, Mission Creek, and Moonshine Creek.

The mainstem Umatilla River is critical rearing habitat for naturally produced summer steelhead. Large numbers of young-of- the-year and lesser numbers of age 1 and 2 juvenile summer steelhead have been observed in the mainstem during escapement surveys and electroshocker sampling. It appears that most of these fish were spawned in lateral tributaries and migrated to the mainstem to rear, as only small numbers of summer steelhead have been observed to spawn in the mainstem (Paul Kissner, CTUIR, unpublished data). The importance of the North Fork Umatilla River to natural summer steelhead production, although it is only a minor summer steelhead spawning and rearing tributary, cannot be overstated. During the critical low summer flow period the influence of cold water from the North Fork moderates high summer temperatures in the upper mainstem and juvenile rearing can occur downstream to Cayuse (RM 67.5). In the mainstem below the McKay Creek confluence (RM 50.5) limited rearing is again possible because of releases of cool water from McKay Reservoir.

Little is known of historical summer steelhead distribution in the Umatilla/Willow subbasin. Oral testimony of tribal members and others indicate that McKay Creek above the reservoir, Butter Creek and Wildhorse Creek historically had spawning summer steelhead (Swindell 1942). Thus, the current spawning distribution is greatly reduced compared to the historic one (Figure 49). In addition, adult steelhead are occasionally found in Willow Creek and a population of resident redband trout is found there; thus it is likely that this creek and its tributaries historically had a population of steelhead. However, a population does not currently exist in Willow Creek as a result of passage problems and the absence of good rearing habitat.

As in most subbasins in the Pacific Northwest that produce natural or wild summer steelhead, anthropogenic impacts in the Umatilla/Willow subbasin have caused major declines in summer steelhead abundance and distribution. The subbasin's adult and juvenile summer steelhead populations have been affected by a variety of human activities that have led to channelization and loss of instream habitat, decreased instream water volume and increased water temperatures, and increased sediment input. These factors are covered in greater detail in Sections 3.1.1.9, 3.1.3.2, and 3.5.1. The distribution of summer steelhead in the Umatilla River has probably been most affected by the construction of McKay Dam, which blocked access to over 30 miles of spawning and rearing habitat. Another major change in summer steelhead distribution was caused by the blockage of Butter Creek by irrigation diversions. Passage problems are also the most likely factor contributing to the extirpation of steelhead in Willow Creek. Passage is blocked during most of the year in Willow Creek below Heppner by diversion dams. Flows in Willow Creek are only substantial enough in the spring to allow passage of remnant mid-Columbia steelhead over the diversion dams located downstream of Heppner (personal communication: K. Ramsey, USFS, January 2004). In addition, Willow Creek Dam was constructed in 1983 upstream of Heppner (at RM 55.5) as a flood control measure. This dam effectively blocks any passage of steelhead and cuts off the upper 24 miles of Willow Creek as well as the upper tributaries.

In addition to passage barriers, unscreened water diversions also have a substantial impact on anadromous fish. Although all known gravity feed diversions in the anadromous portion of the Umatilla subbasin are screened, it is not known to what extent pump diversions have been screened in the anadromous portion of the subbasin. In addition, although the total number of unscreened diversions in Butter and Willow Creeks is unknown, several diversions on Willow Creek are known to lack screens (personal communication: K. Ramsey, USFS, January 2004).

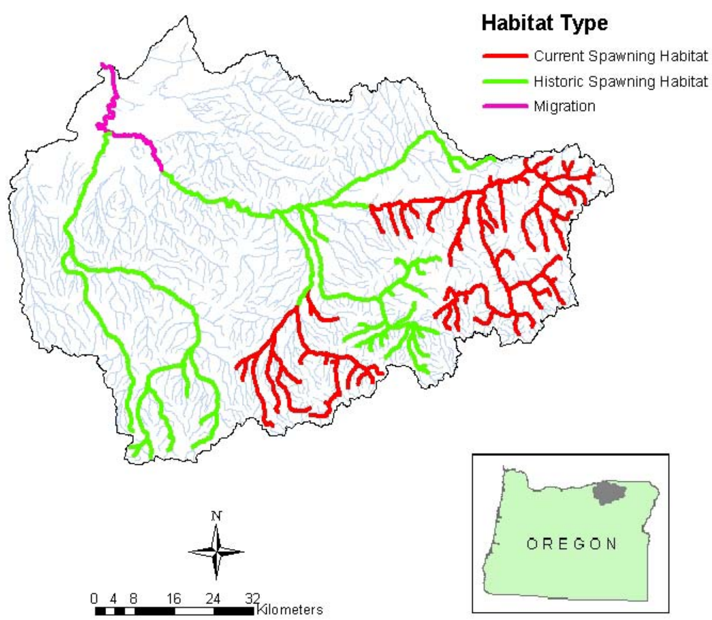


Figure 49. Current and historic distribution of spawning habitat for summer steelhead in the Umatilla River subbasin. This figure does not include the Willow Creek subbasin which was most likely spawning habitat for summer steelhead historically.

The distribution of rearing summer steelhead has most likely been impacted by warm temperatures in the lower sections of the Umatilla River and Willow Creek and by the loss of rearing habitat in the mainstem Columbia River. High water temperatures caused by the ponding of flow in the reservoirs make these areas currently of little value for rearing, except during the winter and spring. While it is unclear how important the Columbia River was for summer steelhead rearing, evidence from Alaska suggests that large rivers can be important habitat for juvenile steelhead overwintering and rearing.

Spring Chinook

Abundance and Population Trends

The total return of spring Chinook salmon to TMFD since the first adult return in 1988 has varied between 13 (in 1988) and 5,061 (in 2002) and averaged 1,968 adults. Annual return of jack spring Chinook salmon during this period varied between 3 and 210. In 1996 the first naturally produced adults returned to TMFD and naturally produced adults have returned each year since then (Figure 50). However, during this time hatchery adults have comprised the great proportion of the return (from 84% to 98.8%). The estimated natural component of the adult return to TMFD from 1996-2003 has varied between 22 (in 1999) and 348 (in 2000) and averaged 158 adults. As with steelhead, between 1999 and 2002 an increasing number of adults have returned to TMFD and it is possible that this reflects a phase shift in the PDO to more favorable ocean conditions.

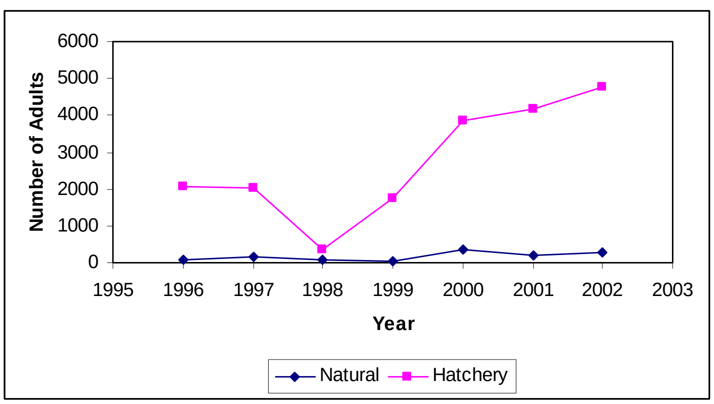


Figure 50. Spring Chinook adult returns to TMFD. Data from Kissner (2003).

Juvenile abundances of spring Chinook have been estimated through electrofishing at 25 index sites in the upper Umatilla River and its tributaries by the CTUIR (Contor and Sexton 2003). Figure 51 shows the catch-per-unit effort averaged across the 25 index sites. The number of juveniles caught varied across years and varied greatly between sites within years (as revealed by the large standard deviations in Figure 51). In contrast to adult returns to TMFD, no obvious trend in juvenile numbers exists across years.

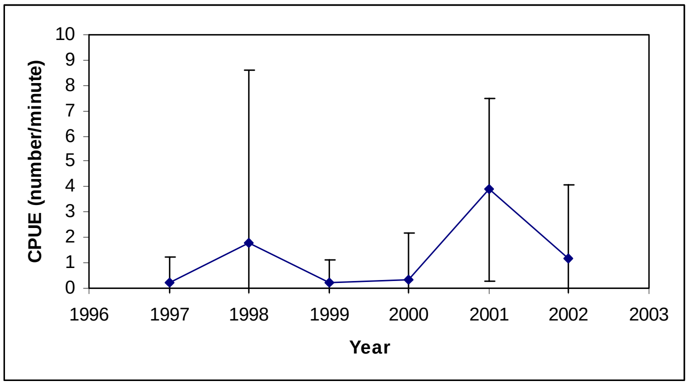


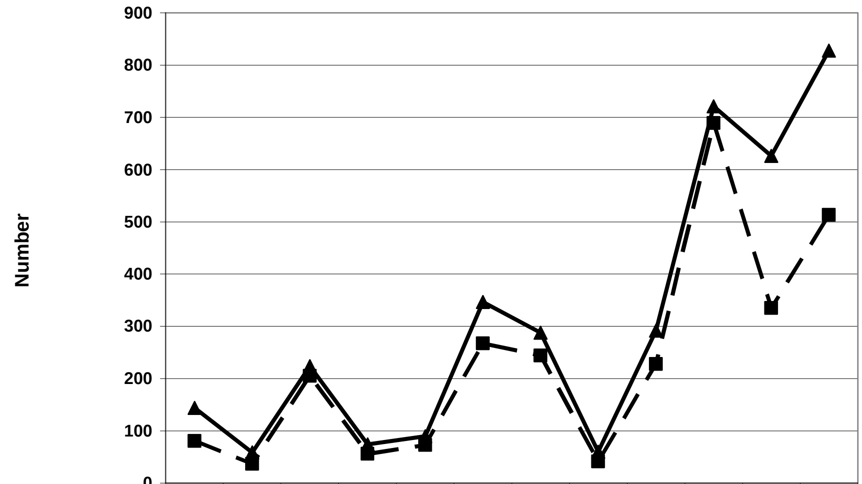
Figure 51. Average annual catch per unit effort (CPUE) (± 1 standard deviation) from 25 index sites in tributaries of the Umatilla River for juvenile spring Chinook. Data from Contor and Sexton (2003).

Additional data on numbers of spring Chinook adults counted at TMFD, disposition, escapement, and harvest from 1989 to 2002 can be found in Table 2 of Appendix B.

Productivity

As with steelhead, data exist to estimate spring Chinook productivity in three ways, the number of redds and redd to spawner ratio, the number of smolts and smolt to spawner ratio, and the number of adults returning to spawner ratio.

Spawned females and redd numbers: Because spring Chinook spawn over a fairly small area in the Umatilla/Willow subbasin (see Figure 59) it is possible to get a count of the number of females that actually spawned by an examination of carcasses. This is a much more accurate measure of the number of individuals that spawn than spawning escapement. A tight relationship exists between the number of spawners and the number of redds (based on a linear regression analysis, $R^2 = 0.88$, $p < 0.001$) (Figure 52). As with steelhead, the number of redds and the number of spawners increased from 1999 to 2002, suggesting an increase in productivity in this system (Figure 52). However, the number of spawners is a function of the number of returns to TMFD, and thus this apparent increase in productivity could reflect improved ocean conditions and not necessarily changes within the subbasin.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Redds observed	144	59	224	74	90	347	288	60	292	721	626	828
Spawned females	81	37	205	56	73	267	244	41	228	689	335	513

Year

Figure 52. The number of spring Chinook spawned females and redds counted in spawning reaches. Figure from Kissner (2003).

Number of smolts and smolts per spawner: The number of spring Chinook smolts leaving the subbasin was estimated from 1995 to 1999 using a irrigation canal bypass trap (in 1995 and 1996 at RM 3.7) and rotary screw traps (in 1997, 1998, and 1998 at RM 1.2). During this time the number of smolts peaked in 1997, but showed no obvious increasing or decreasing trend over time (Figure 53). The ratio of the number of smolts to the number of adult carcasses peaked in 1998 (Figure 54) because of a large drop in the number of adult carcasses found in 1998 relative to 1997 (Figure 52). Again, no obvious trend over time exists for this measure of productivity (Figure 54).

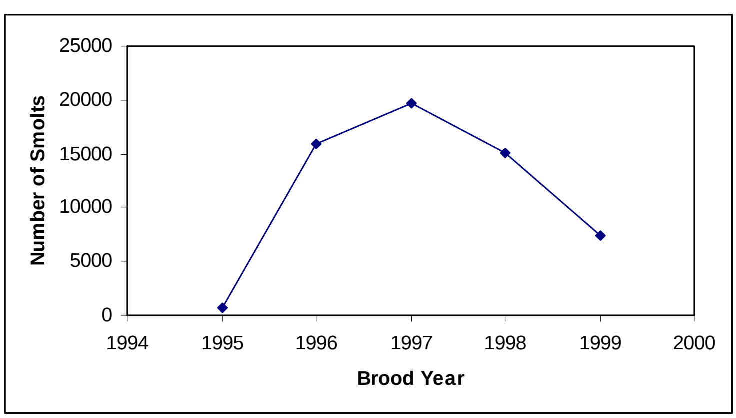


Figure 53. An estimate of the number of spring Chinook smolts leaving the Umatilla River based on captures of smolts near the Umatilla River's mouth. Data from Chess et al. (2003).

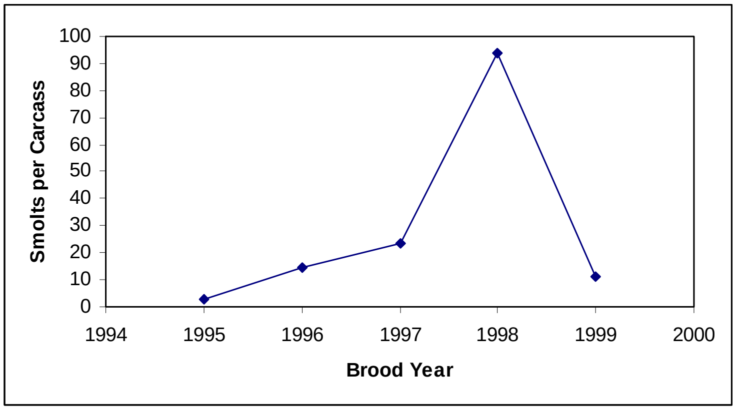


Figure 54. The smolt to adult carcass ratio for a given brood year. Data from Chess et al. (2003).

<u>Number of returning adults per spawner</u>: This measure of productivity was estimated by determining the total number of adult returns for a given brood year divided by an estimate of the number of adults that successfully spawned (based on the proportion of carcasses found that were spawned out). A value of 1 for this measure indicates that the population is replacing itself and values greater than 1 indicate that the population is growing. For the six years in which data are available to calculate this measure of productivity, the value exceeded 1 only in the first year (in 1992), and was low with no obvious trend for the five years after that (Figure 55). Thus, natural production by spring Chinook is not replacing the small population that currently exists in the subbasin.

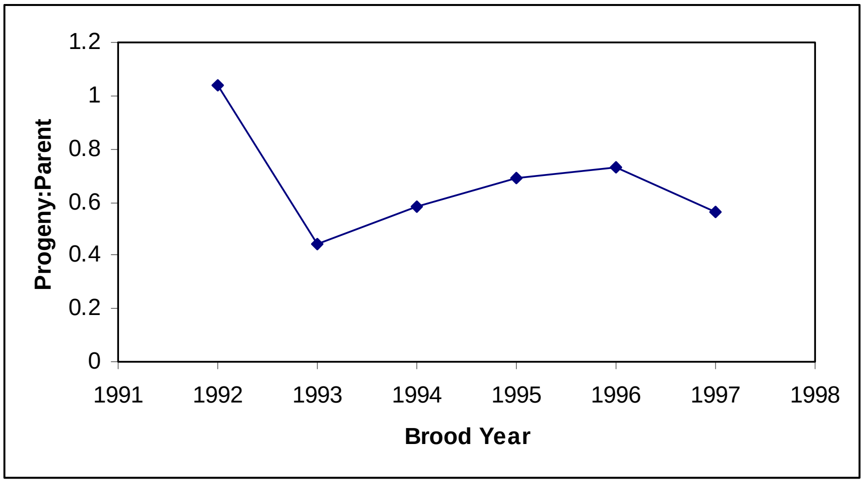


Figure 55. Natural productivity of spring Chinook in the Umatilla/Willow subbasin as estimated by the number of progeny (adult returns) to the total spawning escapement. Data from Chess et al. (2003).

Life History
The endemic spring Chinook population went extinct in the Umatilla/Willow subbasin in the early 1900s. In 1986 spring Chinook salmon were re-introduced into the subbasin. These fish were from Carson Hatchery Stock which is a mixture of upriver spring Chinook races that spawn above Bonneville Dam. This stock enters the Columbia River from the ocean from February through April. Entry into the Umatilla River begins in late March, peaks in May, and is mostly complete by the end of June (Zimmerman and Duke 1996). The majority (approximately 75%) of a run enters the Umatilla River in May. Adult returns to the subbasin from natural spawners began in 1996, but make up only a small percentage of the total adult returns (Figure 50).

Natural Umatilla River spring Chinook salmon adults return to spawn after two or three years of ocean residency. Because a high percentage of the spring Chinook salmon return to the Umatilla River are of hatchery origin and very few naturally produced fish have returned to TMFD, it is difficult to determine the age structure of the naturally-produced population in the Umatilla/Willow subbasin. However, the nearby John Day subbasin (which drains into the same Columbia River pool) has a naturally reproducing population of spring Chinook that can be used as a surrogate to reconstruct the likely age structure of the natural return to the Umatilla River. Wild spring Chinook salmon adults returning to the John Day are 81% age four (2 years ocean residency) and 16% age 5 (3 years ocean residency). “Jacks” make up three percent of the return and are of age 3 (1 year ocean residency).

In the Umatilla/Willow subbasin spawning begins in early to mid-August, peaks in late August/early September, and ends in late September (Figure 56). Juveniles emerge from the gravel in January and February (Kissner 2003).

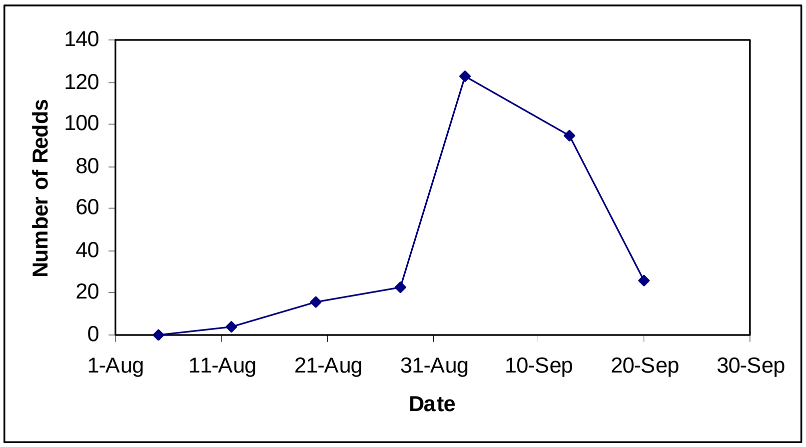


Figure 56. Timing of new spring Chinook redds in the Umatilla subbasin. Data from Kissner (2003).

Smolt outmigration from the subbasin begins in March, peaks in late March through late April, and is generally complete by late May (Figure 57). However, downstream movement of presmolts and smolts in the upper river begins in October and these individuals rear for 5 or 6 months in the middle mainstem (Figure 58).

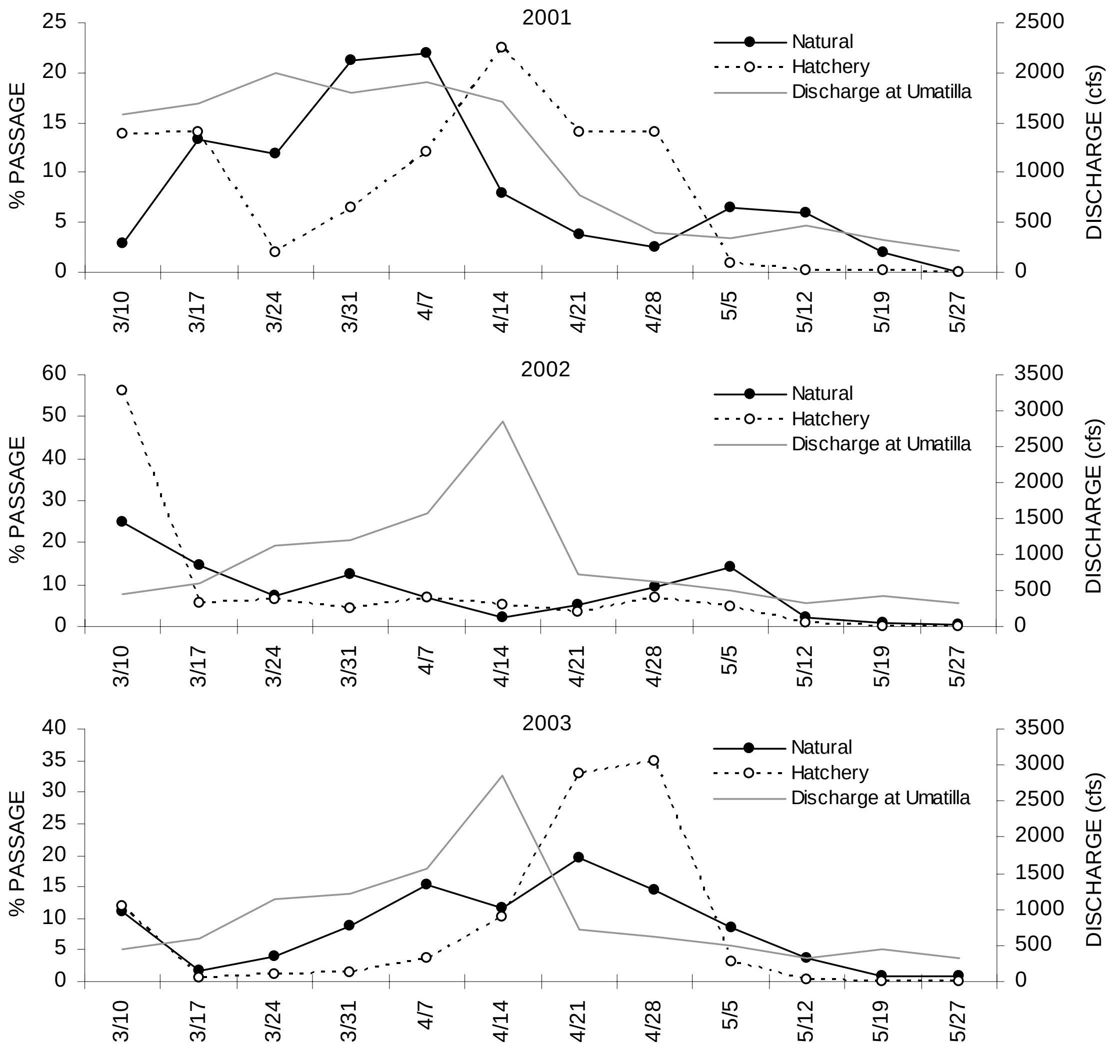


Figure 57. Migration timing of natural and hatchery spring Chinook smolts counted near the Umatilla River mouth during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily Flow data at the lower Umatilla River gauge (RM 2.1) was averaged on a weekly interval. Figure from Chess et al. (2003).

Figure 58 summarizes the life history diversity of naturally produced spring Chinook within the subbasin associate with the timing of movement between tributaries and different areas of the mainstem. Most spawning occurs in the upper mainstem and upper tributaries as well as some spawning in the middle mainstem. Juvenile rearing occurs in the same areas; however, juveniles in the middle mainstem often move upstream in late spring and early summer as water temperatures rise in the middle mainstem. That fall pre-smolts begin to move downriver and can be found throughout the middle and lower mainstem.

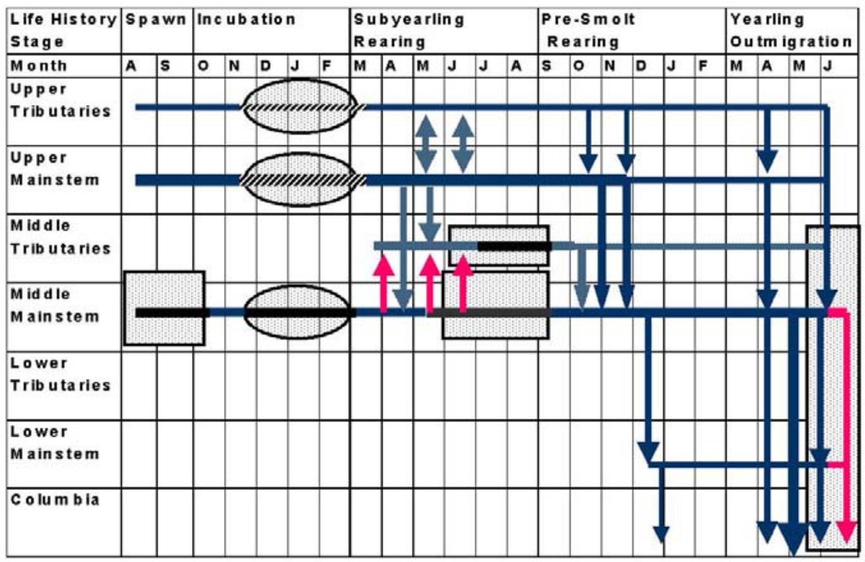


Figure 58. Life history chart of naturally produced Umatilla spring Chinook salmon; shaded ovals represent areas and times where redds are at risk from scouring and/or sedimentation during high flows; shaded rectangles and red arrows represent times and areas where high water temperatures may be limiting. Figure from Contor et al. (1998).

Genetic Diversity
The spring Chinook population in the subbasin is derived from the Carson Hatchery stock. This stock is a mixture of races of upriver spring Chinook that spawn above Bonneville Dam.

No work has been conducted on the genetic diversity of the Umatilla/Willow subbasin spring Chinook population.

Current and Historic Distribution
Most of the natural production of spring Chinook salmon in the Umatilla River occurs in the North Fork Umatilla and in the Umatilla mainstem from the Forks (RM 89.5) to the Bar M Ranch (RM 86) (Figure 59). Minimal production also occurs in Meacham Creek and the North Fork of Meacham. This restricted spawning range results from the high water temperatures that occur downstream of RM 86 during the spawning and early incubation season (mid-August to mid-October). Young-of-the-year have been observed at high densities for approximately 5 miles below the forks during biological surveys.

Older juveniles are more tolerant of higher water temperatures and are thus found rearing and overwintering in reaches of the middle mainstem and tributaries (Figure 58).

Little is known of historical spring Chinook salmon distribution in the Umatilla River Subbasin. However, oral testimony from tribal members and immigrants indicates that the North Fork Umatilla, McKay Creek above the reservoir, and the North Fork of Meacham Creek once had harvestable levels of spring Chinook salmon (Swindell 1942). In addition, spawning occurred in the mainstem from the forks (RM 89.5) to the confluence of McKay Creek (RM 50.5) and in McKay, Birch, and Butter creeks (Figure 10). It is unclear whether the Willow Creek subbasin historically had a spring Chinook population. A compilation of tribal fishing sites gathered from local tribal elders does not mention Willow Creek (Lane and Lane 1979); in addition, Willow Creek is not mentioned in a summary of salmonid distributions made by various fisheries agencies (Van Cleave and Ting 1960). This evidence suggests that the Willow Creek subbasin was not historically an important spawning or rearing area.

Spring Chinook salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities that led to channelization and loss of instream habitat, decreased instream water volume and increased water temperatures, and increased sediment input. These factors are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1. Currently, the reestablished returns of Carson stock spring Chinook salmon are threatened by many of the same anthropogenic impacts that drove the original population extinct. However, the most important factor currently limiting spring Chinook production and distribution is high water temperatures in the mainstem below RM 85.

Figure 59. Current and historic distribution of spawning habitat for spring Chinook in the Umatilla River subbasin.

Fall Chinook

Abundance and Population Trends
The total return of fall Chinook salmon to TMFD since the first adult return in 1988 has varied between 91 (in 1988) and 1,146 (in 2001) and averaged 493 adults. Annual return of jack fall Chinook salmon during this period varied between 29 and 1,158 and averaged 275 jacks (Figure 60). In 1995 the first naturally produced adults returned to TMFD. In 1996 no naturally-produced adults returned and in the following years there was some return, but in very low numbers (Figure 61). However, during this time hatchery adults have comprised the great proportion of the return. The estimated natural component of the adult return to TMFD from 1996-2003 has varied between 22 (in 1999) and 348 (in 2000) and averaged 158 naturally produced adults. As with steelhead and spring Chinook, between 1999 and 2001 an increasing number of adults have returned to TMFD and it is possible that this reflects a phase shift in the PDO to more favorable ocean conditions.

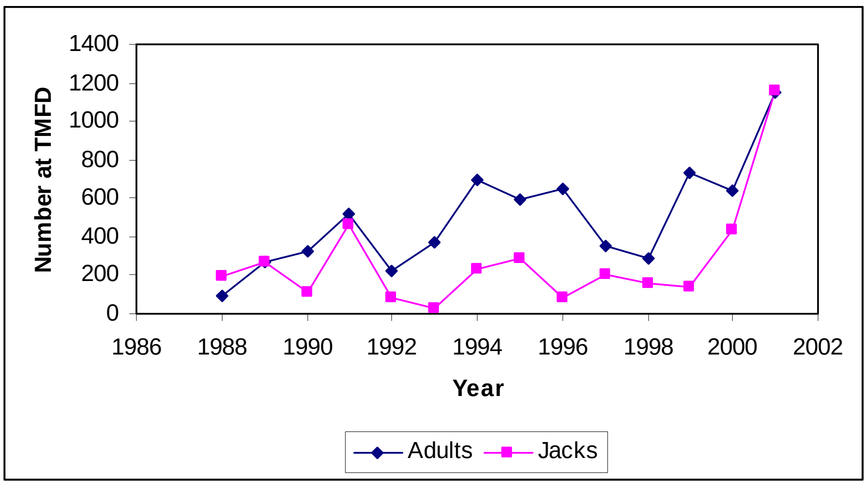


Figure 60. The total number of adult and Jack fall Chinook returns to TMFD from 1988 to 2001. Data from Chess et al. (2003).

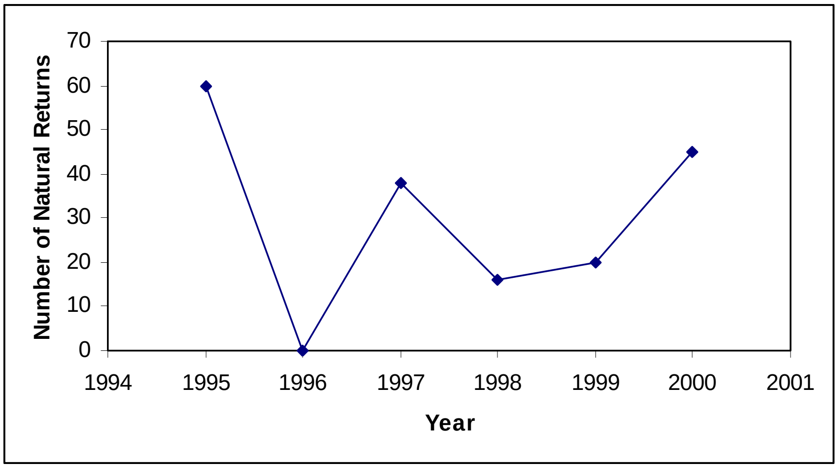


Figure 61. The number of naturally-produced adult fall Chinook returns to TMFD. Data from Chess et al. (2003).

Additional data on numbers of fall Chinook adults and jacks counted at TMFD, disposition, and escapement from 1988 to 2001 can be found in Table 3 of Appendix B.

Productivity

Female escapement and egg deposition: Data on female escapement above TMFD are shown in figure 62 for 1991 to 2000. Female escapement has been very low during this time with no obvious trends except for peak numbers in 1994 and 1995. In 1996 females from the Priest Rapids and Ringold Springs hatcheries were outplanted in the Umatilla River above TMFD to enhance productivity.

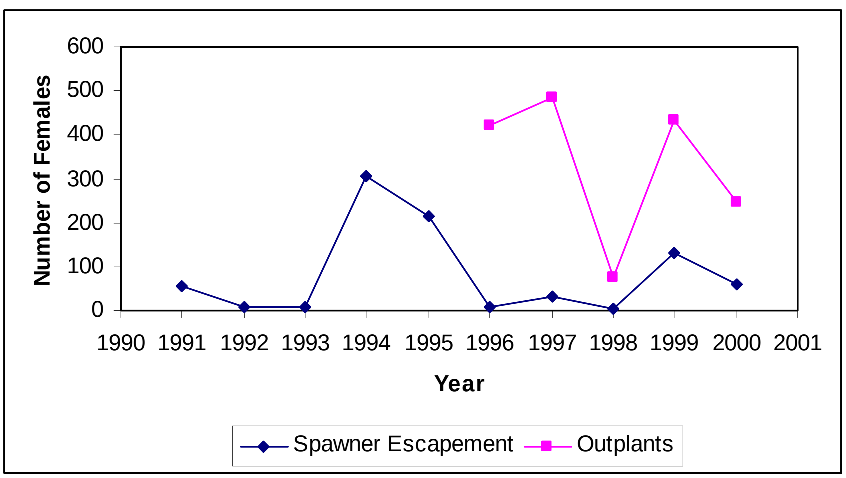


Figure 62. Female escapement above TMFD and the number of females outplanted above TMFD. Data from Chess et al. (2003).

The percent of spawning escapement that actually spawns was estimated by examination and dissection of carcasses to determine whether individuals were spawned out or had died before spawning (Kissner 2003). The surveys were conducted from 1991 to 2001 and reveal that a large percentage of fall Chinook adults spawn (Figure 63).

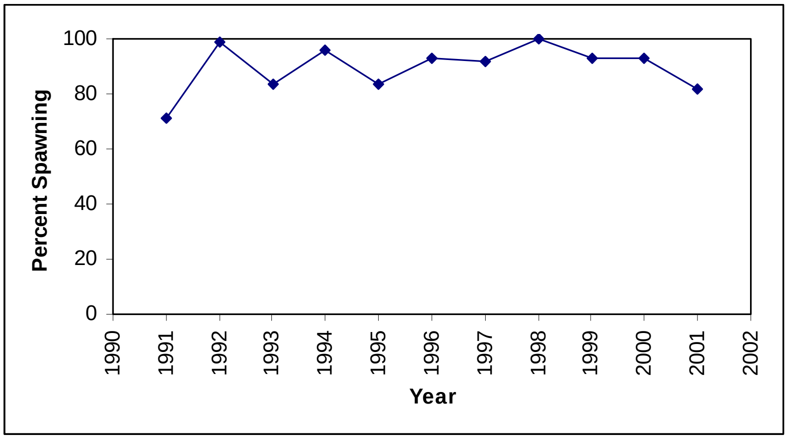


Figure 63. The percentage of carcasses that had spawned as an estimate of the percent of spawning escapement that actually spawns before dying. Figure modified from Kissner (2003).

Redd counts for fall Chinook are difficult for two reasons. First, fall Chinook spawn in the lower and middle Umatilla River mainstem (see Figure 71) in the same areas and at the same time as coho, making the identification to species of a redd difficult. In addition, there is much silt in the middle and lower mainstem, which, when disturbed, can obscure redds. Therefore, estimates of the number of eggs deposited have been made based upon female spawning escapement and the number of outplanted females (Figure 64). No obvious trends exist in egg deposition over this time. Very low numbers were estimated in 1998 as a result of both low spawner escapement and a small number of outplanted females during this year (Figure 62).

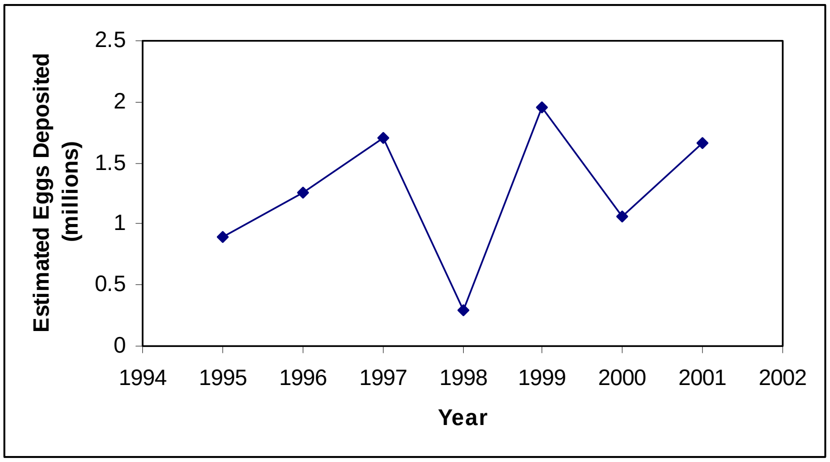


Figure 64. Estimated fall Chinook egg deposition based on female escapement (all years) and outplanted females (1996-2001 only). Figure modified from Kissner (2003).

Number of smolts and smolts per spawner: The numbers of fall Chinook smolts leaving the subbasin have been estimated since 1996 using traps near the mouth of the Umatilla River. Data are shown for the years 1996-2000 in Figure 65. In 1996 and 1998 the numbers were very low, below 1000. Only in 1997 were the number of smolts large, reaching almost one-quarter million; it is unclear as to why the numbers were so large that year.

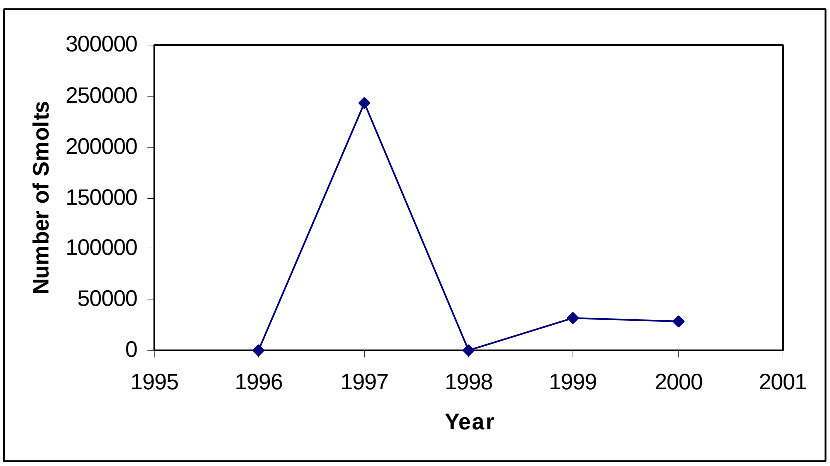


Figure 65. The estimated number of smolts leaving the Umatilla River based on numbers captured in traps near the river's mouth. Data from Chess et al. (2003).

The number of smolts per spawner shows a similar trend (Figure 66). A strong peak occurred in 1997, and very low numbers in all other years. These data do not suggest any trend in productivity for fall Chinook since 1996 when adults started to return to the subbasin.

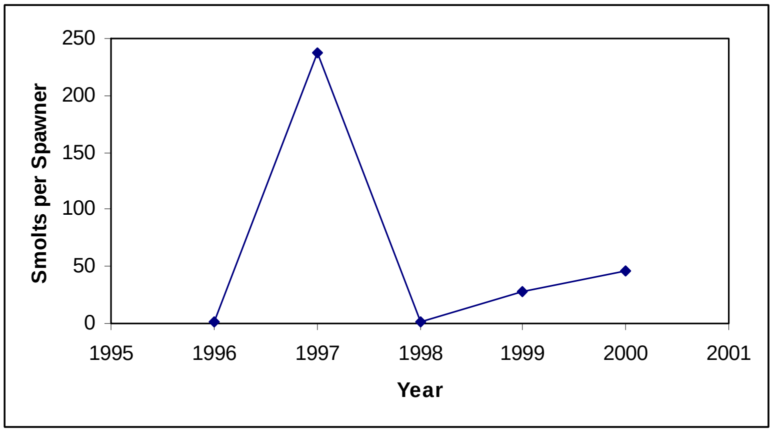


Figure 66. Estimates of the number of smolts produced per spawner. Data from Chess et al. (2003).

<u>Adult returns per number of spawners:</u> For fall Chinook this ratio was calculated as the number of adults returning to TMFD for a given brood year by the total number of adults available to spawn (i.e., spawning escapement at TMFD and in 1996 outplanted females). Data exist to calculate this ratio for only three years (Figure 67). For each of these years, the value of this measure of productivity was well below 1 (the value that indicates replacement of the population). This was true even in 1996 when over 400 females were outplanted above TMFD to supplement the spawning escapement.

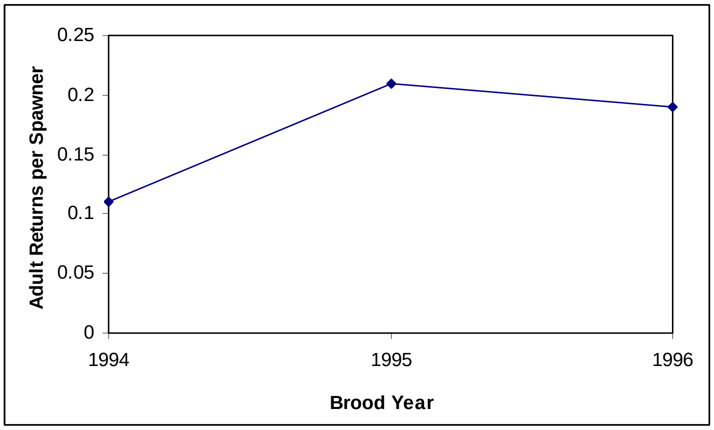


Figure 67. Estimates of the number of adult returns per number of adults spawning for a given brood year. Data from Chess et al. (2003).

All three estimates of productivity indicate that fall Chinook productivity is very low in the subbasin. Developing an understanding of the low level of smolt production and returns is an important issue. The most likely factors influencing productivity of fall Chinook are discussed below under *Current and Historic Distribution.*

Life History

The endemic fall Chinook stock was extirpated from the subbasin in the early 1900s. In 1982 fall Chinook were reintroduced into the subbasin with Tule stock and then starting in 1983 with Upriver Bright stock (Evans 1984).

Fall Chinook spend from two to six years in the ocean; however, no data is available for the age structure of adults returning to the Umatilla/Willow subbasin. Juvenile fall Chinook spend only three to four months in the subbasin before outmigrating as subyearling smolts (Figure 70).

Adults return to the Umatilla River from August through December. Spawning occurs in the lower and middle sections of the mainstem Umatilla River from early November to mid-December (Figure 68). Juveniles emerge from the gravel in April and subyearlings begin to outmigrate in May. The timing of peak outmigration varies from year to year and between natural and hatchery smolts. However, the peak generally occurs between late May and early July and outmigration ends by mid-July (Figure 69).

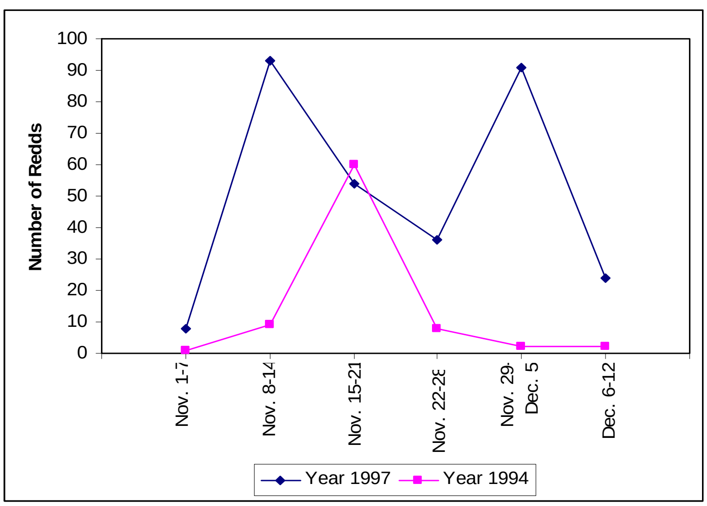


Figure 68. Timing of spawning based upon counts of new fall Chinook redds in the Umatilla River. Data from Kissner (2003).

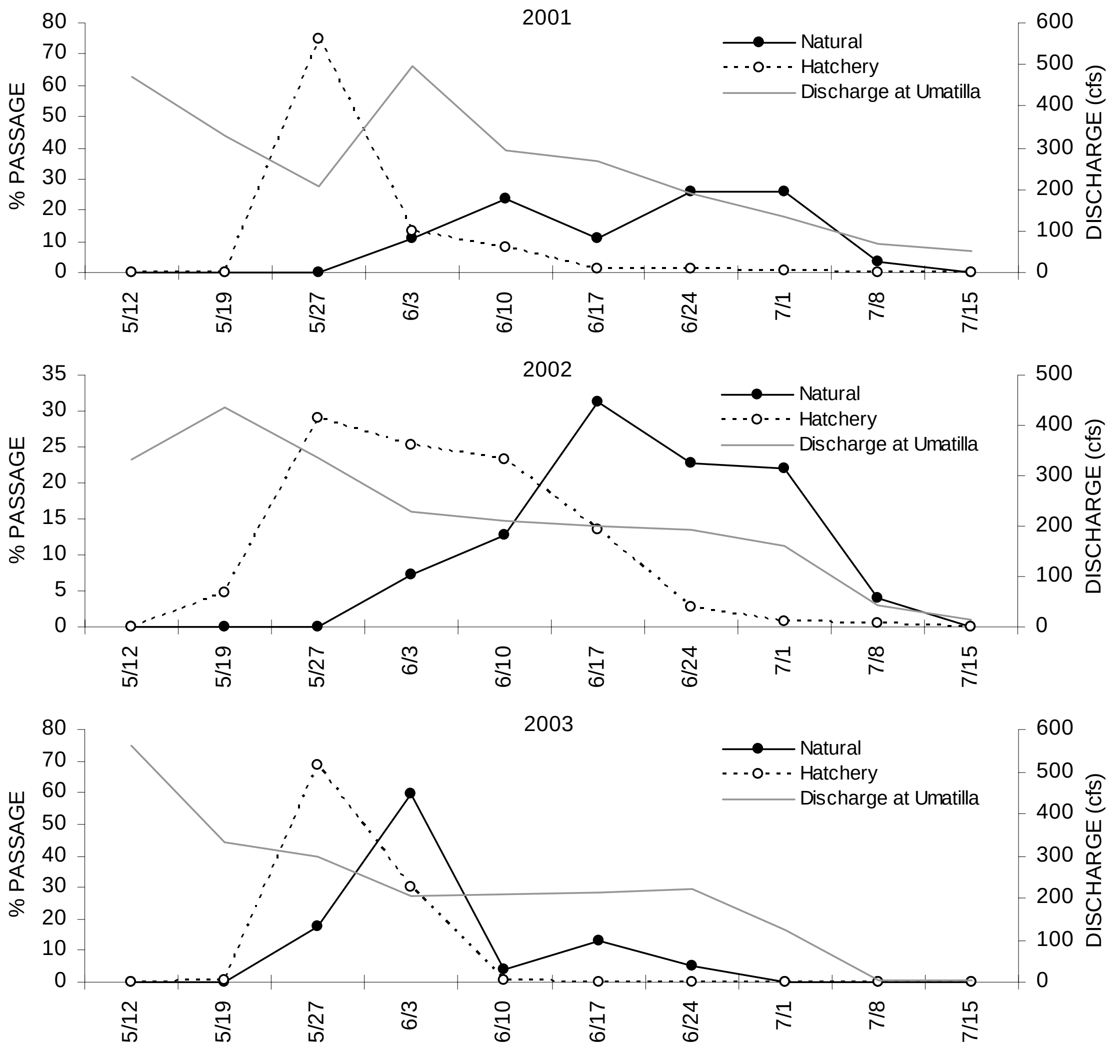


Figure 69. Migration timing of natural and hatchery fall Chinook smolts counted near the Umatilla River mouth during 2001, 2002, and 2003. The percentages were from weekly totals of fish divided by the respective total for the outmigration period. Daily Flow data at the lower Umatilla River gauge (RM 2.1) was averaged on a weekly interval. Data provided by ODFW, May, 2004.

Naturally produced fall Chinook have the most restricted use of the subbasin of all the anadromous focal species (Figure 70). Adults spawn in the mainstems below RM 50.5 and juveniles rear in these same areas before outmigration. Occassionally, fall Chinook redds have been found farther upstream; in 1998 4 redds were found in Buckaroo Creek (a tributary to the mainstem that enters the Umatilla River at RM 70) and in 1999 fall Chinook redds were observed in the mainstem up to RM 67. Use of tributaries is minimal at all life stages.

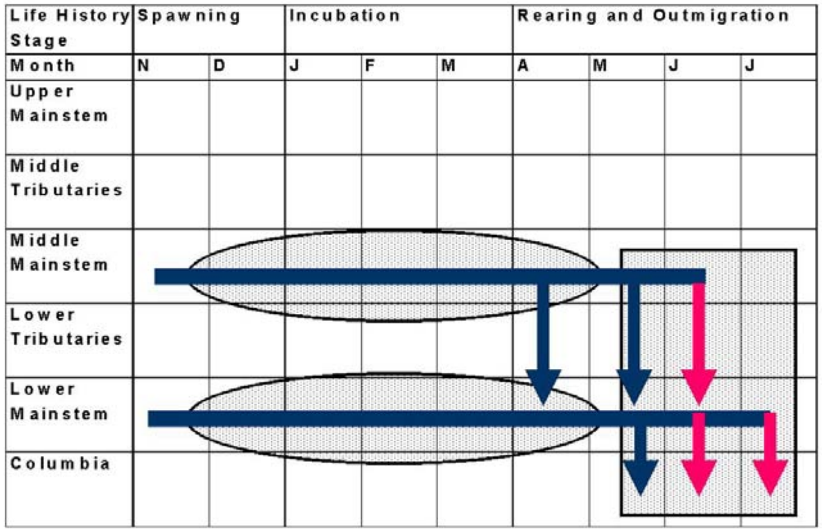


Figure 70. Life history chart of naturally produced Umatilla fall Chinook salmon; shaded ovals represent areas and times where redds are at risk from scouring and/or sedimentation during high flows; shaded rectangles and red arrows represent times and areas where high water temperatures may be limiting. Figure from Contor et al. (1998).

Genetic Diversity

The endemic stock of fall Chinook in the subbasin was extirpated in the early 1900s. In 1982 fall Chinook were reintroduced using Tule stock and then in 1983 with Upriver Bright stock. No measurements of genetic diversity have been made of the population in the subbasin.

Current and Historic Distribution

The current distribution of fall Chinook spawning adults and rearing juveniles is shown in figure 71. Historically, fall Chinook were found in the Umatilla/Willow subbasin. However, the historic distribution of fall Chinook in the subbasin is unknown because traditionally fall and spring Chinook were recognized as one species and it is unclear where divisions between their spawning habitat occurred.

Fall Chinook salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities including habitat destruction, high water temperatures, and reduced flows. Another factor that might have played a larger role in the extinction of fall Chinook in the subbasin than it did for steelhead or spring Chinook was the construction and operation of Three Mile Falls Dam in 1914. This dam would have blocked or greatly impeded access to the river during low flow periods, late summer and early fall when fall Chinook are returning to the subbasin (BOR 1988).

Currently, the reestablished returns of Upriver Bright stock fall Chinook salmon are threatened by many of the same anthropogenic impacts that most likely drove the original population extinct. For fall Chinook perhaps the most important factors that currently limit productivity and may have led to extinction of the original population are: high levels of sediment, which reduces egg survival; high scouring flows, which increase egg and juvenile mortality, and high summer water temperatures, which increase outmigrating smolt mortality (Chess et al. 2003). Interestingly, releases of cold water from McKay reservoir might also limit the current productivity and distribution of fall Chinook. An early analysis of the Umatilla River and its suitability for fall Chinook spawning suggested that the great majority of spawning habitat was above Pendleton (RM 55) (Boyce 1986). However, few fall Chinook spawn above Pendleton, and it is possible that releases from McKay reservoir have created a thermal barrier (cool water below McKay confluence, RM 50.5, and warm water above it) beyond which few fall Chinook pass (Chess et al. 2003).

The factors limiting the distribution and abundance of fall Chinook are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1.

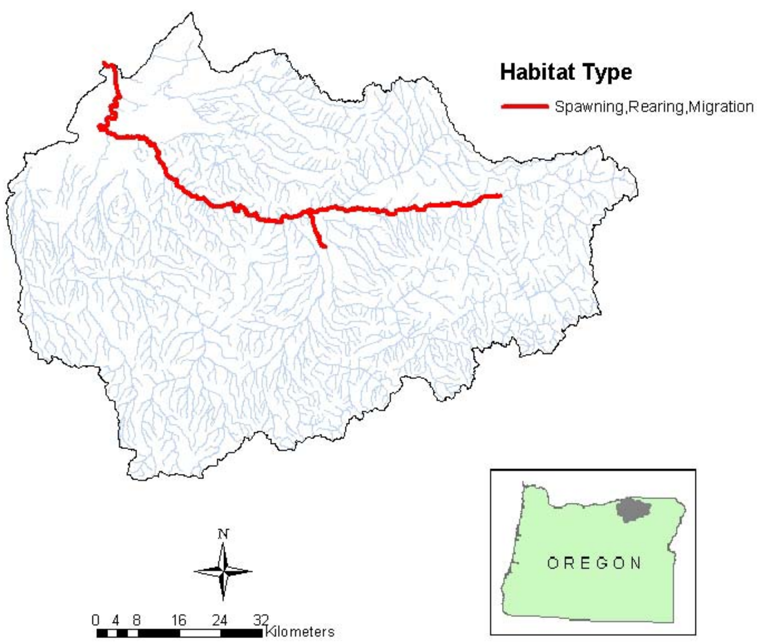


Figure 71. Current fall Chinook habitat use in the Umatilla River.

Coho

Abundance and Population Trends

Coho jack and adult returns to TMFD have been enumerated since 1988. From 1988 to 2003 adult returns have varied widely from 356 (in 1992) and 22,792 (in 2001) and averaged 3,669 adults (Figure 72). Jack numbers have also varied during this time from 16 (in 1993) to 1,276 (in 2000) and averaged 361 jacks (Figure 72). Because of the high costs of marking hatchery fish, only a small proportion of hatchery released coho are marked and therefore a separation of the number of hatchery produced vs. naturally produced returning adults is not available. As with the other focal species, coho returns to TMFD have been large from 1999 to 2003 (average adult returns during the four years from 1999 to 2003 was 8,657 as compared to the average of 3,669 adults during the entire period from 1988 to 2003), suggesting a possible response to the PDO phase shift.

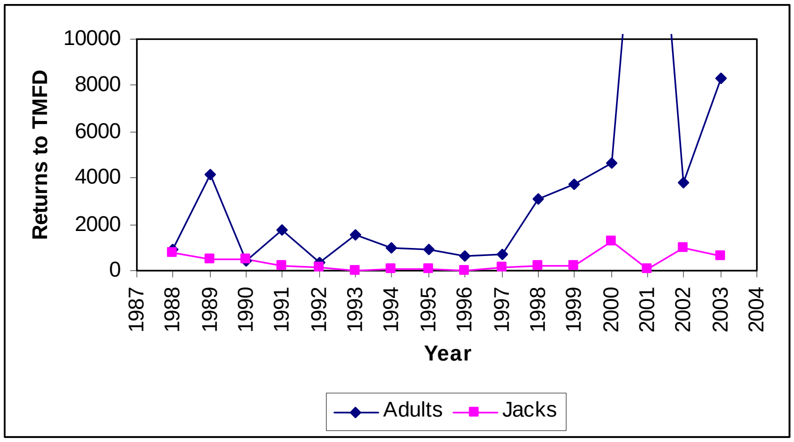


Figure 72. Number of adult and jack coho counted at TMFD from 1988 to 2003. In 2001 the number of adults counted was 22,729. Data provided by CTUIR, DNR, Fisheries Program.

Additional data on numbers of coho adults and jacks counted at TMFD, disposition, and escapement from 1988 to 2003 can be found in Table 4 of Appendix B.

Productivity

Little data exist on the productivity of the coho population in the Umatilla/Willow subbasin. Coho spawn in the mainstem Umatilla River from the mouth to just above the Meacham Creek confluence (RM 79), with the majority of the spawning occurring between RM 25 to RM 79 (Contor 2003; Contor et al. 1997, 1998, 2000). In much of this region high flows that scour redds and fine sediment that covers eggs can be significant risks to egg survival. The actual risk to redds is unclear; however, natural production is considered to be very low (Kissner 2003). The only data on productivity is spawning escapement and the potential number of eggs deposited, these are summarized below.

Total spawning escapement at TMFD has varied greatly between 1988 and 2003 (Figure 73), following the trends in total adult returns. The lowest escapement was 105 (in 1995) and the highest was 22,513 (in 2001) with an average of 3,216 adults available for spawning.

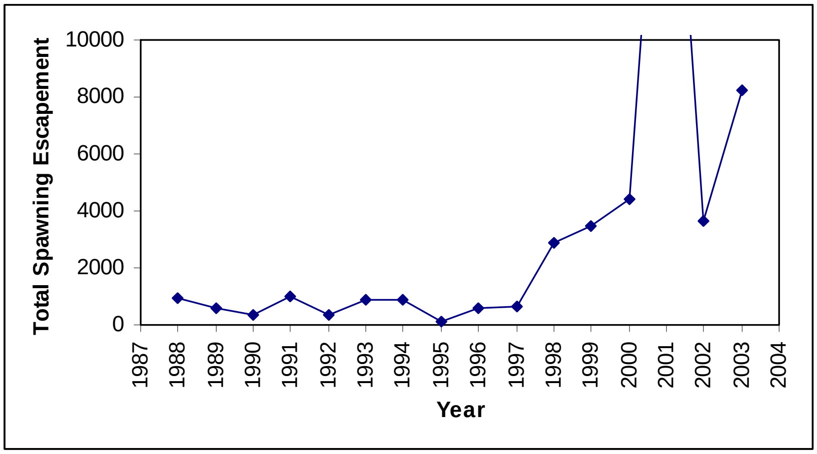


Figure 73. Total spawning escapement at TMFD from 1988 to 2003. In 2001 the spawning escapement was 22,513. Data provided by CTUIR, DNR, Fisheries Program.

Based on carcass surveys conducted by the CTUIR, the proportion of the escapement surviving to spawn is high, particularly between the years 1994 and 2001 when over 88% of carcasses surveyed each year had spawned (Figure 74).

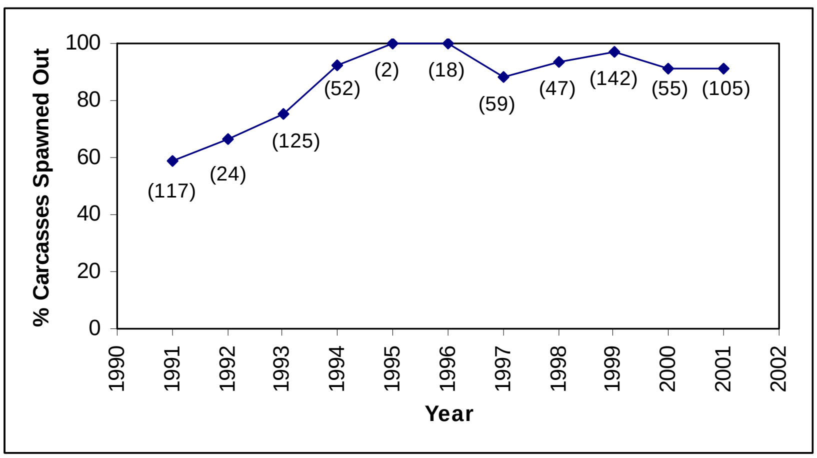


Figure 74. The percentage of all coho adult carcasses found during surveys that had spawned. Numbers in parentheses below data points are the total number of carcasses examined for that year. Data provided by CTUIR, DNR, Fisheries Program.

As with fall Chinook, redd counts for coho are difficult for two reasons. First, the spawning distributions and seasons of coho and fall Chinook overlap making the identification of redds to species difficult. Second, there is much silt in the middle and lower mainstem, which when disturbed can obscure redds, making redd counts difficult. Therefore, estimates of the number of eggs deposited have been made based upon female spawning escapement (Figure 75) (Kissner 2003). The trends in egg deposition follow those in total escapement, with increasing numbers from 1998 through 2000 and exceptionally high numbers in 2001 as a result of a very large number of returning adults in that year.

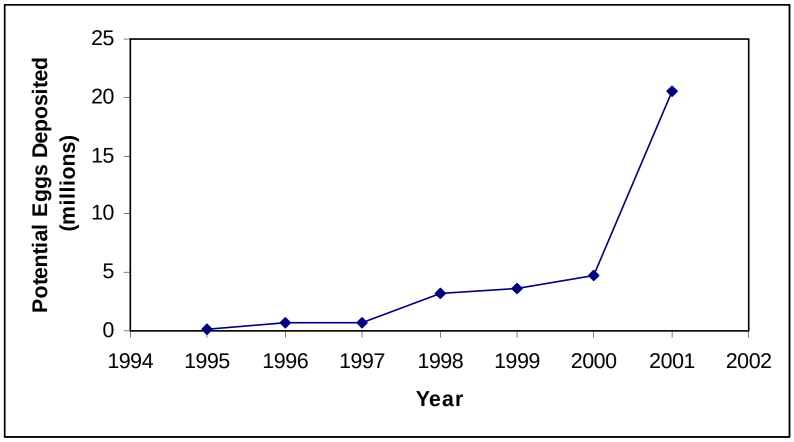


Figure 75. An estimate of the number of coho eggs deposited from 1995 to 2001 based on spawner escapement. Figure modified from Kissner (2003).

Life History

As with Chinook salmon, coho went extinct in the Umatilla/Willow subbasin early in the 20th century. From 1966 to 1969 and then starting again in 1987 hatchery reared coho smolts have been introduced into the Umatilla River. These smolts are from Tanner Creek stock.

Adult coho salmon returning to the Umatilla River typically enter the river from mid-September through mid-December (Figure 76) (Contor et al. 1997). Most returns are adults but three year olds (jacks) are common and have averaged about 9% of the total returns since 1988.

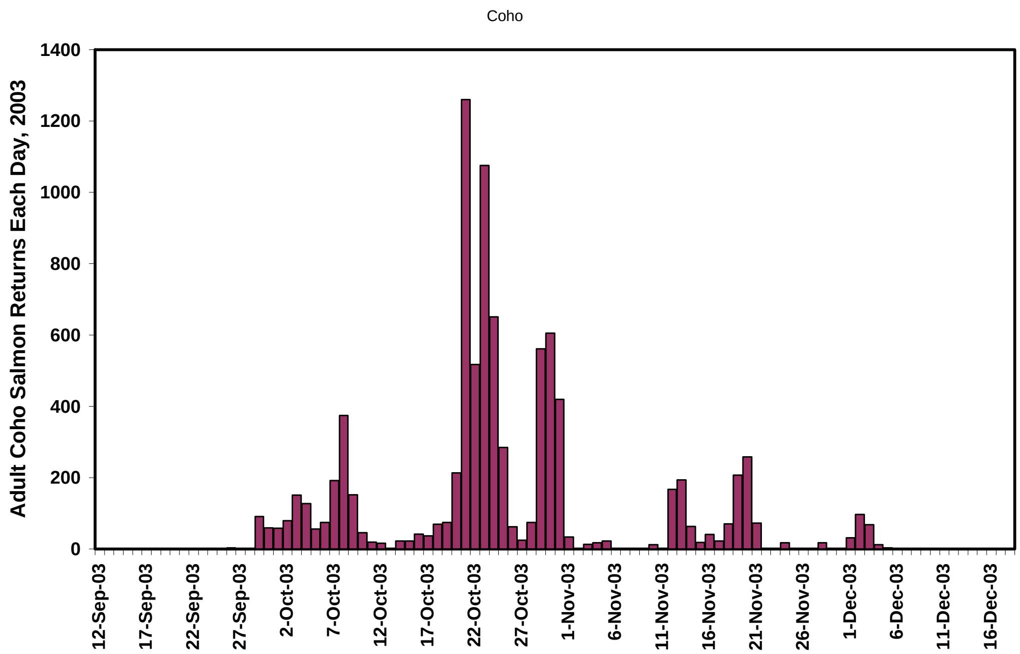


Figure 76. Return timing of coho salmon to the Umatilla River, 2003. Data provided by P. Bronson, CTUIR Passage Biologist, May, 2004.

Spawning has been observed in late October and throughout November and December with a few observations made in January (personal communication: C. Contor, CTUIR, May 2004).

Coho emerge from the gravel in February, March or April depending on the location of the redds in the winter and the associated water temperature and spawn time. Most juvenile coho rear one summer and one winter in the Umatilla before migrating to the Columbia River in April and May (Figure 77).

Extensive surveys of coho smolt outmigration have not been conducted. However, CTUIR and ODFW staff PIT tagged naturally produced juvenile coho in the fall and spring of 2000 and 2001 prior to their outmigration and found that most migrate out of the basin in April and May and are detected in the lower Columbia River dams during April, May and June. Detection rates of PIT tagged coho have been low and the survival estimates for outmigration natural coho salmon are not robust but have been in the 15%-20% range (Contor 2003).

The spatial distribution by life history stage of coho salmon in the Umatilla River subbasin is shown in Figure 77. Coho primarily use the mainstem with only some use of the middle tributaries during their first summer of rearing as mainstem temperatures increase (Figure 77).

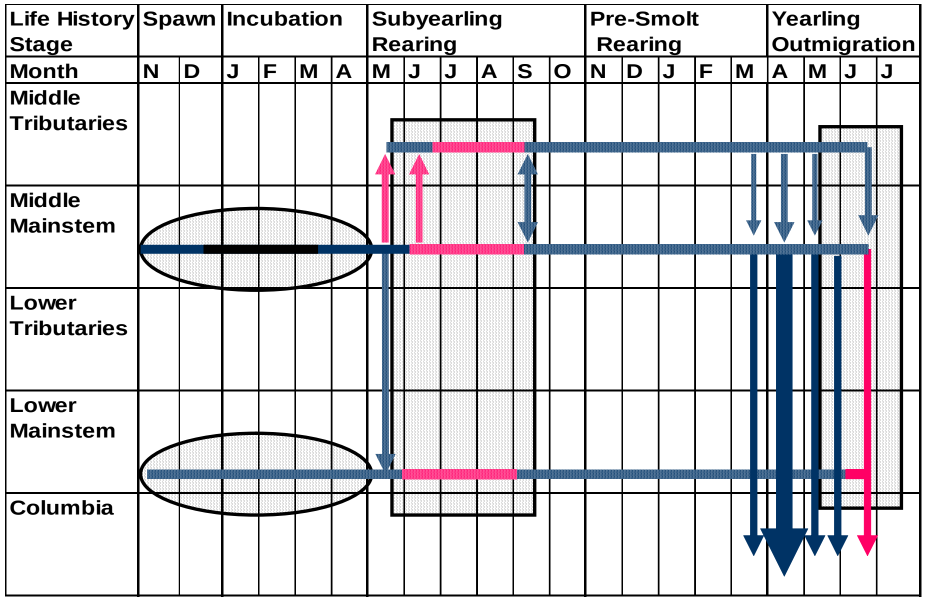


Figure 77. Life history schematic for Umatilla River coho salmon. Shaded ovals represent times where there is occasionally risk to redds from either scour or fine sediment deposition. Shaded rectangles and red arrows represent a risk to fry or parr from elevated water temperatures. Figure from Contor et al. (1998).

Genetic Diversity
Genetic diversity of coho salmon released into the Umatilla River has not been evaluated locally. There is not a local broodstock source for coho and smolts released into the Umatilla River are the progeny of hatchery adults collected in Tanner Creek near Bonneville Hatchery. While recommended by Watson (1996), there has not been a genetic monitoring and evaluation program for the Bonneville Hatchery Coho Salmon Program. However, coho genetics has been examined on a broader scale. Currens et al. (2004) reported that the “heterogeneity among coastal populations was much greater than among lower Columbia River populations” where the Tanner stock comes from. Moran and Bermingham (2004) reported that coho salmon collected from Bonneville Hatchery appeared to be genetically distinct from other populations in the Pacific Northwest.

Current and Historic Distribution
The current distribution of coho salmon is limited to the Umatilla River subbasin; coho are not found in the Willow Creek subbasin. Naturally produced juvenile coho have been found from the mouth of the Umatilla River mainstem to near the North and South Forks (Figure 18). A limited number have been found in Meacham Creek and large numbers have been found in McKay Creek below McKay Dam (Figure 78).

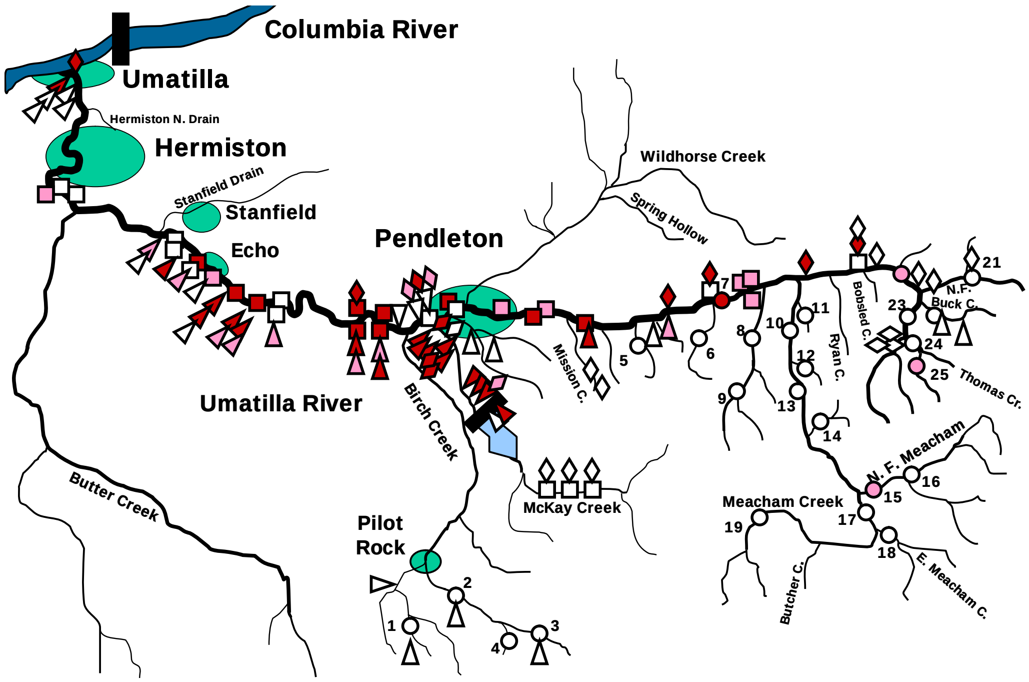


Figure 78. Summary of juvenile coho salmon collected from the Umatilla River Basin, 1999-2002. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Juvenile coho were not captured at locations denoted by white symbols. Figure from Contor (2003).

The current spawning distribution is more limited than the distribution of rearing juveniles. Spawning has been observed only in the mainstem Umatilla River from the mouth to just above the Meacham Creek confluence (RM 79), with the majority of the spawning occurring between RM 25 to RM 79 (Figure 79) (Contor 2003; Contor et al. 1997, 1998, 2000).

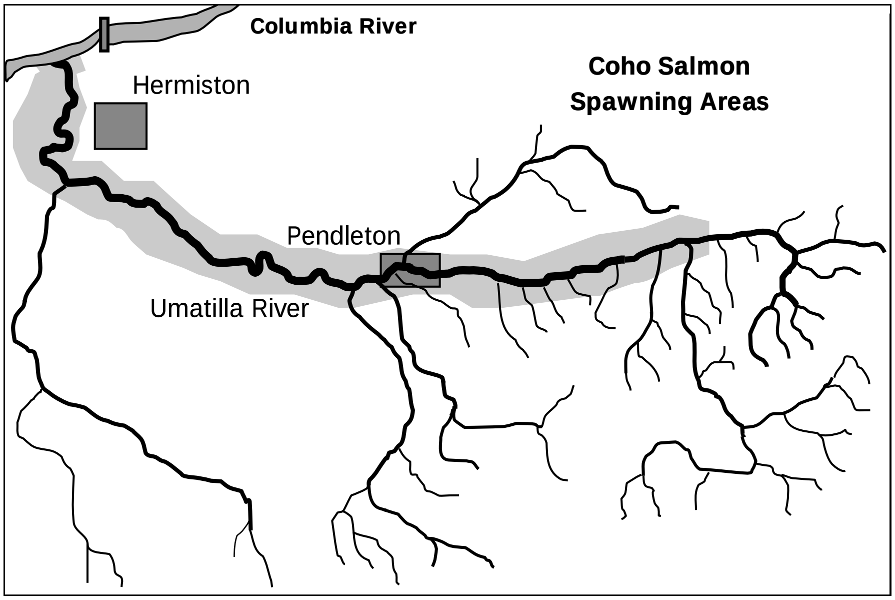


Figure 79. Coho spawning distribution in the Umatilla River Drainage (1989-2003). Figure from CTUIR, DNR, Fisheries Program.

The historic distribution of coho in the Umatilla/Willow subbasin is unclear. Records specifically stating that coho were in the Umatilla River or Willow Creek are not available. The historical distribution of coho salmon in Oregon included many tributaries of the lower and mid Columbia and Snake Rivers as well as most coastal basins (Johnson et al. 1991). Van Cleve and Ting (1960) found historical references stating that "salmon returned to the Umatilla River from spring through fall." Fall Chinook and coho salmon would be the only candidates for salmon returning in the fall. Given that coho were documented in many of the tributaries of the lower and mid Columbia and Snake Rivers, it is reasonable to expect that coho were present in the Umatilla River.

As with steelhead and Chinook, coho salmon were extirpated from the Umatilla subbasin in the early 1900s as a result of a variety of human activities including habitat destruction, high water temperatures, and reduced flows. As with fall Chinook, the construction and operation of Three Mile Falls Dam in 1914 probably played a large role in the extinction of coho from the subbasin as it would have blocked or greatly impeded access to the subbasin during the late summer and fall when coho adults return (BOR 1988).

The factors limiting the distribution and abundance of coho are covered in greater detail in the sections 3.1.1.9, 3.1.3.2, and 3.5.1.

3.2.3.2 Taxa of Interest -- Population Data, Life History, and Distribution

Pacific Lamprey

Abundance and Population Trends

Larval abundance in the Umatilla/Willow subbasin have been estimated since 1998. Densities in 1998 were very low, of 42 index sites surveyed, larval lamprey were collected at only 4 and the densities ranged from $0.001/m^2$ to 0 $0.005/m^2$ (Close and Jackson 2000). In 2000, 30 index sites were surveyed and again larvae were only collected at 4 sites found between RM 2.5 and 22.9 (the survey was conducted up to RM 79.8). Densities of larvae found in 2000 were much higher than they had been in 1998 and ranged between 0.13 and 1.66 individuals per m^2 (Close et al. 2002). In 2000 an adult outplanting program was started which appears to have increased the productivity of the lamprey population in the Umatilla/Willow subbasin. Adults were captured from the John Day subbasin and outplanted in the upper Umatilla River mainstem (RM 61.4 to 87.1) and Meacham Creek. This appears to have been successful in increasing the abundance of larval lamprey. Estimates of larval abundance at 34 index sites in 2002 found high abundances at index sites in Meacham Creek and in the Umatilla River mainstem above RM 63.5. At these sites larval density averaged 18.0 ± 1.9 (standard deviations) individuals per m^2 (Aronsuu et al. 2003). Below RM 63.5 only a few larvae were found as in previous years at 4 of 19 sites.

The abundance of potential outmigrating lamprey was measured with rotary screw traps near the mouth of the Umatilla River in 2000 and 2002. In 2000 trapping took place from 9/1/99 to 3/9/00 and a total of 133 metamorphosed lamprey and 363 larvae were collected (Close et al. 2002). In 2002 trapping took place 10/31/01 to 03/09/02 and a total of only 25 metamorphosed and 58 larval lampreys were collected (Aronsuu et al. 2003). Based on this limited data, it is difficult to make any statements about changes in outmigrant abundance.

Productivity

Productivity of the Umatilla/Willow subbasin lamprey population is very low. In 1998 only 5 adults were observed at TMFD (Close and Jackson 2000). In the fall of 1999 through spring of 2000 only 3 adults were captured near the mouth of the Umatilla River (Close et al. 2002). Finally, in 2002 no returning adults were trapped near the mouth of the river even though over 26,000 and over 11,000 adults were counted at the John Day and McNary dams, respectively (Aronsuu et al. 2003). The absence of any adults observed migrating into the Umatilla River is thought to be the result of extremely low discharge from the Umatilla River into the John Day pool during the time of peak adult migration (late July through September) (Aronsuu et al. 2003).

To increase productivity of the Umatilla population, adults captured in the John Day River have been outplanted into the Umatilla River mainstem and Meacham Creek since 2000 (personal communication: A. Jackson, CTUIR, April, 2004). A summary of the numbers and locations of outplanted adults is presented below in section 3.2.3.3.

Evidence from larval surveys suggests that outplanting is successful in terms of greatly increasing the number of larvae within the subbasin. Prior to outplanting no larvae were observed above RM 22.9. Two years after outplanting high larval densities were observed throughout the areas in which adults were released. The impact of the year 2000 outplanting on outmigration of metamorphosed lamprey will not be evident until 2004 at the earliest as Pacific lamprey juveniles spend 4 to 6 years in freshwater (Kan 1975; Richards 1980).

The productivity of the lamprey population can also be examined through nest counts. Nest counts were conducted in sections of the upper Umatilla River, North and South forks of the Umatilla River, and in Meacham Creek. In 2000 a total of 81 nests were found, 51 in the upper Umatilla mainstem and 30 in Meacham Creek (Close et al. 2002). In 2002 a total of 67 nests were counted, 21 in the upper Umatilla mainstem and 46 in Meacham Creek (Aronsuu et al. 2003). Too little data exists at this time to make any statements about trends in productivity based on nest surveys. However, the nest surveys do provide important information about suitable nesting habitat.

Life History

The life history of Pacific lamprey is complex and involves a larval stage, metamorphic outmigrant stage, marine parasitic stage, and a spawning migration. Pacific lamprey exhibit a protracted freshwater juvenile residence in the stream benthos. Larvae, often referred to as ammocoetes, leave the nest approximately two or three weeks after hatching, drift downstream (usually at night), and settle in slow depositional areas such as pools and eddies (Pletcher 1963). The larvae then burrow into the soft sediments in the shallow areas along the stream banks (Richards 1980). The larval stage has been estimated to range from 4-6 years (Pletcher 1963; Kan 1975; Richards 1980) although it may extend up to 7 years (Hammond 1979; Beamish and Northcote 1989). It is not clear how long the larval stage is in the Umatilla/Willow subbasin.

From July through November larvae undergo metamorphosis in which morphological and physiological changes prepare the individuals for a parasitic lifestyle in salt water (Pletcher 1963; Richards and Beamish 1981). Young adult lampreys generally begin their migration to the Pacific Ocean in the fall and continue through the spring. In the Umatilla River outmigration of metamorphosed lamprey was observed in early November in 1999 and 2001 and continued as late as March in 2000; during both outmigrant periods peak numbers were observed in December (Close et al. 2002; Aronsuu et al. 2003).

The ocean life history stage of Pacific lamprey is not well understood, but the duration of ocean residency may vary. The parasitic-phase has been estimated to last for periods of up to 3.5 years for Pacific lamprey in the Strait of Georgia, British Columbia (Beamish 1980). Off the coast of Oregon, the duration of the ocean phase was estimated to range from 20 to 40 months (Kan 1975). Parasitic-phase Pacific lamprey have been collected at distances ranging from 10 to 100 km off the Pacific coast and at depths ranging from 100 to 800 m (Kan 1975; Beamish 1980).

The Pacific lamprey preys on a variety of fish species and marine mammals in the Pacific Ocean. Beamish (1980) reported five salmonid and nine other fish species that are known prey of Pacific lamprey (Table 1). Pacific lamprey has been reported to feed on finback, humpback, sei, and sperm whales (Pike 1951). In addition, feeding occurs on a variety of midwater species such as Pacific hake and walleye pollock in the open ocean (Beamish 1980).

Beamish (1980) suggested that returning adult lampreys enter fresh water between April and June and complete migration into streams by September. Pacific lamprey overwinter in fresh water and spawn the following spring (Beamish 1980). Pacific lamprey does not feed during the spawning migration. They utilize stored carbohydrates, lipids, and proteins for energy (Read 1968). Beamish (1980) observed a 20% shrinkage in body size from the time of freshwater entry to spawning. Pacific lamprey along the coast of Oregon usually begin to spawn in May when water temperatures reach 10°C to 15°C and continue to spawn through July. In the Umatilla/Willow subbasin adults were observed spawning in Meacham Creek in 2002 from the 28th of May until the 13th of June (Aronsuu et al. 2003). Adults die within 3 to 36 days after spawning (Kan 1975).

Current and Historic Distribution

Pacific lamprey larvae are currently found both in the lower Umatilla River mainstem and in the upper mainstem. As stated above, abundances in the lower mainstem are very low and the high abundances in the upper mainstem are most likely the result of outplanting of adult John Day lamprey. In addition to the mainstem, lamprey are also currently found in Meacham Creek, also most likely as a result of the outplanting of adults. Surveys have not been conducted in Willow Creek and its tributaries; however, the passage problems found in Willow Creek most likely preclude any adult lamprey from migrating up Willow Creek to spawn.

Information on the historic distribution of lamprey within the subbasin comes from interviews conducted by CTUIR staff with 12 tribal elders between 1996 and 1999 (Close and Jackson 2001). Results from these interviews reveal that historically lamprey were found in the Umatilla River mainstem from the mouth to the headwaters and harvest occurred from spring through fall (Close and Jackson 2001). No mention is made of lamprey occurring in Willow Creek and its tributaries in these interviews (Close and Jackson 2001) and thus it is unclear whether they occurred historically in this area.

The decline in the distribution of lamprey in the Umatilla/Willow subbasin has been attributed to many of the same factors that have resulted in the decline of anadromous salmon and steelhead populations and include poor habitat, water pollution, passage over dams, and ocean conditions (Close et al. 1995). In addition, another factor that might have contributed greatly to the decline of lamprey in the subbasin was the chemical treatment of the Umatilla River with rotenone in 1967 and 1974 (Close et al. 1995).

Mussels

Current and Historic Abundance and Distribution

Abundance estimates of mussels are most easily made on adults, which are sedentary and thus estimates of abundance and distribution are tightly linked and are presented together here. The following information on the current distribution comes from J. Brim Box (CTUIR, personal communication, April 2004):

> Freshwater mussels have been extirpated from most of the main stem of the Umatilla River and possibly tributaries. Shell evidence and historical records via interviews with tribal elders suggest that mussels were once found in the main stem of the Umatilla River, at least as far upstream as above Mission, but now are confined to a few sites near its confluence. Based on the results of an inventory conducted in 2003, mussels were rare in the main stem and tributaries of the Umatilla River. Mussels were found at only six of the 55 total sites sampled. Only two genera, *Anodonta* and *Gonidea*, were found in the basin. No live *Margaritifera falcata* were found, although at one upstream site numerous shells and fragments were scattered within the river and around the floodplain. In addition, no mussel beds were found on in the Umatilla River, and the maximum number of mussels counted at one site was 52 *Anodonta*. Although *Anodonta* were more abundant at this site than at other sites in the Umatilla River, they were too dispersed to sample quantitatively.

Information on the historical distribution of mussels in the Umatilla/Willow subbasin also comes from J. Brim Box (CTUIR, personal communication, April 2004):

> Historical Data Collection
> Ninety-seven records of historical mussel occurrences in Oregon were obtained, dating back to 1838, from the US Forest Service Freshwater Mollusk Database. Of these records, only two do not list a specific drainage. Accounts from the Columbia River drainage comprise about a third of these records. These records from the Columbia Basin include five of the eight species known to currently occur in the western United States: *Anodonta beringiana, Anodonta nuttalliana, Anodonta oregonensis, Gonidea angulata* and *Margaritifera falcata.* No records were found from the Umatilla River or its tributaries.
>
> Museum Collections
> A total of 81 historical records of freshwater mussels from the western United States (i.e., shell material reposited in museum collections) were found at the United States National Museum (Smithsonian Institution) and California Academy of Sciences. Over half of these records of freshwater mussels were from the Columbia River drainage. However, none was from the Umatilla River or its tributaries.
>
> Interviews
> Although no museum or historical records for freshwater mussels were found from the Umatilla River, tribal elders who were interviewed remembered gathering mollusks at the mouth of the Umatilla and Walla Walla rivers and at the mouth of Squaw Creek. One tribal member

> commented, "at one time mussels were plentiful in all tributaries and bigger mussels were found in the main stem of the Umatilla River" (A. Minthorn, pers. com., 2003, CTUIR tribal member). In the mid 1940s, freshwater mussel shells were observed scattered along the banks of the Umatilla River from river kilometer 107 to river kilometer 99 (Bernadette Nez, per comm., 2003, CTUIR tribal member).

The interviews suggest that historically mussels were abundant throughout the Umatilla River subbasin; however, no mention was made of Willow Creek and its tributaries so it is unclear whether that area had mussels historically and if so, in what abundance. The cause of the change in distribution from historic to current times is unclear. However, mussels are sensitive to a variety of pollutants and disturbances and are one of the most endangered faunal groups in North America (personal communication: J. Brim Box, CTUIR, April 2004). Some of the likely causes of decline in the Umatilla/Willow subbasin include increased sediment input which interferes with mussel filter feeding and oxygen consumption; decreased habitat (low flow areas with stable sediment) resulting from channelization, and input of sewage effluent and pesticides (McMahon 1991).

An important difference in the historical and current mussel populations in the subbasin is the number of taxa. Recent surveys for mussels in the subbasin found only two genera, *Anodonta* and *Gonidea*. However, shell material collected in the subbasin in 2003 suggests that a third genus, *Margaritifera*, was recently extirpated from the subbasin (personal communication: J. Brim Box, CTUIR, April, 2004).

Life History

The life history of the mussels inhabiting the Umatilla/Willow subbasin is not known at this time. However, a generalized life cycle is given here to illustrate the habitat use and complexity of mussel life cycles. This life cycle is from an unpublished report by J. Brim Box (CTUIR).

> Freshwater mussels are unique among bivalves in that they require a host fish to complete their life cycle. Unlike male and female marine bivalves, which release sperm and eggs into the water column where fertilization takes place, fertilization of freshwater mussels takes place within the brood chambers of the female mussel. The female mussel carries the fertilized eggs in the gills until they develop into a parasitic stage called glochidia. Female mussels then release the glochidia into the water column where they must come into contact with a suitable host fish species. Once the glochidia are released they will survive for only a few days if they do not successfully attach to a host fish (O'Brien and Brim Box 1999, O'Brien and Williams 2002). Glochidia may attach to a non-host fish, but the glochidium will fail to encyst and will eventually be sloughed off. After successfully attaching to the host fish, glochidia metamorphose and drop to the substrate to become free-living

juveniles (Jones 1950, Howard 1951). The time required for glochidial metamorphosis varies with water temperature and among mussel species.

The mussel/fish relationship is usually species-specific (Lefevre and Curtis 1912); only certain species of fish can serve as suitable hosts for a particular mussel species. The number of host fish utilized by a mussel species varies. Some mussel species have a very restricted number of host fish species (Watters 1994, Michaelson and Neves 1995) while other mussels parasitize a wide range of fish species (Watters 1994, Haag and Warren 1997). To increase their chances of coming into contact with a suitable host fish, some mussel species lure potential host fish by extending brightly colored portions of their mantles that mimic minnows, insects, or other prey (Coker et al. 1921, Kraemer 1970). In addition, some mussels release glochidia into the water column when light sensitive spots are stimulated by the shadow of a passing fish (Kraemer 1970, Jansen 1990). Other mussel species have evolved elaborate lures resembling fish food as mechanisms to attract specific host fishes (Haag et al. 1995, Hartfield and Butler 1997, O'Brien and Brim Box 1999). Knowledge of the reproductive biology of many mussels is incomplete (Jansen 1990), and the host fishes are known for only about a quarter of the mussel species in North America (Watters 1994).

The duration of the parasitic stage varies from about a week to several months (Fuller 1974, Oesch 1984, Williams et al. 1992), depending on mussel species and as a function of water temperature (higher temperatures causing shorter durations) (O'Brien and Brim Box 1999). After metamorphosis, juvenile mussels drop off from their host fish, and must fall to substrate suitable for their adult life requirements or they will not survive. Suitable substrates include those that are firm but yielding and stable (Fuller 1974). In general, shifting sands and suspended fine mud, clays and silt are considered harmful to both juvenile and mature mussels (Fuller 1974, Williams et al. 1992, Brim Box and Mossa 1999, Brim Box et al. 2002).

Mussels orient themselves on the bottom of a stream with their anterior ends buried in the substrate, usually with the two valves slightly open, which allows the intake of water through an incurrent siphon (and food and oxygen) while allowing waste materials to leave the body through an excurrent siphon (Oesch 1984). Food items include organic detritus, algae and diatoms (Coker et al. 1921, Matteson 1955, Fuller 1974). Increases in fine sediment, whether deposited or suspended, may impact mussels by interfering with feeding and/or respiration (Fuller 1974, Brim Box and Mossa 1999).

Although considered fairly sedentary, adult mussels may move in response to abnormal or transient ecological events. For example, water level fluctuations may cause some mussel species to seek deeper water (Coker et al. 1921, Oesch 1984). Often in late summer, mussel trails are visible as the water recedes. However, mussels colonize upstream areas mainly through the use of the parasitic glochidial life stage. Without this stage, freshwater mussel populations would, over generations, slowly shift downstream.

3.2.3.3 Description of Artificial Production and Captive Breeding Programs

Artificial Production

Artificial production within the Umatilla subbasin includes the summer steelhead, coho, and spring and fall Chinook salmon programs. The summer steelhead, spring Chinook, and subyearling fall Chinook programs are funded by BPA as part of the Northwest Power Planning Council Fish and Wildlife Program. The fall Chinook yearling program is funded under the U.S. Army Corps of Engineers' John Day Mitigation Program, and the coho are produced under the Mitchell Act.

Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program, is the central production facility for the Umatilla Basin Fish Restoration Program. It is operated by ODFW and currently produces summer steelhead, spring Chinook, and subyearling fall Chinook salmon. A number of out of basin hatchery facilities also produce fish for the program. Bonneville Hatchery produces yearling fall Chinook, Little White Salmon Hatchery produces spring Chinook, and Cascade Hatchery and Lower Herman Creek Ponds produce coho salmon.

An integral part of the artificial production program for the basin also includes juvenile acclimation and adult holding and spawning satellite facilities. These facilities are all operated by CTUIR under the Umatilla Hatchery Satellite Facilities Operation and Maintenance project. There are five acclimation facilities in the basin: Bonifer Pond, Minthorn Springs, Imeques C-mem-ini-kem, Thornhollow, and Pendleton (Figure 80). The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, all but two groups of juvenile salmon and steelhead released into the basin are now acclimated. One group of fall Chinook subyearlings is being direct stream released in the mainstem Umatilla River to evaluate alternative release strategies to improve smolt to adult survival. One group of summer steelhead smolts is being direct stream released into Meacham Creek because of poor rearing and release conditions at the Bonifer pond acclimation site.

There are also three adult facilities associated with the Fish Restoration Program. Summer steelhead are held and spawned at Minthorn, fall Chinook at Three Mile Falls Dam, and spring Chinook at South Fork Walla Walla (Figure 80). Three Mile Falls Dam may also be used for holding and spawning coho salmon. Broodstock for these facilities are collected and transported from the Three Mile Falls Dam Adult Trapping and Handling Complex by the Umatilla River Fish Passage Operations project. The number of broodstock collected at Three Mile Falls Dam and green eggs taken for each species is listed in Table 34.

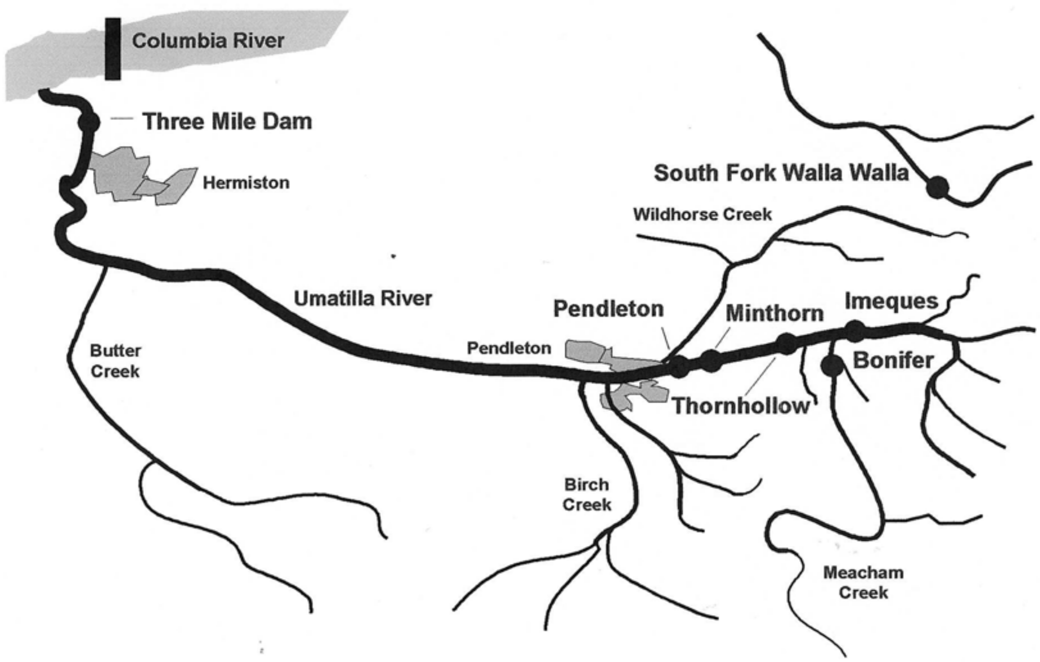


Figure 80. Locations of the CTUIR satellite hatchery facilities. Figure from Rowan (2003).

Table 34. The number of broodstock collected at Three Mile Falls Dam and green eggs taken for each species from 1983 to 2003. Data provided by ODFW, April, 2004.

Brood Year	**Summer Steelhead**		**Coho**		**Fall Chinook**		**Spring Chinook**	
	Number of Brood Collected	Number of Green EggsTaken	Number of Brood Collected	Number of Green Eggs Taken	Number of Brood Collected	Number of Green Eggs Taken	Number of Brood Collected	Number of Green Eggs Taken
1983	161	132,000						
1984	52	100,000						
1985	104	150,000						
1986	69	166,000						
1987	148	239,760						
1988	133	121,980						
1989	150	214,712						
1990	92	130,274						
1991	202	410,356			347	601,548		
1992	225	476,871			211	195,637		
1993	128	255,441	580	676,171	347	352,320		
1994	135	234,432						
1995	154	223,525	860	945,828				
1996	133	215,408			576	778,058		
1997	110	209,639			299	641,961	597	1,029,237
1998	116	228,622			199	257,311	202	455,953
1999	128	224,716			464	541,821	631	942,988
2000	130	200,825			603	1,081,481	619	1,120,995
2001	115	226,685			486	732,205	630	1,175,281
2002	110	180,955			559	678,122	586	1,017,113
2003	109							
Total	**2,704**	**4,342,201**	**1,440**	**1,621,999**	**4,091**	**4,778,983**	**3,265**	**5,741,567**

Summer Steelhead

The first releases of hatchery summer steelhead occurred from 1967 through 1970 and were of Skamania and Oxbow stocks (Appendix B, Table 5). The first release of Umatilla stock steelhead occurred in 1975 and releases every year since have been of endemic stock. Broodstock for the program are collected at Three Mile Dam on the lower Umatilla River. Historically, numbers released and release locations have varied; however, the current program is to acclimate and release 150,000 smolts in the basin annually: 50,000 direct stream released into Meacham Creek, 50,000 acclimated at Minthorn springs and 50,000 acclimated at Pendleton (Appendix B, Table 6). However, the Bonifer acclimation site is not being used due to poor rearing and release conditions. The group of fish previously acclimated and released from Bonifer Pond is now direct stream released into Meacham Creek at the mouth of Boston Canyon.

In addition, to the artificial propagation and introduction of hatchery steelhead, rainbow trout have been stocked in the subbasin to provide a sports fishery. Widespread stocking of rainbow trout occurred throughout the subbasin from the 1940s until the 1970s. A more controlled and limited stocking program was started by ODFW in 1994 and involved stocking trout in the upper Umatilla mainstem and McKay Creek as well as in Willow Creek. However, all stream stocking of rainbow trout in the Umatilla River and its tributaries ceased in 1999 as a result of concerns regarding interbreeding between rainbow trout and summer steelhead. The numbers and locations of stocked rainbow trout during the 1990s program are shown in Appendix B Tables 7 and 8.

Spring Chinook

Spring Chinook salmon from Carson stock have been released since 1986 (Appendix B, Table 9). Beginning with the 1998 releases, Carson stock spring Chinook returning to the Umatilla River have been the primary broodstock source for the Umatilla River program (Appendix B, Table 9). The goal for the program is to collect all broodstock at Three Mile Dam. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 810,000 yearling smolts annually into the upper mainstem Umatilla River (Appendix B, Table 10).

Fall Chinook

Fall Chinook salmon have been released in the Umatilla River Basin every year since 1982 (Appendix B, Table 11). These releases have included both yearling and subyearling life history stages. The 1982 release was from Spring Creek tule stock. Since then, all releases have been of upriver bright stock. Upriver brights returning to the Umatilla River have been the primary broodstock source for the yearling John Day Mitigation Program since 1997. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 480,000 yearling and 600,000 subyearling smolts annually into the mainstem Umatilla River.

In addition to the juvenile release programs, an adult fall Chinook-outplanting program was initiated in 1996. Surplus upriver bright stock from Priest Rapids and Ringold Springs hatcheries are released into natural production areas in the mid Umatilla River. The goal of the program is to release 1,000 adults annually. Actual releases have ranged from 200 to 970. (Table 35).

Table 35. Fall Chinook adult outplants released into the Umatilla River since 1996.

Year	Number of adults released
1996	712
1997	940
1998	200
1999	970
2000	471
2001	943
2002	Not Available
2003	Not Available

Coho

Coho salmon have been released from 1966 through 1969 and from 1987 to the present and have been primarily of Tanner Creek stock (Appendix B, Table 12). Broodstock for the program are collected at Bonneville Hatchery. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 1,500,000 smolts annually into the mainstem Umatilla River at the Pendleton Acclimation Facility (Appendix B, Table 6).

Pacific Lamprey

CTUIR has been working cooperatively with the USGS-Biological Resource Division, Columbia River Research Lab (CRRL) in Cook, WA to develop and refine artificial propagation techniques for Pacific lamprey. Lamprey were collected from the John Day River in 1998 and manually spawned at CRRL in June 1998. Although these techniques have not been finalized and are still under refinement, artificial propagation is one option that the CTUIR is considering for reestablishment of Pacific lamprey in CTUIR's ceded areas.

Lamprey collected from the John Day River and the John Day Dam are being used to reestablish larval abundance in the Umatilla River by outplanting them in prime natural production locations close to spawning time. Collected lamprey are transported to the CRRL, and treated with oxytetracycline at a dose of 10 mg/kg for bacterial infections and treated with 37% formaldehyde (formalin) for external parasites. Fish are maintained in 0.9-m diameter tanks supplied with river water at a temperature of 6-8°C. To induce sexual development of lamprey, water temperature was increased from 6°C in May to 15°C by mid June 2000. They are then transported to the Umatilla River for outplanting. A summary of the number and location of outplants is given in Appendix B Table 13.

Artificial Production and Introduction: Ecological Consequences

To date, there has been little direct study into the ecological consequences of artificial production and introductions in the Umatilla/Willow subbasin and this is a significant data gap. Perhaps the most significant finding to date on the consequences of artificial production/introduction in the subbasin is the work of Currens and Schreck (1995) on the population genetics or rainbow trout. The authors found that that so much genetic variation existed in juvenile redband/steelhead from within a sampling location that it was difficult to detect geographic patterns among fish from different tributaries within the subbasin or to differentiate redband trout from steelhead. However, redband trout sampled from McKay Creek above McKay Dam (which are separated from steelhead and other redband trout in the subbasin by McKay Dam) were genetically distinct from all the other redband trout in the subbasin. The authors reported that the most likely cause for genetic divergence of this group of fish from others in the Umatilla basin is the introduction of genetic material from females of non-native (stocked) strains of rainbow trout. Therefore, stocking of redband trout has led to a genetically distinct population in the subbasin.

Another potentially important ecological consequence of introductions has been inclusion of additional predators into the subbasin. As mentioned in section 3.1.1.5, several species of centrarchid sunfishes were introduced into both the Umatilla and Willow subbasins in the later part of the 20th century. These introductions occurred in both McKay and Willow Creek reservoirs. At this time the only known significant colonization of centrarchid fish in lotic habitats has been that of smallmouth bass in the lower Umatilla River. No information exists on the abundance or productivity of this population of exotic predators, however, it can be hypothesized that these fish are preying on rearing and outmigrating salmonid juveniles and other native fishes. However, evidence from the John Day Reservoir indicates that, at least in that system, smallmouth bass are not important predators of outmigrating smolts (Rieman et al. 1991; Beamesderfer and Ward 1994).

The reintroduction of spring Chinook could be benefiting bull trout by restoring part of their historic prey base. The summer rearing distribution of these overlaps very closely, therefore, juvenile spring Chinook would be very much available to bull trout as prey. No study of this interaction has been done, and is therefore is hypothetical in nature.

The artificial production program through the release of large numbers of salmonid smolts in the spring could have a number of ecological consequences. For example, the elevated number of smolts in the river could be attracting avian predators to the area that were not present historically. Inter- and intra-specific competition might be severe given the number of smolts released. Severe intra-specific competition between hatchery released smolts and naturally produced smolts could have important consequences for the size and survival of naturally produced steelhead and salmonids. However, there has been no direct study of predator-prey interactions or competition within and between species in the Umatilla/Willow subbasin and this remains a significant data gap.

Relationship between naturally and artificially produced populations

Because the native salmon populations in the basin went extinct and have been reintroduced with hatchery stocks, comparisons of the hatchery and naturally producing fish have not been made. However, steelhead were not extirpated from the subbasin, but natural production has been augmented by hatchery releases since 1967. Differences in life history characteristics of naturally and hatchery produced steelhead are outlined below. To date no studies have specifically addressed interactions between naturally produced and hatchery steelhead and this is an important data gap.

Chess et al. (2003) summarized various characteristics of natural and hatchery steelhead returning to the Umatilla River. The authors found the following:

- For timing of adult returns to TMFD no large scale seasonal separation was found between natural and hatchery steelhead; however, at a monthly scale within years return timing is significantly different between hatchery and naturally produced adults for most years examined (return years 1992-1993 to 1999-2000).

- The percentage of both males and females of natural and hatchery origin were found to be significantly different for run years 1992-93 through 2001-02. Natural female steelhead comprised 69.3 % of the natural return while females comprised 57.3% of the hatchery return. Natural male steelhead comprised 30.7 % of the natural return while males comprised 42.7% of the hatchery return (Chess et al. 2003).

- Natural steelhead smolts begin outmigrating earlier than hatchery smolts although this is heavily influenced by the timing of release of the hatchery smolts.

- Hatchery production is intended to be used as a tool to increase adult returns. Data on the ratio between of the number of adult returns per “spawner” (or broodstock individual) indicates that adults harvested for broodstock return more adults than natural producers (Figure 81). In terms of producing beyond replacement, hatchery steelhead were above replacement in 7 of 8 years examined, while naturally spawning steelhead were above replacement in only 2 of 10 years examined (Figure 81).

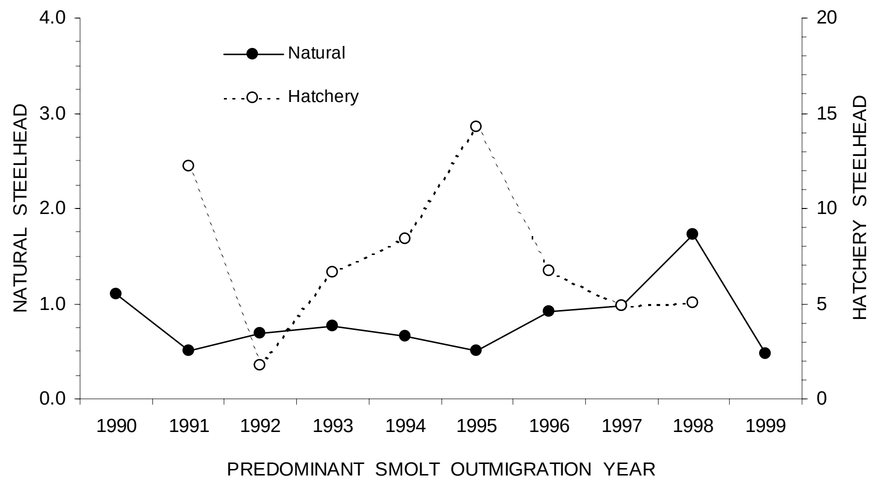


Figure 81. The adult returns per spawner ratio for naturally spawning fish and hatchery broodstock fish. A value of 1 indicates that the population is replacing itself (i.e., one adult returns for every spawner). Figure from Chess et al. (2003).

Finally, information collected by the CTUIR exists to compare the ability of hatchery and naturally produced steelhead to spawn. Observations at steelhead spawning grounds suggest that hatchery-reared fish contribute to natural production to a similar level as naturally-reared fish. In 2001, 23 observations were made of spawning individuals in which the identity, natural vs. hatchery, could be determined. Hatchery-reared fish made up 26.1% of the spawners and naturally-reared fish made up the other 73.9%. In the same year, the fish available to spawn were 26.6% hatchery-reared and 73.4% naturally-reared. In 2002 a similar trend was found. Hatchery-reared fish made up 45.2% of the observed spawners and naturally-reared fish made up the other 54.8% (from a total of 42 observations), and the fish available to spawn were 34.7% hatchery-reared and 65.3% naturally-reared (Kissner 2003).

3.2.3.4 Harvest in the Subbasin

Bull Trout

No estimates of harvest are available for bull trout fisheries, either historic or current. Prior to 1986, the bag limit and season length were the same as those for trout discussed below. In 1986, harvest was restricted to two bull trout over 16 inches. In addition to a sports fishery, tribal angling accounted for some harvest, but most tribal members release bull trout (Buchanan et al. 1997). By 1994 the taking of bull trout was prohibited and in 1998 bull trout in the Columbia River basin were listed as threatened by the USFWS (2002). In the Umatilla/Willow subbasin a prohibition on all angling for bull trout has been in place since 2002.

Redband Trout

No estimates of harvest are available for resident trout fisheries, either historic or current. Streams in the Umatilla/Willow subbasin have had a general trout season throughout modern times. It is likely that small numbers of anadromous steelhead juveniles are harvested in the Umatilla subbasin as part of the general trout season, but as with other fisheries, regulations have become increasingly restrictive primarily to protect anadromous juveniles. The general trout season opens the last week of May through the end of October and this season format has been in place for decades. Prior to 1998, the bag limit was 5 trout over 6 inches in length. In 1998 the minimum length was increased to 8 inches to further protect anadromous juveniles. In 1997, the Umatilla River and tributaries upstream of the confluence of Ryan Creek were closed to harvest (however, catch and release with the use of flies and lures is allowed) to improve the trout fishery and provide further protection of anadromous juveniles.

Non-anadromous streams are generally opened the third weekend of April and closed the end of October; size and bag limits are the same as those listed above for anadromous streams.

Summer Steelhead

Non-tribal fisheries for summer steelhead have existed throughout modern times, although as the need for conservation has increased, angling and harvest opportunities have changed. Since the 1992-93 run year, all non-fin clipped steelhead are required to be released unharmed. The open season has been September 1 though April 15 since the 1992-93 run year as well. Prior to this the season was open from December 1 through March 31. The bag limit varied over the years from two fish/day – 10/year, to two fish/day – 40/year, and finally two fish/day – 20/year. The open area for the fishery is from the mouth upstream to the western boundary of the Umatilla Indian reservation upstream from the Hwy 11 Bridge in Pendleton. See Appendix B Table 14 for a synopsis of non-tribal angling seasons.

An intensive creel census has been conducted on the non-tribal fishery since the 1992-93 run year, prior to this harvest was determined by estimates developed from annual punch cards returned by anglers. Punch card estimates are subject to response bias and provide data with a low level of confidence. ODFW harvest data estimates that sport anglers catch between 60 to 550 steelhead in recent years, but anglers have only kept up to about 100 steelhead per year. For the entire fishery since the 1992-93 run year, percent of the run caught is 17.1% for natural steelhead and 11.4% for hatchery steelhead, and hatchery steelhead harvest is 8.9% (Appendix B, Table 15). Historic angler punch card data shows harvest of as many as 1900 fish in the past, but these data or much less accurate than the recent creel census data (Appendix B, Table 16).

Tribal harvest estimates average about 46 steelhead over the period from 1992-1993 to 2000-2001 with the harvest of wild steelhead ranging from 0% to 25% of the total harvest (and averaging just under 11%) (Appendix B, Table 17).

The percentage of the steelhead run harvested from the Umatilla River and its tributaries by tribal and non-tribal fishers combined is shown in figure 82. This figure reveals a trend towards an increase in the run harvested over the period from 1992-1993 to 2000-2001.

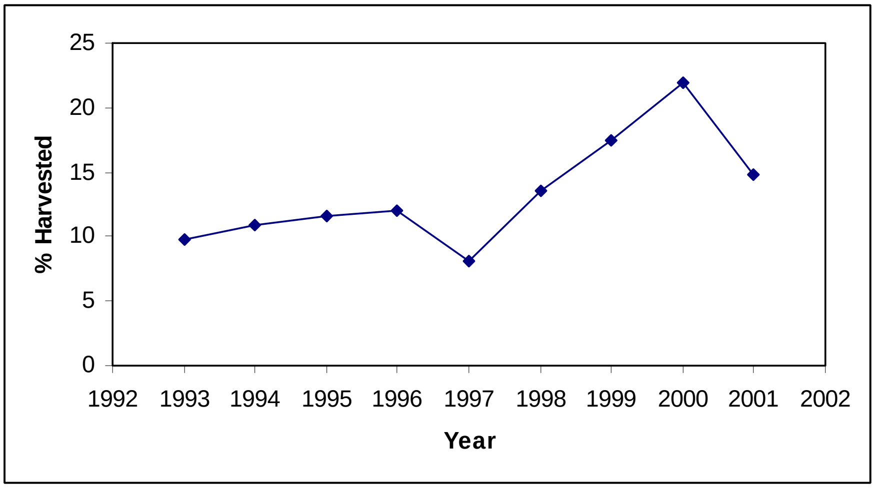


Figure 82. The percentage of the hatchery adult steelhead return harvested by the non-tribal and tribal fishery in the Umatilla River. Data from Chess et al. (2003) and Kissner (2003).

Spring Chinook

As a result of the spring Chinook hatchery program, returns of spring Chinook have been adequate to support tribal and non-tribal fisheries on the Umatilla River in ten out of the last thirteen years. From historical accounts it is known the Umatilla River once provided substantial fisheries for spring Chinook. Van Cleve and Ting (1960) cited reports of tribal and non-tribal fishers harvesting “thousands and thousands” of salmon from spring to fall at the sites of Three Mile Falls and Hermiston Power and Light dams in 1914. Spring Chinook were thought to have been eliminated from the Umatilla Basin shortly after the construction of Three Mile Falls Dam in 1914 (Boyce 1986). However, some angling on a remnant run or strays from other systems occurred in the Umatilla River as recently as 1956 and 1963; however, reported catch rates were low (OGC 1956 and 1963). Spring Chinook fisheries were essentially non-existent for many years prior to 1990 when fish first started returning from the current hatchery program.

The current spring Chinook fishery is managed closely by ODFW and CTUIR to insure that program goals for natural production and broodstock are met in addition to harvest. Annual harvest levels are set depending on the number of returning adults as determined by pre-season return projections. The area of the river open to non-tribal harvest has varied over the years, but is currently from the mouth to the CTUIR western reservation boundary (Appendix B, Table 18).

In 2002, tribal and sport anglers harvested an estimated 990 spring Chinook salmon from the Umatilla River (Appendix B, Tables 18 and 19). Run sizes, angling effort, catch, and harvest for the non-tribal fishery was substantially higher in the 2000-2002 run years than any previous year. Increased effort, catch, and harvest was primarily due to the earlier and longer fishing seasons and the opening of the lower river (below TMFD) initiated in 2000 (Appendix B, Table 18). In contrast, tribal harvest peaked in 2000 and declined thereafter (Appendix B, Table 19).

Between 1991 and 2002 the average harvest of spring Chinook (tribal and non-tribal combined) was 13.4% of the returns to the Umatilla River. While the percent of the run harvested has varied over this period of time, no obvious trends exist in the percent taken (Figure 83). This is true even with the increase in angling effort in recent years as a result of recent large runs.

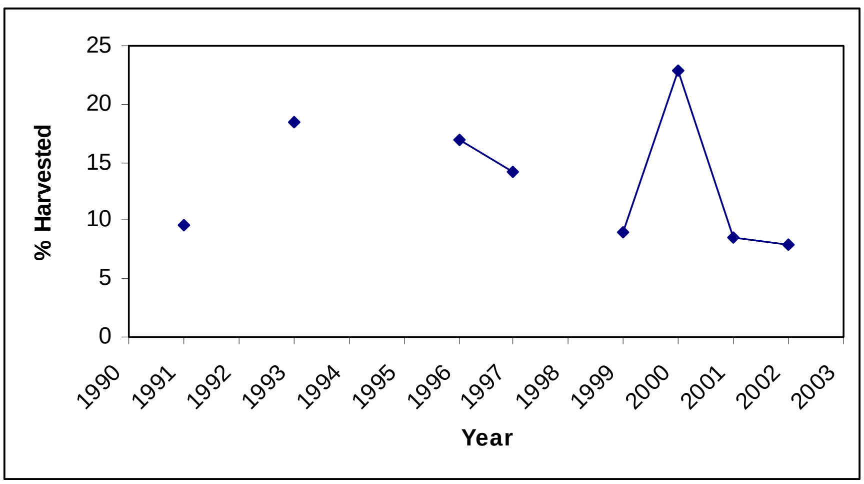


Figure 83. The percentage of the spring Chinook return harvested by the non-tribal and tribal fishery (combined) in the Umatilla River. Because of low return numbers there was no spring Chinook fishery in 1992, 1994, 1995, and 1998. Data from Chess et al. (2003) and Kissner (2003).

Fall Chinook and Coho

As a result of the coho and fall Chinook hatchery programs, a non-tribal sport fishing season for fall salmon has been open since 1989 (Appendix B, Table 20). However, there has been significant contrast in the success of the coho and fall Chinook hatchery programs that has translated to difference in harvest opportunities for these species. The coho hatchery program has been successful in returning relatively large numbers of coho adults to the Umatilla River annually and has resulted in a fishery for adults and jacks that has gradually become more liberal since the first season in 1989. In contrast, the fall Chinook hatchery program has fallen far short of goals for the program and has provided for a jacks only harvest opportunity in order to meet program goals for broodstock and natural production.

While the coho run has provided significant opportunity for sport fisheries, the opportunity for harvest has been limited by the fish's lack of enthusiasm to strike lures. The average number of adult coho caught per year from 1992 to 2001 was 240 and the average number of jacks caught was 62. Over this ten year period the catch composition was 58.9% adults and 41.1% jacks (Appendix B, Table 21). This catch represents only about 5% of the total run for adults, but over 33% of the jack run. In contrast to steelhead there is no evidence of any trends in the percentage of the total run harvested from 1992-2001 (Figure 84). Over 75% of the catch is harvested on average. Table 10 summarizes the coho harvest for 1992-2001.

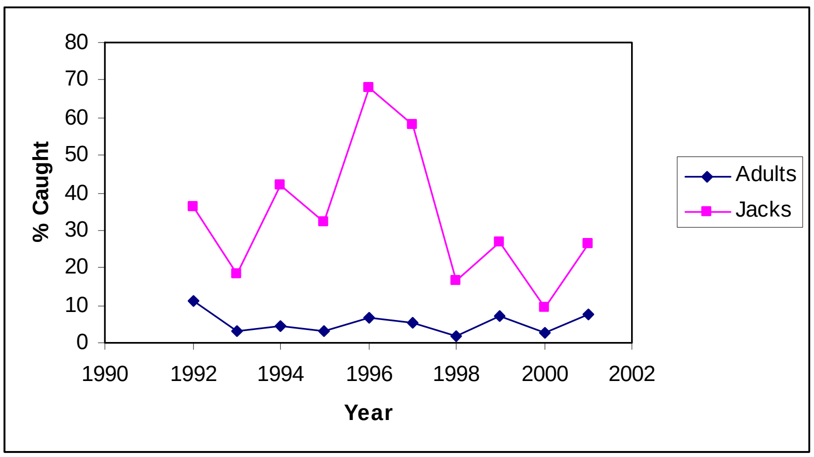


Figure 84. The percentage of the total coho run caught in the Umatilla River by the non-tribal sports fishery. Data from Chess et al. (2004).

Fall Chinook jacks also provide some angling opportunity. Fall Chinook adults are harvested downstream of the Highway 730 bridge (approximately RM 0.25), which is used to define the boundary between the Columbia and Umatilla Rivers for purposes of sport angling regulations. These regulations do not allow for harvest in the Umatilla River (Appendix B Table 20); however, surveys are made of the number of adults caught in the Umatilla River below the Highway 730 bridge to estimate the percentage of the total run harvested (Appendix B, Table 21). The average number of adult fall Chinook caught per year from 1992 to 2001 was 50, the average number of jacks caught was 40, and subjacks 174 (Appendix B, Table 21). Over this ten year period catch composition has averaged 54.8 % subjacks, 27.8% adults, and 17.4% jacks for fall Chinook (Appendix B, Table 21). This catch represents on average 8.6% of the adult run, 12.3% of the jack run, and 27.7% of the subjack run (Appendix B, Table 21). As with coho, no obvious trend exists over the ten years surveyed in the percent of the fall Chinook run harvested (Figure 85).

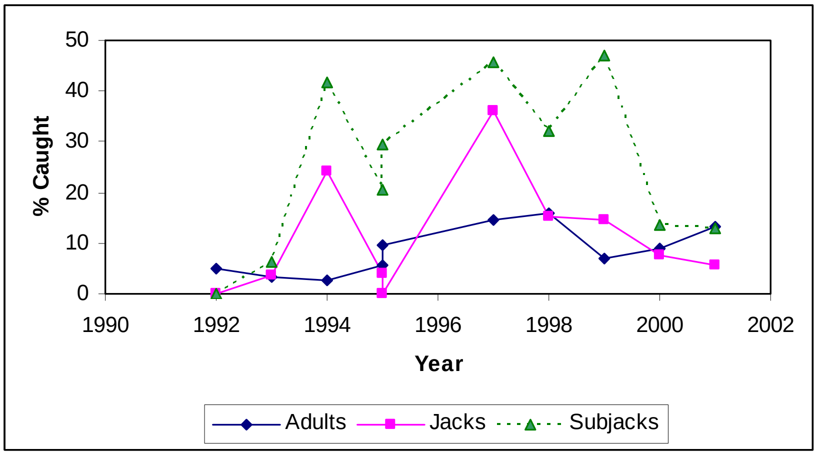


Figure 85. The percentage of the total coho run caught in the Umatilla River by the non-tribal sports fishery. Data from Chess et al. (2004).

Tribal harvest of fall Chinook and coho salmon runs has been monitored via post-season interviews from 1996 to 2003. No tribal effort or catch was reported during these interviews. For example, in 2003 95 tribal anglers were interviewed and none reported fishing in the subbasin for fall Chinook or coho while many reported harvesting steelhead and spring Chinook (personal communication: C. Contor, Fisheries Biologist, CTUIR, May, 2004).