3. Hood River Subbasin Assessment

3. 1. Subbasin Overview

3.1.1 General Description

Location

The Hood River is located in Hood River County in north central Oregon and joins the Columbia River 22 miles upstream of the Bonneville Dam. The Hood River Subbasin is bounded on the west by the Cascade Mountain Range crest, on the east by Surveyors Ridge and the Wasco County line, on the south by the White River drainage. The subbasin includes the towns of Parkdale and Odell, and part of the City of Hood River.

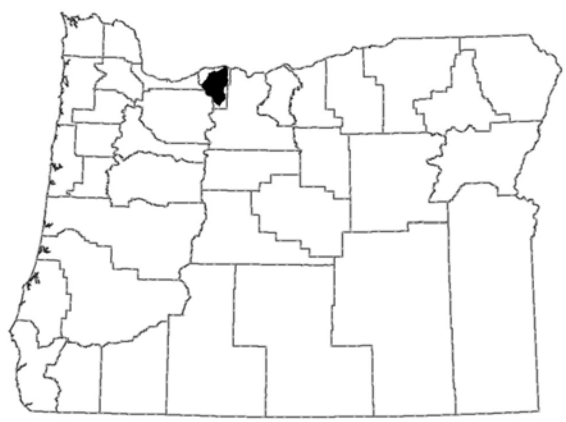

Figure 1. Location of Hood River Subbasin in Oregon.

Size

The Hood River drainage basin size is 339 square miles or 217,492 acres.

Geology

The Hood River Subbasin is dominated by the 11,245 foot high strato-volcanic cone of Mt. Hood formed of lava and pyroclastic flow deposits. Volcanic rock forms ridges and drainages beyond the base of Mt. Hood, and Columbia River basalt is the most widespread rock formation. Pleistocene-era glaciers and Holocene floods have shaped the landscape into steep narrow valleys, and terraces of clay, silt, sand, gravel and boulders (PacifiCorp, 1998). The Hood River Valley, as it is locally known, is separated into an upper and lower valley by the 2,642-foot elevation Middle Mountain. The lower valley is a broad north-sloping bench. The mainstem Hood River cuts deeply into this bench forming a steep canyon. Streams in the upper valley are less deeply incised. Most channels have high gradients, but the many streams including the Hood River and its East and West forks all contain gentle reaches under 2.5 percent gradient in relatively broad valleys. Boulder-rubble substrates dominate most streambeds. The Hood River's major tributaries originate on Mt. Hood and 5 uppermost tributaries are fed by glacial sources. These glacial streams transport large amounts of sediment into the Middle Fork, East Fork, and mainstem Hood River, and to a lesser extent into the West Fork Hood River. Mt. Hood continues to experience extensive glacial erosion. Natural landslides, debris flows, and dam-break floods originating on the moraines and slopes of Mt. Hood frequently impact downstream channels. Long, steep gradients allow small mass-wasting events to gain size and destructive force before reaching gentler slopes. The Newton Creek landslide in 2000 and the Pollalie Creek landslide in 1980 are examples of large catastrophic debris flows that were initiated by smaller landslides.

Climate and Weather

The Hood River is located in the transition zone between the west side marine climate and the drier continental climate to the east. Maritime weather systems sometimes enter via the Columbia River Gorge and moderate its otherwise continental climate (Pater et al. 1998). Annual precipitation has a pronounced geographic distribution with an average of 130 inches per year along the Cascade crest to less than 30 inches along the northeast subbasin boundary. Snowfall is heavy at high elevations and can reach 30 feet deep at timberline on Mt. Hood (SWRB 1965). Most precipitation falls from November through January. Rainfall amounts from June through September average less than one inch per month (Sceva 1966). The mean annual temperature near the City of Hood River at 510 feet elevation is 52 °F.

Land Cover

The greatest proportion of land cover in the subbasin is conifer forest. Vegetation cover types are variable depending on elevation, longitude, and aspect. Douglas fir dominates the western subbasin, interspersed with western hemlock, red cedar, Pacific silver fir, noble fir, grand fir, and Englemann spruce. Ponderosa pine and Douglas fir stands dominate the eastern subbasin area, interspersed with white pine, tamarack, and hemlock. At lower elevations, Oregon white oak and pine-oak stands are common, especially to the east and on south-facing slopes, with deciduous stands including large leaf maple in some areas, and grasslands on the eastern foothills of the Cascades.

Land Use and Population

Approximately half the subbasin is within the Mt. Hood National Forest or designated wilderness areas. Major land uses on non-federal lands are agriculture and timber production. Approximately 25 percent of the subbasin or 50,000 acres are managed as industrial forest. The majority of private land is zoned either as Forest or as Exclusive Farm Use (EFU). Of the 27,201 acres zoned as EFU land, 15,000 acres are planted in orchard crops. Small urban centers exist in Odell, Parkdale, and the City of Hood River. The population is dispersed, with 67% of residents living outside of urban growth boundaries (USFS, 1996a). An estimated 16,245 people were living inside the subbasin boundary in 2003. This estimate was obtained by subtracting half the current population of the City of Hood River and all of the City of Cascade Locks population from the current population of Hood River County (Portland State University, 2003). Hood River County experienced an annual growth rate of approximately 2% from 1990 to 2000.

Economy

Agriculture is the leading industry followed by tourism and forestry. The Hood River Valley contributes about a third of the total U.S. winter pear crop. Apples, cherries, blueberries, peaches, and wine grapes are also grown in smaller amounts. The fruit industry generates $65 to $70 million annually for the local economy and employs between 1,000 to 2,800 people depending on the time of year. The fruit industry is experiencing economic stress due to global competition, market consolidation, and other trends. Agriculture contributes about 10 percent of total income in the County, down from 20 percent in 1974 (USFS, 1996a). The wood products industry has declined in recent years, including the closure of two large sawmills. Tourism has expanded into the second biggest economy in the area. Recreational use of the Mt. Hood National Forest and other forest land has risen along with growth in Portland, in the Columbia River Gorge area, and in the tourism industry. The City of Hood River is an international windsurfing destination. Whitewater kayaking, angling, hiking, camping, backcountry winter sports, off-road vehicles, and mountain biking are increasing recreational uses. A strong link between tourism and land development in the Hood River Valley is noted by historians and continues today (USFS 1996b).

Land Ownership

Sixty-five percent of the Hood River watershed is publicly-owned. A map of land ownership is provided in Appendix A, Map 6. Fifty-two percent are federally managed lands in the Mt. Hood National Forest and the Mt. Hood Wilderness Area. About 25% of the subbasin is industrial forest land owned by Longview Fibre Company and Hood River County, and 21% is privately owned (Table 1).

Table 1. Land ownership in the Hood River Subbasin.

OWNERSHIP	ACRES	PERCENT OF SUBBASIN
Bureau of Land Management	367	0.17%
City of Hood River	14	0.01%
Hood River County	204	0.09%
Hood River County Forest	26206	12.04%
Longview Fiber Co.	27502	12.63%
OTHER	2453	1.13%
Private	45733	21.01%
S.D.S. Co., LLC	465	0.21%
State	1085	0.50%
State Highway Comm.	6	0.00%
USDA Forest Service	113661	52.21%

Human Disturbances to Aquatic & Terrestrial Environments

The principal human disturbances to aquatic habitats in the Hood River subbasin are:

- Loss of the extensive delta area at the Hood River mouth by inundation from Bonneville reservoir.

- Diminishment or depletion of stream flows at irrigation, hydropower and municipal water diversions
- Fish migration barriers at dams, diversions, and road crossings
- Loss of large woody debris recruitment and reduced riparian- floodplain interactions caused by historic timber practices
- Channel confinement and interference with stream and riparian processes by roads and other land use.
- Water quality alteration by sediment inputs from roads and irrigation networks, pesticide and nutrient contamination from agricultural and other non-point sources, temperature increases from flow modification, reservoir discharge (Laurance Lake), or riparian vegetation removal.

Principal terrestrial habitat disturbances include:

- Conversion of conifer forest to agricultural, residential and other land cover types
- Suppression of natural wildfire regimes,
- Introduction of non-native plants and animals,
- Fragmentation of forest stands by timber harvest and construction of road, rail, trail, and utility corridors.

Since the 1880s, streams have been diverted into canals and ditches to irrigate orchards and other crops. Dams were built for mills, irrigation, or power generation. The largest and most significant dams remaining in the subbasin are Powerdale Dam in the lower Hood River and Clear Branch Dam in Clear Branch of the Middle Fork Hood River. The ditching and draining of wetlands and springs has been common in agriculture and other land uses. Historic timber practices including splash damming and stream clearing continue to effect fish habitat. Symptoms of disturbance are channel incision, fewer pools and pieces of instream wood, and less variation in water velocity and substrate size (USFS 1996a; USFS 1996b). Channel confinement by roads, revetments, and bridge fills affects at least 24 miles of stream in the subbasin (HRWG 1999).

Timber management and fires suppression has altered the age, species composition, and structure of native forest stands in lower and mid-elevation forests while headwater forest areas remain less altered. The availability of contiguous mature forest habitat has been reduced by harvest-related fragmentation. Agricultural, industrial and residential land uses have created a net loss of shelter for resident birds and mammals, especially in winter, at elevations under 2,500 feet. Another structural attribute of native forests, missing in fruit orchards and most rural residential properties are damaged live trees, standing dead trees, and large-diameter downed trees that provide nesting cavities, scanning perches, and insect-feeding substrate for birds and a variety of other wildlife (Wells, J. 1999). Vehicle traffic and year-round trail and backcountry recreation has likely affected wildlife species that are intolerant of human activity.

3.1.2. Subbasin Existing Water Resources

Watershed Hydrography

The Hood River has 3 main tributaries – the East, West, and Middle Forks. These originate on Mt. Hood and flow generally northward. The West Fork joins the mainstem Hood River 12 miles from its mouth on the Columbia River, while the Middle and East Fork Hood River converge with the mainstem Hood River near River Mile 15.0. Other major tributaries include the Dog River, Clear Branch and Lake Branch, and Neal, Tony, Evans, Odell, and Green Point creeks. According to GIS analysis of this data, the Hood River subbasin has an estimated 992 miles of mapped stream, excluding segments labeled as ditch or canal. Of these, an estimated 123 miles are mapped as anadromous fish habitat and 260 miles as resident fish habitat. The watershed hydrography data source for this assessment was the Oregon/Washington Hydrography framework (REO, Version 13, 2003). This framework delineates 12 sixth-field Hydrologic Unit Code (or HUC 6 watersheds (Map 1, Appendix A.) These watershed boundaries are a significant departure from the fifty 6 HUC watersheds used in previous watershed assessments.

Hydrologic Regime

Fifty-two percent of mapped streams have perennial streamflow based on the GIS data used in this assessment. In the EDT model, the overall flow regime of the subbasin was characterized as "rain on snow transitional". The hydrology of the Hood River is characterized by highly variable stream flows and rapid runoff. The relatively short, steep morphology of the drainage basin promotes flood peaks that are brief in duration, a characteristic sometimes described as "flashy". Runoff is especially rapid during early winter storms before freezing conditions arrive at high elevations (SWRB 1965). Mt. Hood glaciers and snowmelt help support summer base streamflows in the Hood River. Five upper tributaries to the Hood River are fed by glacial sources. Snowmelt typically begins in April. The dynamic hydrograph of the Hood River is heavily influenced by glacial recession and rain-on-snow events.

Long-term flow records exist for gage stations on the Hood River and the West Fork Hood River. Flow duration statistics for the Hood River are shown in Figure 2. The mean annual flow of the Hood River is 1062 c.f.s. (U.S.G.S 1412000, Hood River at Tucker Bridge). The median monthly low flow of the Hood River at the Tucker Bridge gage is 369 c.f.s. in August (U.S.G.S, 1990). The West Fork Hood River contributes 51% of the average annual stream flow of the Hood River (Underwood, K.D. 2003). The mean annual flow of the West Fork Hood River is 554 c.f.s. and the mean monthly low flow is 157 c.f.s. and typically occurs in September.

Rain-on-snow floods are relatively common and occur most frequently between December and February. The reported flood threshold at the Tucker Bridge gaging station is 4,500 c.f.s. For comparison, the record daily Hood River discharge was 33,200 c.f.s. in December 1964 (USGS 1987). The second highest daily discharge occurred in February 1996 at 23,300 c.f.s. The record daily discharge for the West Fork Hood River was 15,000 c.f.s. in December 1964.

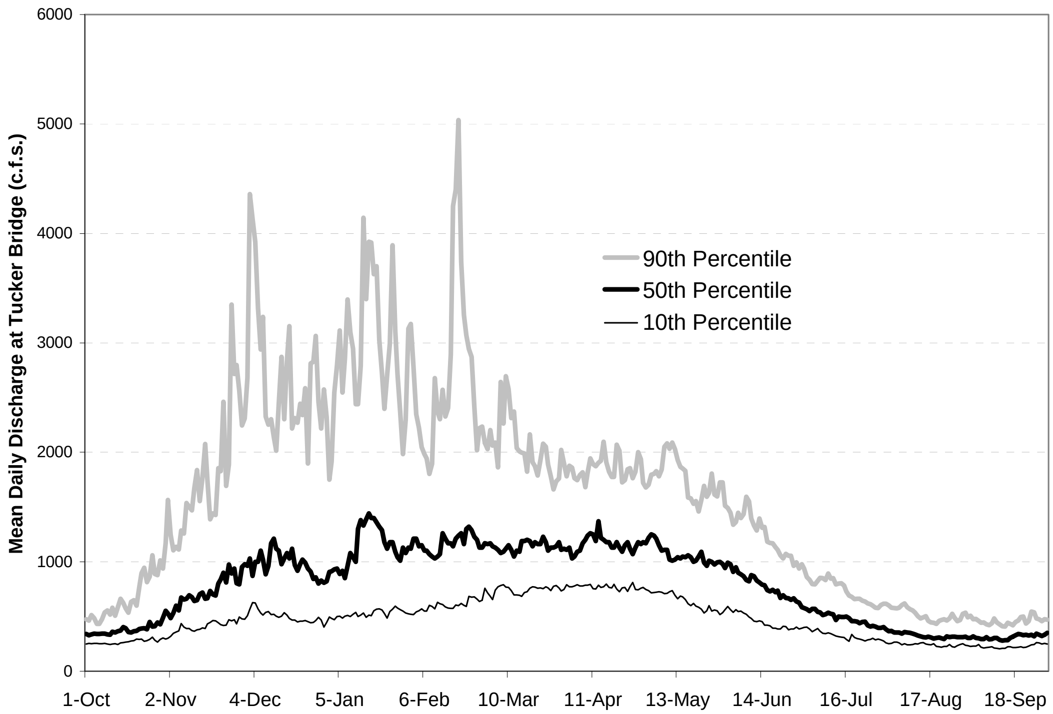

Figure 2. Flow duration statistics for the Hood River based on daily discharges at U.S.G.S. Gage 14120000 Hood River at Tucker Bridge, for the water years 1966 to 2002.

Several major springs discharge from lava rock formations. A 2002 infrared survey of the Middle Fork Hood River detected four cold-water springs between the Laurance Lake outlet and the East Fork Hood River confluence (Watershed Sciences, LLC, 2003).

Water Quality

Natural Conditions: Water quality in the Hood River is strongly influenced by Mt Hood glaciers. The transport of glacial flour, or fine ground-up sand and stone, from glacial headwater tributaries during summer melt can dramatically increase water turbidity in downstream areas. The West Fork is the least influenced by glacial turbidity, while the East Fork and Middle forks were the most heavily influenced (USFS, 1996b). Glacial melt typically occurs between July and October, however, glacial water turbidity is strongly affected by air temperatures on Mt. Hood and can vary widely within a 24-hour period and from day to day. Summer glacial turbidity levels vary around 2 to 20 NTU, with much higher levels at times in the glacial headwater streams. (Appendix B, Figure 1). Literature indicates that glacial turbidity levels such as those found in the Hood River subbasin are high enough to decrease primary production, macro-invertebrate production, and subsequent fish growth and survival. Lloyd et al. (1987) found that turbidity of only 5 NTU could decrease primary production in shallow streams by 3-13%. An increase of 25 NTU decreased primary production by 13-50% in shallow streams.

Water Quality Impairment: Water quality monitoring activities indicate that water temperature, turbidity and fine sediment, pesticide contamination, and nutrient enrichment are elevated in several stream reaches. These are briefly discussed below.

Temperature: Several stream segments were included in the 1998 Oregon 303-d List for exceeding Oregon water quality criteria (Figure 2). The 2002 Oregon 303-d List includes tributaries exceeding standards for the pesticides chlorpyifos and Guthion, and the metals iron and zinc. Temperatures exceeding state criteria have been measured in stream reaches influenced by water diversion, reservoir storage, and reduced riparian shade levels. In a few reaches, temperatures exceeding criteria, particularly the 10º C bull trout criterion, may occur under apparently natural conditions.

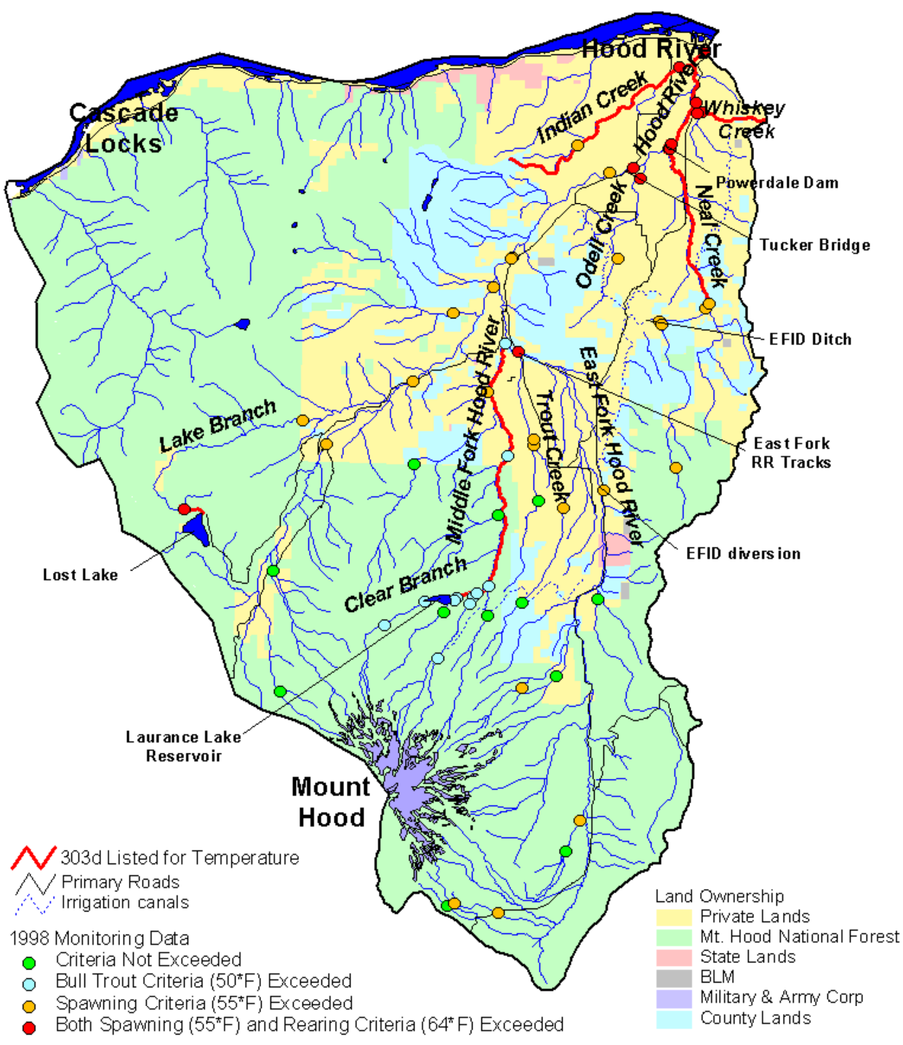

Figure 3. Stream segments where 1998 Oregon temperature standards are exceeded.

Locations where water temperatures are of particular concern are discussed below.

- *Clear Branch below Laurance Lake Reservoir*. Lower Clear Branch exceeds the bull trout criteria of 10º C. The bottom-outlet reservoir retains heat during spring and summer, eventually discharging water that can at times be 3º to 9º C warmer than Clear Branch inflows above the reservoir. Temperature increases occur during critical summer rearing and fall spawning periods for bull trout (Buchanan et. al., 1997). A longitudinal temperature profile of Clear Branch and the Middle Fork Hood River from an August 2, 2002 Forward Looking Infrared study graphically depicts warming below the reservoir (Appendix B, Fig. 2).
- *East Fork Hood River below the East Fork Irrigation Diversion*. Monitoring between 1990 and 1998 indicates that the 17.8º C criteria is consistently exceeded. A comparison of monitoring sites found that the lower East Fork at River Mile 3.7 had the warmest temperatures in the subbasin with average daily maximums of 21.0º and 21.5º C (USFS, 1996. Potential causes include extensive water diversion and solar heating due to a wide braided channel.
- *Neal Creek*. 1998 monitoring data shows a maximum 7-Day Moving Average (7DMA) of 20.7º C at the mouth, while the mouths of the East and West Forks showed maximum 7DMAs of 14.8º and 17º C, respectively. West Fork Neal Creek temperatures appear to be increased by the East Fork Irrigation District ditch system. Low riparian shade levels exist along several miles of the creek.
- *Hood River from Powerdale Dam to the Powerhouse* (R.M. 4.0 to R.M.1.0). The 17.8º C criteria was exceeded based on 1995 and 1996 monitoring. The hydro diversion of up to 500 c.f.s. contributed to warming in the bypass reach. Dam removal is scheduled for June 2010 under a 2003 settlement agreement filed with the Federal Energy Regulatory Commission. Interim measures in the agreement include minimum instream flow increases predicted to help meet state criteria.

Nutrient Enrichment: Phosphorous and nitrogen concentrations are elevated in some lower Hood River tributaries, notably Odell, Lenz, and Baldwin Creeks (HRWG, 1996). Potential sources include fertilizer, livestock waste, septic systems, wastewater discharge, and soil erosion. Several industrial and municipal wastewater discharge permits are administered by DEQ in the subbasin. Elevated phosphorous inflows and internal loading in the Laurance Lake Reservoir has stimulated annual cyanobacterial algal blooms since 1997. The lake is classified as mesotrophic, and lake P levels have ranged from 0.016-0.047 mg/L (Penuelas, R, 1999). The interaction of the 1996 flood and natural geologic factors are suspected as the source of the elevated P inflows.

Turbidity and Fine Sediment: Turbidity and sediment inputs from human activities include: (1) fine sediment runoff from forest roads; (2) irrigation system interbasin transfers, overflows, and return flows; (3) exposed soils in livestock areas adjacent to streams; (4) winter sanding of roads and parking lots; and (5) landslides from forest or irrigation activities. Turbidity and fines in the Neal Creek are heavily influenced by the creek's use as a conveyance for irrigation water from the glacial East Fork Hood River to to the lower east Hood River valley. Data collected by DEQ during the irrigation season on 8/6/98 showed that turbidity in Neal Creek downstream of the EFID ditch (impairment source) was 35 NTU and TSS was 36 mg/L (Appendix B, Figure 1).

Pesticide Contamination: Organophosphate and other insecticides are used on orchards in the winter, spring, and summer, and may be used year round in urban areas. The timing of use overlaps with adult and juvenile steelhead migration, spawning, early life stage development, and the life stages of other fishes and aquatic species. Between 1999 and 2003, water samples were collected at multiple locations during periods of pesticide use in orchards. DEQ toxicologists have monitored water, fish, and macroinvertebrates at selected sites and control sites since 1999. OSU has also collected water samples including 48-hour hourly auto-sampling events in Neal Creek. *Chlorpyrifos* (Lorsban) was detected in Neal and Indian creeks, with some samples exceeding both the acute and chronic state water quality criteria (DEQ 1999). Between 1999 and 2002, the maximum *chlorpyrifos* concentrations in Neal Creek grab samples ranged from 0.2 to 0.48 ug/L, or between 2.5 to 6 times the acute water quality criterion, and between 5 to 12 times the chronic criterion. *Azinphos methyl* (Guthion) was detected in the Hood River, Neal, Indian, and Trout creeks. Concentrations above the chronic water quality criteria were found in Neal and Indian creeks and the Hood River. Between 1999 and 2002, maximum *azinphos methyl* concentrations in Neal Creek grab samples in ranged from 0.04 to 0.186 ug/L (Jenkins, J. 2003), or between 4 and 19 times the chronic water quality criterion. No acute criterion is established for Guthion. Bioassay work by DEQ in 2001 and 2002 found that caged steelhead held in Neal and Lenz creeks exposed to high pesticide levels had depressed brain acetylcholine esterase activity compared to steelhead held at sites with low or no pesticide contamination or control fish. Within-season changes in macroinvertebrates were detected in sampling locations after periods of spray application. Post-spray collections had lower numbers of dominant species than in pre-spray collections (Foster, E. et al, 2003). Concerns about stream contamination have prompted a major effort by local growers to implement pesticide best management practices in orchards.

Riparian Resources

Riparian shade levels and large woody debris recruitment potential were assessed along 170 miles of stream length on non-federal lands in the Mainstem, East Fork, and Middle Fork Hood River watersheds using 1995 and 1999 aerial photographs (Nelson, C. 2000, Salmenin, E. 1999). Riparian large wood recruitment was unsatisfactory along 64 percent of the stream length assessed in the lower Hood River and its tributaries compared to 54 percent in the East and Middle Fork watersheds. Shade levels in the lower Hood River watersheds were found to be high (>70 percent shade) along 51percent of the total riparian area assessed, medium along 21percent, and low (<40 percent shade) along 28 percent. Results were similar in the East and Middle Fork subwatersheds. A detailed assessment of riparian vegetation was conducted by DEQ in 2001 for the Western Hood River Basin Total Maximum Daily Load study temperature model. The model predicted that achieving system potential riparian shade conditions reduced maximum daily temperatures in the East Fork Hood River, the Hood River, and Neal Creek compared to existing riparian conditions (DEQ, 2001).

Wetland Resources

A total of 783 wetlands covering 1,950 acres were identified by the 1981 National Wetlands Inventory (NWI) in the subbasin. Wetland density among 6th field HUC subwatersheds ranged from a low of zero to a maximum of 17 percent in the Lost Lake subwatershed, and was less than 1 percent overall. Actual acreages of wetlands and wetland disturbances in the subbasin are believed to be underestimated by the NWI (Salminen, 1999). Of the total acreage identified, 23 percent are in the Riverine System, 21 percent in the Lacustrine System, and 56 percent are in the Palustrine System. The NWI identified wetlands that have been modified by human activity but noted only 10 wetlands or 31 acres disturbed by draining or ditching. Wet meadows greater than 10 acres that are considered special habitats in the Mt. Hood Forest Plan include Elk Meadow and Horsethief Meadow. Outside of the federal lands, among the most significant wetland habitats is a sizable complex of forested and emergent wetland located at a former river bend along the Hood River near River Mile 2.5 A wetlands inventory and functional assessment prepared for lands within the City of Hood River Urban Growth Boundary (Saich, J. 2003) identified several significant smaller wetlands. No wetland field inventory is available for other non-federal lands in the subbasin.

3.1.3. Hydrologic and Ecologic Trends in the Subbasin

Macro-climate and Influence on Hydrology

Computer models are in general agreement that the Pacific Northwest climate will become warmer and wetter over the next 50 years with an increase of precipitation in winter and warmer, drier summers (USDA Forest Service 2004). This could result in more flooding and landslides (Mote et al. 1999), and increased wildfire risk compared to previous disturbance regimes. Many models predict warmer winter temperatures and loss of moderate-elevation snowpack in the region (Mote et al. 1999). This would lead to lower spring and summer runoff and negative impacts to streamflows and water supply. Alpine glaciers in the Cascade Range have shrunk substantially as average annual temperature has risen 0.5 to 2 degrees Celsius since the mid- to late 1800s (O'Connor, J.E., and Costa, J.E., 1993.), including Mt Hood glaciers in the Hood River Subbasin. Photos taken in 1901 of the Eliot Glacier in the subbasin show a dramatic retreat in the glacial ice volume of as much as 40-50% (Tom DeRoo, geologist Mt Hood National Forest). A series of drier, warmer years from 1975-1995 and 2001-2003 have been accompanied by lower streamflows and accelerated glacial recession. During an extensive warm and dry cycle, accelerated glacial retreat exposes more loose sand and moraines on Mt Hood that can become unstable during the following wet cycle. Following the warm dry period of the last 20 years, major debris flow events on Mt Hood have become much more frequent since 1996.

Macro-climate and Influence on Ecology

Little information was located on how climate change or climate trends are affecting vegetation and ecology in the Hood River Subbasin. Drought stress in recent years has favored bark beetle and spruce budworm infestations of Douglas fir, white pine, and Ponderosa pine stands in the subbasin (Bruce Hostetler, Mt Hood National Forest, pers comm). Climate change is generally associated with changes in disturbance regimes including long term patterns of fire, drought, insects, and diseases that influence forest development (USDA Forest Service, 2004). These changes could alter the distribution of vegetation types, affecting wildlife populations and /or biodiversity.

Human Use Influence on Hydrology in Subbasin

Hydrologic alterations in the subbasin include water diversion, changes in forest land cover to other uses, wetland conversion, road construction, and timber harvest. The Hood River mouth at its confluence with the Columbia River has been inundated by the Bonneville Pool and further modified by diking and landfill.

Water Diversion: Stream flow is interrupted or diminished by irrigation, domestic, municipal, and hydroelectric diversions. The total volume of legally appropriated water rights for out-of-stream uses is approximately 678,094 acre feet, or 94 percent of the estimated median natural stream flow at the Hood River mouth (Parrow, 1998). The estimated actual consumptive diversion for the peak summer irrigation period is at 296 c.f.s. or 40 percent of the average natural flow of the Hood River from July to September. Information about diversion points, return flows, and consumptive use levels are provided in Appendix B, Table 1.

The most significant alterations of the natural flow regime are the Pacificorp Powerdale Dam hydroelectric project (Hood River at RM 4.5) and irrigation withdrawals. Powerdale Dam diverts up to 500 c.f.s. from a 3 mile bypass reach in the Hood River. This diversion is subject to minimum instream flow requirements which up until recently allowed for a diversion of up to 80% of the available streamflow. Five irrigation districts account for the majority (~95%) of the consumptive water use in the subbasin. Major diversions are located on the East Fork Hood River (RM), mainstem Hood River (RM 11); Coe Branch; Eliott Branch; Clear Branch at the Dam; West Fork Hood River; The upper Dog River is legally depleted each summer at the City of The Dalles municipal diversion. Prior to efficiency measures in the mid 1990s, the East Fork Hood River became fully depleted below the East Fork Irrigation District diversion during severe droughts.

The majority of water supply in the subbasin is obtained by the direct diversion of surface water or springs. Only a small amount of groundwater is withdrawn for human use. Construction of Green Point Reservoirs in Ditch Creek and Laurance Lake Reservoir on Clear Branch inundated a total of 1.7 miles of stream habitat. Laurance Lake impounds 5,500 acre-feet behind Clear Branch Dam. The Farmers Irrigation District operates the Green Point reservoir system. The storage volume is approximately 1000 acre-feet.

Peak Flow Alterations: The Forest Service hypothesized that forest management, especially road construction and removal of wood from channels, has increased peak flows in the West Fork over natural conditions (USFS 1996a). Upland harvest has likely elevated peak flows in 2 to 5 year events, changing them to a chronic habitat disturbance.

Within the East and Middle Fork watersheds, Trout, Evans, and Tony creeks and the Lower East Fork Hood River were found to be the least hydrologically recovered, while the remaining watersheds met or surpassed the recovery threshold based on canopy closure. Road systems and impervious surfaces are assumed to affect the hydrology of drainage basins by intercepting surface and subsurface water flow, altering runoff patterns, and constraining stream channels from natural movement and adjustment patterns. GIS analysis of road densities among the eleven 6 HUC watersheds in this assessment indicate a range from 6.2 miles/ mi^2 (Lower Hood River) to a low of 1.3 miles/ mi^2 (Pinnacle Creek). Impervious surface is generally low in the subbasin.

Historic timber practices have reduced instream wood recruitment compared to natural conditions. Large woody debris (LWD) slows moving water and tends to desynchronize the timing of peak inflow from the outflow, lowering the peak flow (Watershed Professionals Network 1999). The use of splash dams occurred through the 1940s in the subbasin, and stream clearing was an encouraged practice in the 1960s and 70s. All large wood was cleared from the East Fork Hood River between Robinhood and Sherwood campgrounds in 1979. Reduced LWD has resulted in higher flood velocities, less interaction between streams and floodplains. Historic logging and clearing of streams and riparian areas has decreased large woody debris recruitment, in turn reducing pool area, pool complexity and pool frequency compared to natural conditions in the majority of subbasin streams. Flood refuge, hiding cover, over-wintering and productive early rearing habitats (i.e. shallow lateral habitats, side channels) for fish are lacking. Most channels lack the complex structure needed to retain gravels for spawning and invertebrate production.

Base Flow Alterations: The use of drain tiles and ditches to reduce soil saturation is associated with agriculture and other land uses in the subbasin. A network of open irrigation ditches and road ditches intercept surface flows and shallow groundwater at numerous locations. Loss of wetland recharge and storage functions has probably had a greater effect on base flows in small streams than on subbasin peak flow characteristics (Rick Ragan, USFS, pers comm). Irrigation overflows and canal leakage may increase summer stream flows in Baldwin, Odell, and Tieman creeks. The West Fork Neal Creek flows during the irrigation season are increased 5 to 10-fold over the natural baseflow by the creek's use as an inter-basin irrigation transfer system.

Human Use Influence on Ecology in Subbasin

Forest Land Conversion: Vegetation and wildlife habitats in the middle and lower subbasin area have been substantially altered in the last 150 years. Conversion of conifer forest to agriculture, residential, and other development is the most significant change since the late 1800s. A major ecological consequence of the conversion of low elevation conifer forest to orchard and residential environments is the loss of winter range and key structural habitats for wildlife. Fruit tree and most residential landscapes lack the year-round hiding, thermal and snow accumulation cover or shelter for birds and mammals that conifer forests provide. The result is a net loss of shelter for resident birds and mammals, especially in winter, at lower basin elevations (Wells, 1999). Other attributes of native forests that are lacking in most low elevation lands are damaged live trees, standing dead trees, and large-diameter downed trees. This has decreased the availability of nesting cavities, scanning perches, and insect-feeding substrate for birds and a variety of other wildlife. Remnant forest patches among cultivated and developed lands in the subbasin are often fragmented. In many areas, riparian vegetation is the last stronghold of native plant form and function in the Hood River Valley.

Timber Harvest: Timber harvest has increased forage and edge habitat preferred by deer and elk, and in turn has probably increased these populations relative to pre-European settlement, along with cougar, their main predator. The winter range of large migratory animals like deer and elk in the Hood River Valley has been usurped by human habitation (Wells 1999). Half the remaining winter range of deer and elk in the subbasin as a whole is on private land.

Fire Suppression: Fire suppression since the 1880s has resulted in changes in forest structure and ecology including an invasion of Douglas fir into Oregon white oak stands in the subbasin (Robin Dobson, USFS). In absence of periodic wildfire, stands of fire-dependent vegetation such as oak are diminishing, reducing forage and cover for the wildlife species associated with these communities.

Fragmentation by Human Travel and Utility Corridors: The construction of utility corridors and human travel corridors (roads, highways, railroads and trails) has resulted additional fragmentation and disturbance of wildlife habitats. According to the GIS analysis performed for this assessment, the combined human travel corridor density is 4.3 miles per sq. mile, excluding utility lines and unmapped trails (Appendix A, Map 2)

Wetland and Stream Alteration: The ecology of wetland and stream habitats has been altered as well by human activity. Vegetation removal, water diversion, and storage contributes to warm water temperatures exceeding the preferred ranges for salmonids in a number of stream reaches. Agricultural and other human activities have resulted in pesticide contamination and elevated nitrogen and phosphorous levels in several lower Hood River tributaries, with some evidence of adverse effects on macroinvertebrates and fish. Chronic fine sediment inputs and increased turbidity from forest road runoff and irrigation systems affects primary production and macroinvertebrate production. Lloyd et al. (1987) found that turbidity of only 5 NTU could decrease primary production in shallow streams by 3-13%. An increase of 25 NTU decreased primary production by 13-50% in shallow streams.

3.1.4. Regional Context

Relation to the Columbia Basin

The Hood Subbasin is 169 miles from the mouth of the Columbia River at the Pacific Ocean. The Hood Subbasin is one of 62 subbasins in the Columbia River. At 349 square miles, the Hood Subbasin makes up 1.6 percent of the Columbia River Basin. Anadromous fish produced in the Hood River must pass a single Columbia River mainstem dam, Bonneville Dam, and its reservoir, Lake Bonneville, as smolts and returning adults.

Relation to the Ecological Province

The Columbia Gorge province includes the Columbia River and all tributaries between, and including, Bonneville and The Dalles Dam. The Hood River Subbasin is one of 7 subbasins within the Columbia Gorge Province. The Hood Subbasin represents 11 percent of drainage area in the Province.

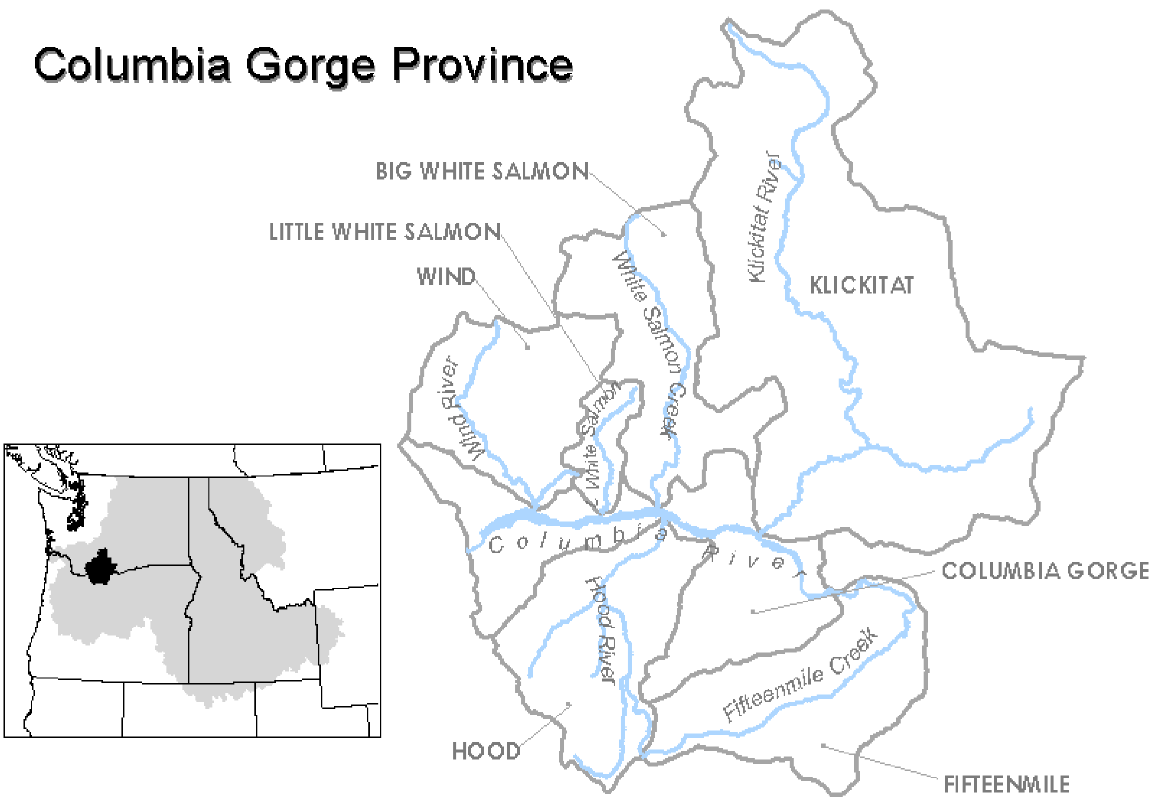

Figure 4. Relation of the Hood Subbasin to the Columbia Gorge Province.

Relation to Other Subbasins within the Province

The Hood Subbasin ranks 4th in size among the other subbasins in the Columbia Gorge Province. Within this Province, the Hood Subbasin accounts for 51 percent or 139,861of the total salmon production goal the Columbia Gorge Province (Phil Roger, Draft Interim

Subbasin and Provincial Objectives, April 23, 2002 memo to Oregon Coordinating Group).

Unique Qualities of the Subbasin within the Province

The Hood River supports a greater diversity of native salmonid fish species compared to other subbasins in the Columbia Gorge Province. These include spring chinook, fall chinook, and coho salmon, winter steelhead, summer steelhead, bull trout, cutthroat trout, and rainbow trout. Due to the influence of glacial recession and other natural disturbances, aquatic habitat conditions in the Hood River subbasin vary dramatically from year to year.

NMFS Evolutionary Significant Units (ESUs)

The Hood River drainage is within the Lower Columbia River ESU for steelhead (Threatened - 3/98), one of 5 ESUs for steelhead in the Columbia River basin. The Hood River drainage is the western-most drainage in Lower Columbia River ESU. This ESU also includes the Sandy, Wind, Willamette, Washougal, Lewis, Kalama and Cowlitz river drainages. The Hood River drainage is the westernmost drainage within the Lower Columbia River ESU for chinook salmon (Threatened - 3/98), one of 8 ESUs for chinook in the Columbia River basin. The lower 5 or so miles of the Hood River are included in the Columbia River Chum Salmon ESU.

USFWS Designated Bull Trout Planning Units

The U.S. Fish and Wildlife Service listed the Columbia River Distinct Population Segment of bull trout as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). Within the Columbia River Distinct Population Segment, the recovery team identified 22 recovery units including the Mt. Hood Recovery Unit (RU). The Mt Hood RU encompasses the Hood River drainage in its entirety, and drainages eastward up to and including Fifteen Mile Creek, westward up to and including the Sandy River, and the adjacent mainstem Columbia River. The northwestern limit of the Mt. Hood RU extends to Bonneville Dam. The Hood River drainage is identified as the core habitat area within the Mt Hood RU because it currently supports the only known spawning population of bull trout in the unit. Bull trout migrate seasonally from the Hood River to the mainstem Columbia River using the Columbia during part of their life history. Designation of the Mt. Hood RU is based in part on the inclusion of Hood River bull trout within a single Gene Conservation Group (GCG) by Oregon Department of Fish and Wildlife (Kostow 1995). Three records of bull trout in the Sandy River indicate the possibility that the Sandy River watershed supports a population of bull trout, or that bull trout foraging or overwintering in the Columbia River, possibly from the Hood River population, may occasionally be entering the Sandy River or other tributaries downstream of the Hood River recovery unit boundaries.

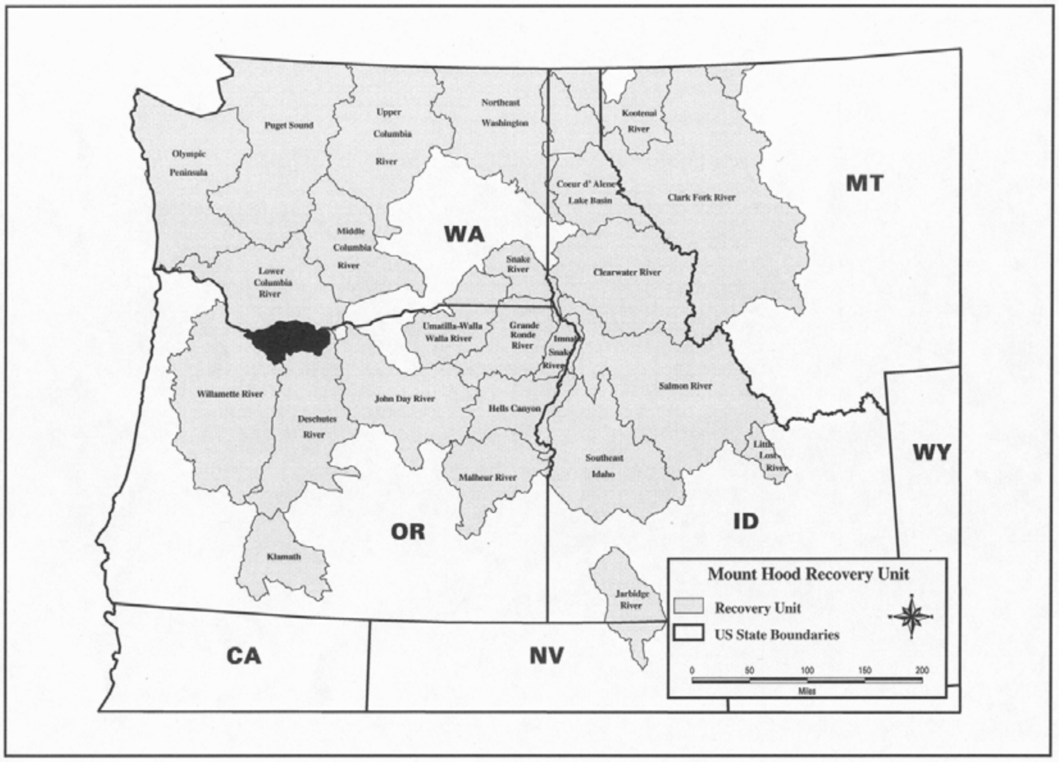

Figure 5. Mt Hood Recovery Bull Trout Recovery Unit is shown in black within the Columbia River Distinct Population Segment.

External Environmental Impacts on Fish and Wildlife

External impacts on fish and wildlife in the Hood River include climate cycles, mainstem fish passage, estuary and ocean conditions; harvest; habitat conditions and land use in adjacent subbasins, and human population growth. Anadromous fish survival during freshwater life stages is influenced by drought and flood patterns, while ocean survival is influenced by temperature and upwelling cycles that determine predator and prey abundance and distribution. Mainstem fish passage in the Columbia River at Bonneville Dam, such as predation and warm summer and fall temperatures in the Bonneville reservoir, affects the survival of adults and juvenile fish migrating to and from the Hood River. Estuarine habitat modifications and artificially elevated sea bird and/or marine mammal predation in the Lower Columbia River represent an additional impact. Climate and precipitation cycles are associated with patterns of fire, drought, insects, and diseases that control forest and vegetation development. Climate effects can alter the distribution of vegetation types and associated wildlife strongly affecting the ecology of the subbasin. Growth and land development in adjacent subbasins are a significant factors that impact migratory wildlife. Regional population growth is contributing to a rising demand for outdoor recreation opportunity and real estate development that ultimately affects fish and wildlife in the subbasin.

3.2. Focal Species Characterization and Status

3.2.1 Ecologically Important Native or Non-native Fish and Wildlife

Fish species known to occur in the Hood River Subbasin are shown in Table 2. According to the Northwest Habitat Institute database, 402 species of wildlife are present or potentially present in the Hood Subbasin. This list is available online at www.nwhi.org/ibis.

Table 2. List of fish species present in the Hood River Subbasin.

Anadromous Fish	Native (N) or Introduced (I)
Spring chinook salmon	**N**
Fall chinook	**N**
Summer steelhead	**N**
Winter steelhead	**N**
Sea-run coastal cutthroat trout	**N**
Pacific lamprey	**N**
Coho salmon	**N**
Resident Fish	
Bull trout	**N**
Coastal cutthroat trout	**N**
Rainbow trout	**N**
Mountain whitefish	**N**
Sculpin *(Cottus sp.)*	**N**
Suckers *(Catostomous sp.)*	**N**
Northern pikeminnow	**N**
Dace	**N**
Stickleback	**N**
Brown trout	**I**
Brook trout	**I**
Kokanee	**I**
Smallmouth bass	**I**
Brown bullhead	**I**

Species Designated as Threatened or Endangered

Three fish and two wildlife species occurring in the Hood River Subbasin are listed as Threatened under the federal Endangered Species Act (ESA) or by the state of Oregon. No species currently listed as Endangered by either Oregon or the federal government are known to regularly occur in the subbasin. No plant species in the subbasin are listed under the Endangered Species Act. The Lower Columbia River anadromous or sea-run form of coastal cutthroat trout *Oncorhynchus clarki clarki*, including the Hood River population, is listed as a Critical Sensitive Species by Oregon. The resident form of cutthroat trout is listed as a Vulnerable Sensitive Species. The Northern gray squirrel is listed as Threatened in the State of Washington. Pacific lamprey were listed as a state sensitive species in 1993. Because of the apparent declines in lamprey populations, conservation groups in Oregon, Washington and California prepared a petition to give lamprey federal protection under the Endangered Species Act in January 2004.

Table 3. Fish and wildlife species listed as threatened in the Hood River subbasin.

Species	Federal Status (ESA)	State of Oregon
Bull Trout *(Salvelinus confluentus)*	Threatened	Threatened
Steelhead Trout (*Oncorhynchus mykiss)*	Threatened	Threatened
Chinook Salmon *(O. tshawytscha)*	Threatened	Threatened
Bald Eagle *(Haliaeetus leucocephalus)*	Threatened *proposed for de-listing*	Threatened
Northern Spotted Owl *Strix occidentalis caurina*	Threatened	Threatened
Wolverine *(Gulo gulo)* possibly extirpated, present in the 1980s	---	Threatened

Species Recognized as Rare or Significant Locally

Table 4. Selected wildlife species that are known to occur in the Hood River subbasin that are recognized as rare, uncommon and/or sensitive.

Birds		
Pileated woodpecker	Bufflehead	Loggerhead shrike
Northern goshawk	Barrows goldeneye	Three-toed woodpecker
Mountain quail	Lark sparrow	Lewis woodpecker
Great gray owl	Clarks nutcracker	White headed woodpecker
Flammulated owl	Common loon	Williamsons sapsucker
Northern pygmy owl	Harlequin duck	Black-backed woodpecker
Western bluebird	Sandhill crane	Pileated woodpecker
Horned grebe	Black rosy finch	Clark’s nutcracker
Lark sparrow	Wood duck	
Amphibians		
Cascades frog	Cascade torrent salamander	Larch Mountain salamander
Spotted frog	Copes giant salamander	Western toad
Tailed frog	Oregon slender salamander	
Red-legged frog	Larch mountain salamander	
Reptiles		
Western pond turtle	Painted turtle	Sharp tailed snake
Mammals		
American Marten	Long-eared myotis	Townsend’s big-eared bat
Fisher	Long-legged myotis	Hoary bat
Red fox	Silver-haired bat	Red tree vole

Species of Special Ecological Importance to the Subbasin

The carcasses of anadromous fish are a significant source of food and marine nutrients for aquatic and terrestrial species. Salmon carcasses provide a critical aquatic and terrestrial food source in the fall and winter, and steelhead in spring. Larval lamprey or ammocoetes are important because they clean the stream by filter feeding organic material and provide a food source for predator fish, including juvenile salmonids.

Beaver create and maintain wetlands and complex stream habitats of great value to several salmonid species especially as critical overwintering habitat. Beaver ponds provide habitat for wildlife species and promote stream-floodplain interaction and groundwater recharge. Beaver are an IBIS "Critically Linked with Fish" species.

Resident coastal cutthroat trout *Oncorhynchus clarki clarki* are important as indicators of the water quality and habitat integrity of headwater and other streams. American marten are a Forest Service Management Indicator species with a role as a medium home-range carnivore in mixed-conifer cover types from mid to high elevation.

Black-tailed deer and elk are managed game species and a Forest Service Management Indicator Species. Big-game movement patterns indicate the degree of connectivity across cover types in the subbasin, and are dependent upon adequate summer and winter range habitat. Grazing, browsing and foraging by deer and elk in the subbasin influences forest vegetation structure, composition, and density.

Clark's nutcracker is an alpine Partners in Flight (PIF) species associated with old-growth white-bark pine and is dependent on its pine cone seeds. These pines grow at high elevations at or above the timberline in the Mt Hood and Cooper Spur area. There are declines in white-bark pine stands, especially in early succession, from fire suppression, replacement by competing conifers, lack of regenerating young trees, and more recently due to blister rust disease. The pine appears to be totally dependent on Clark's nutcrackers (Marshall et al. 2003) for stand regeneration. Clark's nutcrackers cache huge numbers of white-bark pine seeds (up to 100,000 seeds per bird each year) in small, widely scattered caches usually on bare ground. This is ideal for regeneration of the pine since many caches are never used.

Lark sparrow is a PIF species associated with oak savanna, oak-pine stands, and eastside interior grasslands found mostly on along the mid to lower eastern boundary of the Hood River subbasin. Western gray squirrel is an Oregon Game Species and a Forest Service Management Indicator Species, that uses a Ponderosa pine dominant, westside oak and dry Douglas-fir forest type. Fire is an integral part of the ecosystem for both the lark sparrow and the western gray squirrel and helps control invasive plant species and retain native plant species.

Northern spotted owl is associated with mixed-conifer forest cover types with old-growth or late-succession forest structural characteristics (snags, coarse woody debris, and multiple vegetative layers). Large contiguous blocks of forest are critical to the owl's successful reproduction and survival.

Species Recognized by Tribes For Cultural or Spiritual Significance

Members of the Confederated Tribes of the Warm Springs Reservation retain fishing, hunting, and gathering rights in the subbasin arising from the Treaty with the Tribes of Middle Oregon signed on June 25, 1855. Under this treaty, seven bands of Wasco and Sahaptin-speaking Indians ceded ownership of ten million acres of tribal land, including the Hood River Subbasin, to the United States (BPA 1996). A wide range of fish, wildlife, and plants are utilized by the Tribes and have a significant cultural or spiritual value. Pacific lamprey are a valued traditional food and have religious, medicinal, and ceremonial importance to tribal members. Lampreys are an important component of the tribal subsistence fisheries that occurs annually in Fifteenmile Creek, Deschutes River and Willamette River. Lampreys are fatty and highly nutritious. Lampreys have also been used for medicinal purposes. The oils of the "eels" have been used as hair oil and were traditionally mixed with salmon and used as a cure for tuberculosis. Spring chinook are an especially significant species in Northwest tribal culture in part because it is the first salmon to return each year and it appears as a bright plump fish months prior to spawning. Deer and elk remain a very important cultural and subsistence species for the Tribes. In addition to the meat, skins, horns and other parts are used to make drums, clothing, and other traditional items.

3.2.2. Focal Species Selection

List of Species Selected

Aquatic

Bull trout
Steelhead trout (summer and winter run)
Chinook salmon (fall and spring run)
Coastal cutthroat trout
Pacific lamprey

Terrestrial/Wildlife[2]

Northern spotted owl
Western gray squirrel
Lark sparrow
Clark's nutcracker
Black tailed deer
Elk

[2] American marten were originally selected as a focal species but later deleted due to a significant overlap with spotted owl habitat. Harlequin duck were also originally selected, but deleted due to time constraints.

Methodology for Selection

The focal species were selected based on their relevance to 3 or more of the following criteria, using guidance from the Northwest Power Planning Council (NWPPC 2001-20):

1) Status under the Endangered Species Act (ESA), or sensitive status in Oregon and/or Forest Service Region 6;
2) Ecological significance or ability to serve as an indicator of environmental health for other species;
3) Importance to tribal culture;
4) Ability to gage the effectiveness of management actions;
5) Ability to represent an important land cover type or subcover type consistent with the Northwest Habitat Institute Interactive Biological Information System (IBIS).

Table 5. Focal species list and selection criteria for the Hood River Subbasin

FOCAL SPECIES	Population Status or Concern	Management Scope Exists	Ecological Significance or Indicator	Tribal Cultural Importance	Represents Priority Habitat Type (WILDLIFE)
Steelhead trout	X	X	X	X	
Cutthroat trout	X	X	X		
Bull trout	X	X	X	X	
Chinook salmon	X	X	X	X	
Pacific lamprey	X	?	X	X	
N.spotted owl	X	X	X	X	X
Elk	X	X	X	X	X
Black tailed deer		X		X	X
Lark sparrow	X	X	X		X
Clarks Nutcracker	X	?	X		X
Western gray squirrel	X	X	X		X

Each ESA-listed fish species in the subbasin were selected as focal species. Although the subbasin is within the Lower Columbia Chum Salmon ESU, chum were not selected because they are not present and little is known about historical populations in the Hood River. Although they are not included in the Lower Columbia Chinook ESU, spring chinook were selected because they are the target of an ongoing salmon reintroduction program and are of special cultural significance the tribes. Coastal cutthroat trout were selected because of their Sensitive species listing by the U.S. Forest Service Region 6 and the State of Oregon, and because they may serve as indicators of the health of headwater and other streams for rare or sensitive invertebrates.

Wildlife selection was based on the added criteria of the species' ability to represent distinct IBIS land cover types in the subbasin (Table 6). Deer and elk are managed game species that are important to tribal culture and subsistence, and to the general community. Both deer and elk utilize a wide range of available forest, edge, and mixed cover types, including orchards and pasture on an opportunistic basis. Because of their extensive migrations both within the subbasin and to adjacent subbasins, elk were selected to represent migration routes and forest habitat connectivity as a subcover element also important for other species. Lark sparrow and western gray squirrel represent important and threatened lower elevation cover types in the subbasin, that also provide deer and elk winter range. Despite its listed status, the bald eagle was not selected because they are more common along the Columbia River, and management strategies for fish were expected to improve habitat conditions for bald eagle in the subbasin.

Table 6. Focal wildlife species and associated IBIS vegetative land cover types.

Wildlife Species	**IBIS Vegetative Cover Type** ***Subcover Type***
Clark's nutcracker	Subalpine Parkland Alpine Grasslands and Shrublands
Lark sparrow	Ponderosa Pine Dominant; Interior Grasslands, Westside Oak and Dry Douglas-fir
Northern spotted owl	Mesic Lowland Conifer-hardwood forest; Montane Mixed Conifer forest; Interior mixed conifer forest
Western gray squirrel	Ponderosa Pine Dominant Westside oak and Dry Douglas-fir
Black-tailed deer Elk	All forest types in subbasin Mixed Environs *(including the opportunistic use of agriculture and pasture)* *Movement patterns across all cover types*

3.2.3 Aquatic Focal Species Population Delineation and Characterization

Steelhead Population Data and Status

Winter Steelhead Abundance: Escapements to the Powerdale Dam trap ranged from 206-1,017 wild, 108-917 Hood River stock subbasin hatchery, and 1-38 stray hatchery winter steelhead for the 1991-1992 through 2000-2001 run years (Olsen, E., 2003). (Figure 6)

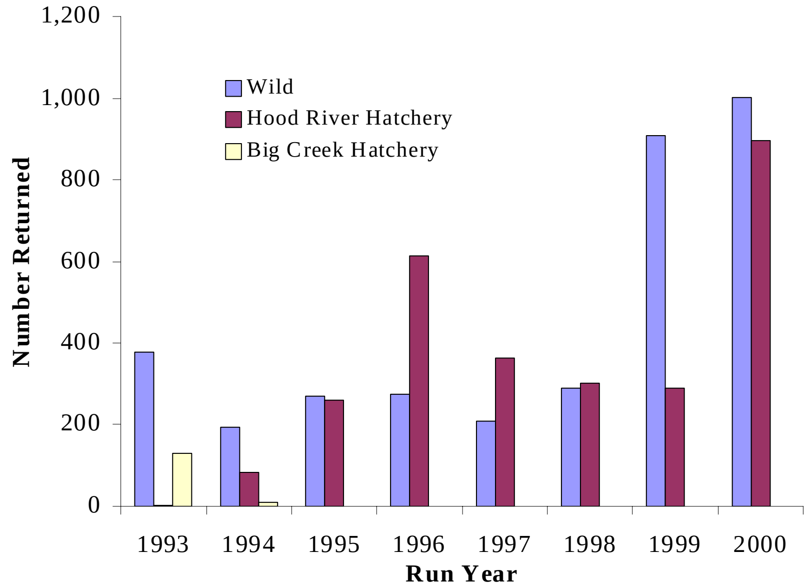

Figure 6. Number of adult hatchery and wild adult winter steelhead captured at Powerdale Dam for run years 1994-2001.

Summer Steelhead Abundance: Adult returns of wild/natural origin summer steelhead to Powerdale Dam ranged from 79 to 650 fish for the years 1992 to 2003 with an average of 261 fish (Rod French, ODFW, pers. comm.). Escapements to the Powerdale Dam trap ranged from 79-490 wild, 485-1,726 Skamania stock subbasin hatchery, 7 Hood River stock subbasin hatchery, and 2-18 stray hatchery summer steelhead for the 1992-1993 through 2000-2001 run years (Figure 7).

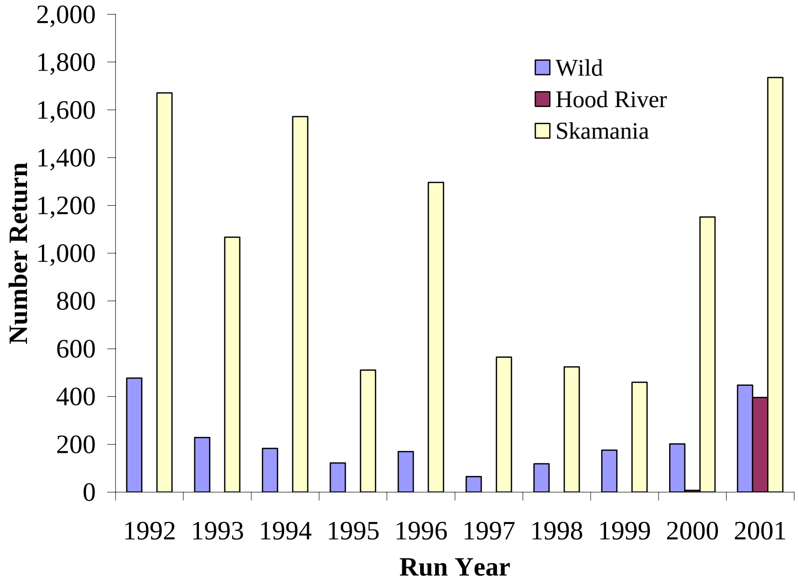

Figure 7. Number of adult hatchery and wild adult summer steelhead captured at Powerdale Dam for run years 1992-2001.

Winter Steelhead Productivity: During the period from 1994 to 2001, the recruits per spawner (R/S) for wild winter steelhead averaged 1.98 and ranged from 0.87 to 3.71.

Summer Steelhead Productivity: For summer steelhead, the recruits per spawner (R/S) averaged 0.18, and ranged from 0.38 to 0.09. The low R/S for summer steelhead indicated the natural spawning population was not replacing itself (Underwood, K.D. et al, 2003).

Winter and Summer Steelhead Life History Diversity: Steelhead return to the Hood River at 2 to 6 years of age, with most fish returning at age 4. Adults typically spend from 1–3 years in the ocean, with an average of 2 years. About 6% of returning steelhead adults are repeat spawners. Smolts range in age from 1- 3 years with most spending 2 years of their life in freshwater (Olsen, E. 2003). Outmigration extends from late March through July, and peaks in early May. Screw trap data indicate that winter steelhead smolts primarily migrate from the East Fork in the fall and move into the upper mainstem Hood River. In contrast, winter steelhead smolts migrate from the Middle Fork primarily in the spring. Summer steelhead in the Hood River tend to remain and rear near their spawning reach and migrate from the West Fork in the spring.

Winter and Summer Steelhead Carrying Capacity: The annual smolt production potential of the Hood River for steelhead was estimated for the BPA Hood River Production Program Review in 2003. This analysis estimated a subbasin habitat production potential of 16,970 winter steelhead smolts and 13,860 summer steelhead smolts (Underwood, K.D. et al, 2003). These estimates were developed using the Unit Characteristic Method or UCM (Cramer, S. 2001). UCM carrying capacity estimates for the Hood River were lower than previous estimates developed in 1990 using the Smolt Density Model (SDM). UCM smolt densities estimates ranged from 0.1 to 3.4 smolts/100m^2. In contrast, the

SDM assigned densities from 3 to 10 smolts/100m^2. The estimated actual number of juvenile steelhead migrating from the Hood River ranged from 2,664 to 24,481 annually during 1994 to 2001, based on screw trap data. Screw trap data indicate that the current number of smolts migrating from the Hood River are significantly lower than the predicted estimates from either the UCM, SDM, or EDT models (Table 7).

Table 7. Comparison of subbasin habitat production potential estimates from three different models to actual steelhead juvenile migrant trap data in the mainstem Hood River at river mile 4.5.

Population	**Unit Characteristic Method**	**Smolt Density Model**	**Ecosystem Diagnostic and Treatment Model**
Winter steelhead	16,790	69,958	35,975
Summer steelhead	13,860	57,750	47,411
Model estimate totals	*30,830*	*127,708*	*83,386*
Estimated # of steelhead outmigrants from trap data 1994-2001	2,664 – 24,481		

Winter and Summer Steelhead Population Trend: Hood River steelhead are considered depressed by ODFW and CTWS, and were listed in 1998 as threatened under the ESA. Harvest records indicate that thousands of steelhead returned to Hood River each year during the 1960s. The annual sport harvest of summer steelhead ranged from 2,406 and 4,455 between 1980 and 1990 (O'Toole and ODFW 1991). However, the proportion of hatchery fish in the sport catch was not documented. The short-term trend for wild winter steelhead returns since 1999 is substantially higher than the previous 6 years based on continuous trap data. Wild summer steelhead do not show the same increasing trend.

Steelhead Unique Population Units: Both summer and winter run steelhead populations exist in the subbasin. The differences between the two stocks include adult return timing, median time of spawning, spatial distribution, emergence timing, and relative size at return (Olsen, E. pers. Comm.). Winter steelhead returns begin in February, peak in late April, and decline in May. Winter steelhead spawning occurs from February 15 to June 15. Summer steelhead returns begin in mid-March, peak in early July, decline in August, and have a second peak in November. Summer steelhead spawn from February 15 to April 30. The median spawning period for winter steelhead is about 2 weeks later than for summer steelhead. Winter steelhead spawn primarily in the Hood River mainstem, Middle Fork, and East Fork, while summer steelhead spawning is limited to the West Fork. Due to their later return, summer steelhead spend longer in the ocean and return at a larger size compared to winter steelhead of similar saltwater age.

Steelhead Genetic Integrity: DNA sampling has shown that winter steelhead and summer steelhead in the Hood River are genetically distinct from one another (Neraas, L.P. and P. Spruell, 2001). Indigenous winter steelhead have had less genetic influence from out of basin hatchery stocks than summer steelhead population. No non-indigenous winter steelhead have been stocked into the Hood River since 1992 when a Hood River broodstock program was initiated. Indigenous summer steelhead are likely to have experienced more interbreeding and genetic influence from out of basin hatchery stocks, particularly the Foster/Skamania stock. No non-indigenous hatchery summer steelhead have been allowed to spawn with wild/natural origin fish above Powerdale Dam since August 1997 (HRWG 1999).

Steelhead Population Risk Assessment: The probability of declining to a 4-year average of 50 spawners per year within 100 years was recently calculated to be 84% for winter steelhead and 99% for summer steelhead (NOAA, 2003). This calculation used stochastic projections based on factors including 1992-2000 abundance levels, and the average percent of spawners of hatchery origin (52% for winter steelhead and 82% for summer steelhead). Wild summer steelhead have had significant genetic influence from non-native hatchery stocks, and their spawning habitat area is limited to the West Fork Hood River. Environmental variation adds another element of risk to the subbasin steelhead populations, given the frequency of large-scale debris flows on Mt. Hood and other natural events.

Chinook Population Data and Status

Spring Chinook Abundance: The current actual wild or natural escapement of spring chinook in the Hood River ranged from 18 to 89 adults between 1992 and 2003, and averaged 54 fish (Rod French,ODFW, pers comm.). Total combined wild and hatchery returns to the Powerdale Dam trap ranged from 53 to 1091 adults (Figure 8).

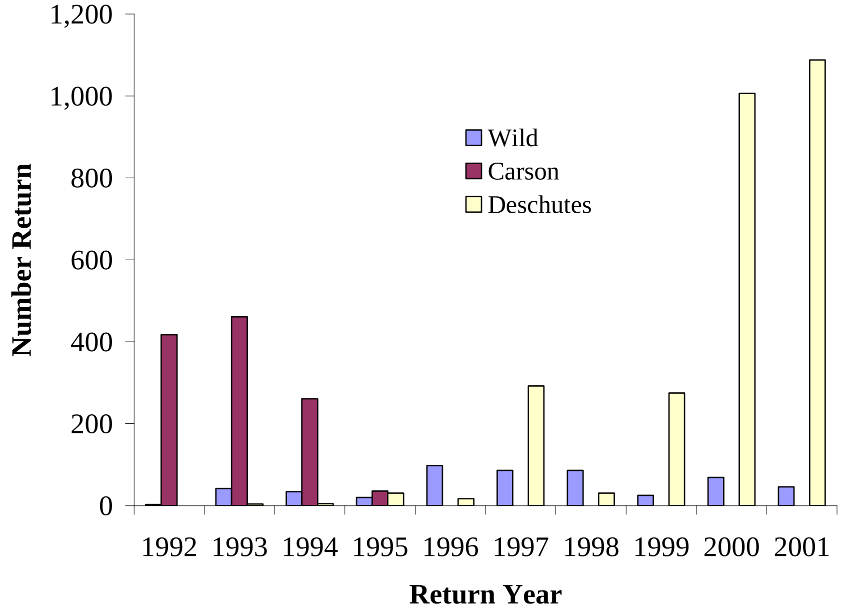

Figure 8. Number of adult hatchery and wild spring chinook captured at Powerdale Dam for run years 1992-2001.

Fall Chinook Abundance: Fall chinook abundance in the Hood River is currently very low. For the period from 1992 -2003 the annual return of fall chinook to Powerdale Dam has averaged 26 fish, with a range from 6 to 70. Between 1992 and 1998, fall chinook returns to Powerdale Dam ranged from 6 to 36 unmarked fish, with 2 to 7 marked hatchery strays (Olson and French 1999).

Spring Chinook Productivity: Recruits per spawner (R/S) estimates for spring Chinook were less than one from 1993-1995 due to poor egg-to-smolt survival. Hood River egg-to-smolt survival was very low, averaging 0.55% compared to an average egg-to-smolt survival of 8.71% in the Warm Springs River (Underwood, K.D. et al, 2003).

Chinook Life History Diversity: Spring chinook enter the Hood River from April to September, and spawn beginning in mid-August through late September. Fall chinook enter from early July through October, and spawn in late September through early November. Outmigrant trap data from 1994 to 2001 suggests that wild spring Chinook predominantly migrated out of the Hood River in the fall (Underwood, K.D. et al, 2003). Ocean-type fall migrants, or those that outmigrate in late summer/fall after emergence are estimated to make up 85% of the population. Stream-type residents and transients, or those that either leaver the subbasin as yearlings in the second spring after emergence and near their spawning reaches, or rear by redistributing to locations downsteam from their spawning reach, make up 15% of the population. Scale analysis indicates that naturally produced spring chinook returning to the Hood River migrated as both subyearling (23%) and yearling smolts, while fall chinook migrate as subyearlings (Underwood, K.D. et al, 2003). Mini-jacks and jacks, i.e. precocious male spawners, accounted for a high proportion of hatchery spring chinook returns to Powerdale Dam compared to wild returns, apparently a result of the fast growth of fish reared in the hatchery compared to wild fish (Underwood, K.D. et al, 2003). The age at adult return for most wild/naturally spawning spring and fall chinook was age 4, although it ranged from 1-5 years.

Chinook Carrying Capacity: The annual average production potential of the Hood River for spring chinook was recently estimated to be 15,692 smolts in recent BPA Hood River Production Program Review (Underwood, K.D. et al, 2003). This estimate was made using the Unit Characteristic Method or UCM and was lower than an earlier estimate of 42,410 smolts using the Smolt Density Model. The UCM predicted that the maximum smolt densities to be 1.6 to 3.5 smolts/100m^2 per stream reach. Actual smolt production measured by screw trap data reached 11,745 smolts in 1994, and ranged from 873 to 1,723 during the period 1995 to 1999. These data suggest that the subbasin was producing less than 10% of the estimated capacity (Underwood, K.D. et al, 2003). Screw trap data indicate that the current number of smolts migrating from the Hood River are significantly lower than the predicted estimates from either the UCM, SDM, or EDT models (Table 8). A life cycle model developed for the HRPP review estimated that roughly 125 adult spring Chinook were needed to fully seed the Hood River to capacity.

Chinook Population Trend: The indigenous spring chinook stock was extirpated by the early 1970s (CTWS and ODFW 1991). A population is being reintroduced as part of the

HRPP using spring chinook from the Deschutes River. Since 1994, the number of returning hatchery spring chinook increased, while the number of wild (naturally produced) fish decreased, suggesting that the current hatchery program was not meeting its supplementation goal (Underwood, K.D. et al, 2003). The indigenous fall chinook stock is extinct. Little is known about its historical abundance. Fall chinook in the Hood River are believed to be hatchery strays and the progeny of hatchery strays. Coincident with a record high run at Bonneville Dam, 109 fall chinook returned to Powerdale Dam in 2003. The prior record was 36 since continuous trapping began in 1992.

Table 8. Comparison of subbasin habitat production potential estimates from three different models to actual chinook juvenile migrant trap data in the mainstem Hood River at river mile 4.5.

Population	**Unit Characteristic Method**	**Smolt Density Model**	**Ecosystem Diagnostic and Treatment Model**
Spring Chinook	15,692	42,410	7,311 (w/o harvest)
Fall chinook	--	--	63,408 (w/o harvest)
Estimated # of chinook outmigrants from trap data 1994-1999	873 - 11,745		

Chinook Unique Population Units: Both spring and fall-run chinook occur in the Hood River. Differences in life history characteristics between the two stocks include adult return timing, median time of spawning, spatial distribution, smolt age, age at return, and relative size at return. The majority of the fall chinook spawn in the lower Hood River below Powerdale Dam, although spawning also occurs in the lower East Fork (BPA 1996) and West Fork Hood River. Spring chinook spawning occurs primarily in the West Fork Hood River and in the lower portions of several West Fork tributaries

Genetic Integrity: The present spring chinook run is mostly from Deschutes River stock. Deschutes River spring chinook smolt releases began in 1993, while releases from Carson hatchery broodstock were made from 1986 to 1990. The genetic makeup of fall chinook is likely very similar to Spring Creek National Fish Hatchery (R. French, ODFW, pers. comm.).

Population Risk Assessment: Without continued hatchery supplementation, the spring chinook population could face a moderate to high risk of extinction. While the number of hatchery fish has increased, the population size of wild or natural spawning spring chinook remains low. Suitable spawning habitat for chinook is geographically restricted to mostly to the West Fork subwatersheds, as the East and Middle Fork mainstems are less suitable for fall spawning due to glacial sediment loads. The supplementation program has not yet worked to create a locally adapted population, although productivity may increase in response to recommended changes in hatchery practices by taking broodstock from fish only returning to the Hood River, and continued habitat restoration

(Underwood, et al. 2003). Environmental variation adds another element of risk to the population, given frequent large-scale debris flows on Mt. Hood and other natural events. Spring chinook adults are vulnerable to poaching, hooking, and/or harvest-related mortality due to their extended exposure to spring and summer sport and tribal fisheries. The fall chinook population, which is believed by area fish managers to be the progeny of hatchery strays, faces a high risk of extirpation because of stock origin and because its distribution is limited to the mainstem Hood River, which experiences high glacial sediment loads.

Bull Trout Population Data and Status

Bull Trout Abundance: A comprehensive population assessment is not available, but at present the total number of adult bull trout in the recovery unit is believed to be less than 300 (USFWS, 2003). A population size of at least 500 adults is recommended in order for the population to be considered recovered (USFWS, 2003). Snorkel surveys conducted in Clear Branch above Clear Branch Dam found annual high counts of 51 to 200 adult and juvenile bull trout between 1996 and 2003. Surveys below Clear Branch Dam found annual high counts of 0 to 3 bull trout. Migratory bull trout have been counted at the Powerdale Dam fish trap continuously since 1992, with numbers trapped ranging from a high of 28 fish in 1999 to 2 fish in 1993 (Figure 9). Counts were made from 1963-1971, but these are considered incomplete because they were either not continuous or made in only one of two dam fish ladders operated at the time.

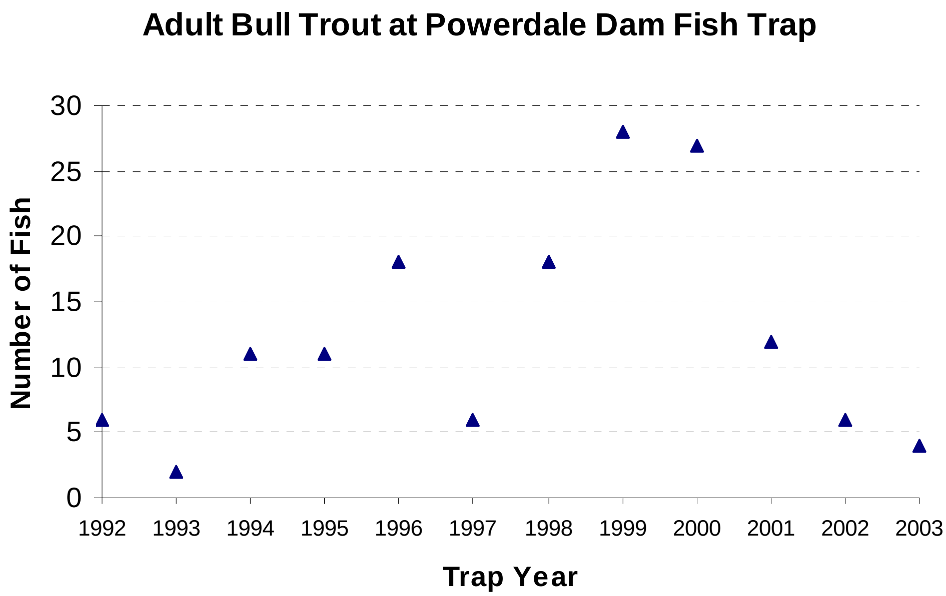

Figure 9. Adult bull trout captured in the Powerdale Dam trap for years 1992 to 2003.

Bull Trout Productivity: Data is not available to develop an estimate of productivity for bull trout in the subbasin.

Bull Trout Life History Diversity: Bull trout in the Hood River subbasin remain in freshwater throughout their life history and are believed to exhibit 3 life history patterns.

Resident and migratory life history forms are found above and below the Clear Branch Dam. A fluvial population migrates between tributaries used for spawning and early rearing, using larger streams such as the Hood River mainstem and the Columbia River for late juvenile or adult rearing. An adfluvial population spawns and rears in upper Clear Branch and Pinnacle Creek and uses Laurance Lake for rearing. Resident bull trout generally confine their migrations within their natal stream (Buchanan et al. 1997). Scale analysis indicates that of bull trout captured at Powerdale Dam are 3 to 8 years old.

Bull Trout Carrying Capacity: Data is not available to develop an estimate of habitat carrying capacity for bull trout in the subbasin.

Bull Trout Population Trend: The current population trend is unclear from the available data. Both the annual snorkel survey data from 1996 -2003 and the Powerdale Dam adult trap counts from 1992-2003 show moderate to high variation from year to year. In 2002 and 2003, an increase in juveniles was observed in Clear Branch above Clear Branch Dam compared to previous years, while the number of adults remained similar to previous years. It is too early to tell whether this recent increase in juveniles reflects a population trend, a shift in rearing distribution in response to habitat restoration, or a short-term environmental variation in juvenile recruitment. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in indicators including trap counts, redd counts, and juvenile and adult observations.

Bull Trout Unique Population Units: Two Local Populations of bull trout were identified in the draft US Fish and Wildlife Service Bull Trout Recovery Plan, one in Clear Branch and one in the Hood River. The two local populations are separated by the Clear Branch Dam, which has blocked the upstream migration of bull trout since its construction in 1969. The success of downstream passage during spillway operation is uncertain, and an effort to trap fish at the base of the dam for upstream transport has not succeeded to date. The Clear Branch Local Population occurs in Laurance Lake Reservoir and in Clear Branch and Pinnacle Creek above the Dam. The Clear Branch Local Population is considered the stronghold for the recovery unit where bull trout numbers are highest and where high-quality habitat is most available. This population unit has an adfluvial life history component, where bull trout forage and overwinter in the reservoir and spawn in the tributaries. Spawning has been confirmed in Pinnacle Creek and in Clear Branch above the reservoir. The Hood River Local Population has fewer bull trout and occurs in Clear Branch below the dam, the Middle Fork Hood River and several tributaries, the Hood River mainstem, and the Columbia River. Spawning has been confirmed in Compass and Bear creeks. The extent to which Clear Branch Dam has imposed a gene flow barrier between the two local populations is uncertain. DNA analysis indicated that Hood River bull trout are genetically distinct from other bull trout in Oregon (Spruell and Allendorf 1997). Genetic analysis suggests that the subbasin was colonized by bull trout from both the coastal and the Snake River local populations (Spruell et al. 2003).

Population Risk Assessment: The Hood River Core Area is considered to be at least at an intermediate threat level based on less than ten years of population trend data (U.S. Fish and Wildlife Service, 2003). Bull trout above Laurance Lake in the Clear Branch are considered to be at risk of a random extinction event due to low numbers, isolation, and at the time of ESA listing were thought to be restricted to a single known spawning area (U.S. Fish and Wildlife Service, 1998). Hood River bull trout are threatened by periodic natural disturbance events, such as glacial outbursts, that are relatively frequent within the spawning areas. Well-distributed and more numerous local populations are essential to spread the risk of these disturbance events. For example, between 1999 and 2003, lower Compass Creek was overtaken by Coe Branch, a glacial stream. Compass Creek is one of only 2 tributaries where the Hood River Local Population below the Clear Branch Dam is known to spawn. It is not known whether Compass Creek still provides suitable spawning habitat, and it is possible that an entire generation of bull trout in Compass Creek was lost during this event (D. Morgan, *pers. comm*., 2003). Bull trout in the subbasin are also threatened by isolation and habitat fragmentation from passage barriers including dams, impaired water quality, and habitat impacts from past and ongoing forest management and water diversion for irrigation (U.S. Fish and Wildlife Service, 1998). Potential hooking mortality in the Laurance Lake sport fishery, and predation by the introduced smallmouth bass population in the lake, are also risk factors but no data is available at the present time for confirmation.

Coastal Cutthroat Trout Population Data and Status

Abundance: Coastal cutthroat trout are native to the Hood River subbasin, and are most numerous as resident fish in the upper tributaries of the East Fork Hood River. Robinhood Creek was found to have had the highest density of cutthroat trout in the subbasin with up to 610 cutthroat per 1000 m^2 of stream (Olsen and French 1996). Annual counts of adult cutthroat trout at Powerdale Dam during 1992-2004 have ranged from 0 to 11.

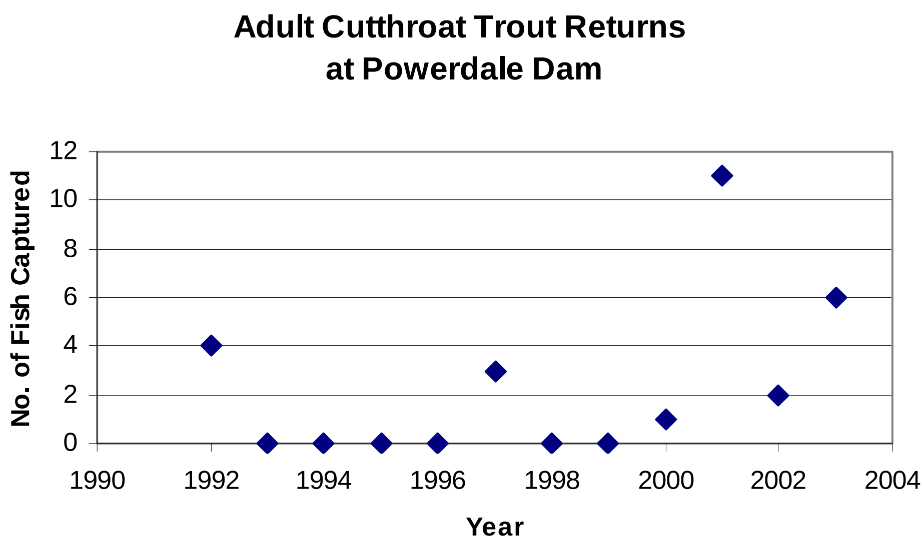

Figure 10. Annual counts of adult cutthroat trout captured at Powerdale Dam 1992-2004.

Productivity: Data is not available to estimate the productivity of cutthroat trout.

Life History Diversity: Both a resident and a sea-run life history form occurs in the subbasin. Very few sea-run or adult cutthroat trout have been counted at the Powerdale Dam fish trap in recent years.

Carrying Capacity: No estimates of cutthroat trout carrying capacity have been developed.

Population Trend and Risk Assessment: While little data exists to assess the population trend of cutthroat trout, the resident life history form is believed by area fish managers to be stable. Nehlsen et al. (1991) considered the Hood River sea run stock of cutthroat trout “at high risk of extinction”. As is the case in the Lower Columbia Basin generally, the anadromous or sea run form of cutthroat is severely depressed. Counts of sea run cutthroat trout at Powerdale Dam during 1963-1971 ranged from 17 to 177 adults (Hooten, B. 1997). In contrast, between 1992 and 2003, the annual counts of sea run cutthroat trout passing Powerdale Dam ranged from 0 to 11 adults (Figure 9). In six out of twelve years, no adult sea run cutthroat trout were captured at the dam. In 1995 and 1996, only 16 and 24 downstream migrant cutthroat were captured in juvenile migrant traps. Captures of cutthroat at screw traps were too few to determine trends in abundance or condition (Underwood, K.D. et al, 2003).

Unique Population Units: Pure cutthroat strains exist in upper East Fork tributaries including Dog River, Tilly Jane, Rimrock, Robinhood, Pocket, and Bucket creeks. Pinnacle Creek fish are largely cutthroat with some rainbow hybridization (USFS 1996b). Dog River, Emil, Robinhood, Pocket and Bucket creek cutthroat were found to have the genetic characteristics of pure cutthroat trout (Greg and Allendorf 1995). An isolated population of cutthroat was found above a falls on Clear Branch a few miles above Laurance Lake (G. Asbridge, p*ers. comm*). The present or historic spawning distribution of sea-run cutthroat trout is unknown. In Tony and Bear creeks, 4 of 11 fish sampled were hybrid cutthroat and rainbow. Lower Dog River contained both pure rainbow and cutthroat tout as well as hybrid fish. No first generation hybrids in the Mt Hood area were observed, suggesting that either hybridization occurred historically more frequently in these populations, or more likely episodically (Spruell, P. et al, 1998).

Pacific Lamprey Population Data and Status

Lamprey Abundance: Historic or current Pacific lamprey abundance in the Hood River subbasin has not been estimated. Lampreys have not been documented above Powerdale in decades. Adults are occasionally observed downstream of the dam. Surveys for western brook lamprey have not been conducted in the basin therefore their presence in the basin is unknown.

Productivity: If lamprey passage is restored at Powerdale dam they may re-colonize the Hood River basin. It is unknown as to whether or not lamprey are present downstream of the dam in sufficient numbers to successfully re-seed the watershed
Carrying Capacity: The Hood River subbasin Pacific lamprey carrying capacity is unknown.

Population Trend and Risk Assessment: Lamprey were reported as widespread "throughout the basin" in a 1963 Oregon Game Commission Report on the Hood River (USFS, 1996a), but have not been observed above Powerdale Dam in at least the last decade. Pacific lamprey may have been extirpated from the Hood River upstream of the Powerdale dam (river mile 4.5). However if dam passage was not limiting, other risks to the lamprey populations in the Hood River would include peak flows, decreased flows, increased water temperatures and poor riparian areas, predation in all life stages, artificial barriers and the lack of appropriate diversion screening for lampreys (C. Brun, 2004). Lamprey are particularly vulnerable to pollution and erratic stream flows during their juvenile or ammocoete life stage because of the length of time they reside in the stream substrate. Migrating ammocoetes are especially vulnerable to predation during their in-river and ocean migration. Most movement appears to occur at night, but their size (up to 10 cm) and the number of predators, especially in the Columbia River poses a serious risk. The population status of Pacific lamprey is of concern region-wide. Fish ladder counts at Bonneville and other Columbia River dams suggest a dramatic declining trend in lamprey numbers. Many more lamprey are counted passing Bonneville Dam than passing The Dalles Dam, however little is known about lamprey holding, spawning and rearing in the Bonneville Pool and its tributaries, including the Hood River.

Unique Population Units: No unique populations of Pacific lampreys in the Hood River are identified. Little is known about Pacific lampreys in part because taxonomy and field identification of the various species is difficult. Generally species differentiation is based on adult characteristics, but lampreys are adults for a rather short period of their total lives (Kostow 2002). Historic life history information for the Hood River lamprey does not exist. Much of the information contained in this assessment is based on observations and data from other Columbia River Basin or Pacific Northwest lamprey populations. Pacific lampreys are an anadromous, parasitic species. They are parasitic during that portion of their life cycle that occurs in the ocean. Adult lampreys return to the Columbia River basin during the summer months. It is assumed that they over-winter in streams prior to spawning the following spring or early summer. Willamette River subbasin lampreys spawn from February through May (Kostow 2002). Lampreys do not feed once they enter freshwater. Adult lampreys may be attracted to pheromones (chemical stimuli) produced by larvae (ammocoetes) living in the stream substrate, rather than relying on a homing instinct. During the over-winter period individuals survive on stored body fats, carbohydrates, and protein. Measurements of adults reported in literature include 39.3 to 62.0 cm for migrating adults and 33.2 to 54.2 for spawning adults (Kostow 2002). Characteristically spawning occurs in a nest constructed of gravel substrate located at the tail-outs of pools or in riffles. Lamprey fecundity is thought to be highly variable, which might suggest a variety of life history patterns or age classes in a single spawning population. It has been estimated that the fecundity rate may vary from 15,500 to 240,000 eggs/female (Kostow 2002). Lampreys spawn in low gradient stream sections. Most authorities believe that all lampreys die after spawning. Lamprey eggs hatch within 2-3 weeks, depending upon water temperature. The juveniles emerge from the spawning gravel at approximately 1 cm in length. The ammocoetes burrow into the soft substrate downstream from the nest and may spend up to six or seven years in the substrate. They are filter feeders that feed on algae and diatoms. The ammocoetes will move gradually downstream, moving primarily at night, seeking coarser sand/silt substrates and deeper water as they grow. They appear to concentrate in the lower parts of basins before undergoing their metamorphism. When body transformation, or metamorphism, from the juvenile to adult stage is complete, they migrate to the ocean from November through June (Kostow 2002). In the Deschutes and Umatilla Rivers this out-migration was observed to occur in the winter to early spring (Kostow 2002, Graham and Brun 2003). Pacific lampreys enter saltwater and become parasitic, feeding on a wide variety of fishes and whales. They appear to move quickly offshore into waters up to 70 meters deep. The length of their ocean stay is unknown, but some have speculated that it could range from 6 to 40 months (Kostow 2002).

Current Focal Fish Species Distribution

Steelhead: The distribution of steelhead spawning and rearing covers a significant portion of the subbasin. Winter steelhead inhabit the East and Middle Forks of the Hood River, while summer steelhead inhabit the West Fork (Appendix A, Map 15). Both summer and winter steelhead occupy the Hood River mainstem. Distribution in the East Fork Hood River extends to Sahalie Falls and includes tributaries below Sahalie Falls. In the Middle Fork Hood River, distribution extends to Clear Branch Dam, part way up Coe Branch, and in several tributaries below. Steelhead extend throughout the West Fork Hood River mainstem, in McGee and Elk creeks, and several tributaries below. Important West Fork tributaries below Elk and McGee include Lake Branch and Green Point Creek (Underwood, K.D., et al.2003).

Chinook: Fall chinook spawn and rear in the mainstem Hood River, in Neal Creek, and in the West Fork Hood River. Spring chinook spawning and rearing primarily occurs throughout the mainstem West Fork and part way up Elk, McGee and Jones creeks, and the lower mile of Lake Branch (Appendix A, Map 15). Spring chinook use of the Middle and East Fork Hood River is believed to be limited to non-existent. Glacial silt loads in believed to quash the effectiveness of fall spawning in these tributaries (Underwood, K.D., 2003).

Bull Trout: The current bull trout distribution occurs in 4 major subbasin areas: the Hood River, the West Fork Hood River, the Middle Fork Hood River, and the Clear Branch of Hood River (USFWS in litt. 2003). Bull trout are consistently found only in the Hood River, the Middle Fork Hood River, and the Clear Branch of Hood River (Appendix A, Map 14). Bull trout distribution in the West Fork is based on isolated, infrequent sightings. Bull trout are found in the Middle Fork mainstem and its tributaries Clear Branch, Laurance Lake reservoir, Pinnacle, Compass, Bear, and Tony creeks, Coe Branch, and Eliot Branch. The bull trout located within the West Fork Hood River are considered a potential local population. Past sightings in the East Fork Hood River are considered incidental and bull trout use of the East Fork is thought to be unlikely due to unsuitable habitat conditions and absence of bull trout during surveys (U.S. Fish and Wildlife Service, 2003).

Cutthroat Trout: Cutthroat are distributed primarily in tributaries to the Hood River, and the Middle Fork and East Forks of the Hood River up to elevations of 3,600 feet or higher (Appendix A, Map14). Cutthroat are not numerous in the West Fork Hood River, where rainbow trout are the dominant resident species. From 1994 to 2003, just one cutthroat was captured in each of only two years in the downstream migrant trap in the West Fork (Olson, E, 2004, unpublished data) compared to an average of 10 in the East Fork and 4 in the Middle Fork. Cutthroat trout are the dominant species in Bear, Tilly Jane and Robinhood creeks. Cutthroat are common throughout Clear Branch above and below Laurance Lake reservoir.

Pacific Lamprey: Pacific lamprey distribution today is believed to be limited to the lower four miles of the Hood River below Powerdale Dam. Lamprey have not been observed above Powerdale Dam in at least the last decade. Several modifications in the fish ladder configuration at Powerdale Dam occurred between the 1960s and the present, and any related effects on adult lamprey migration are unknown. Lamprey do not enter the fish trap at Powerdale Dam. Incidental and limited observations of lamprey have been reported below the dam by local agency fish biologists. However, specialized field surveys for lamprey ammocoetes have not been conducted and the distribution and abundance of lamprey species either above the dam or below the dam is uncertain.

Historic Focal Fish Species Distribution

Steelhead: The historic distribution of steelhead was somewhat more extensive than the current distribution. In the Middle Fork Hood River, steelhead were documented upstream to Clear Branch above Pinnacle Creek by the Oregon Fish Commission in 1963. Steelhead were likely distributed further upstream above the existing diversion dams in Coe and Eliot Branches. Steelhead distribution extended further upstream in Neal Creek.

Chinook: The historic distribution of chinook is believed to approximate the current distribution, based on existing knowledge.

Bull trout: Historic distribution is believed to approximate current distribution based on existing knowledge (U.S. Fish and Wildlife Service. 2003).

Cutthroat Trout: Historic distribution of cutthroat trout is believed to approximate the current distribution based on existing knowledge.

Pacific Lamprey: Historically, Pacific lamprey likely had the widest distribution of any of the anadromous species in the subbasin (Brun, C. 2004). Natural barriers that effectively interrupt the migration of other fish can often be negotiated by this species. Lamprey *"were reported as widespread throughout the basin in a 1963 Oregon Game Commission Report on the Hood River"(*quoted in USFS, 1996a).

Differences in Distribution Due to Human Disturbance

Artificial barriers that are believed to create total barriers to adult steelhead distribution are Clear Branch Dam, Neal Creek irrigation diversion dam, and a road culvert in Eliot Creek at Hutson Drive. These barriers curtail a total of about 4.2 miles of historic spawning and rearing habitat in Neal Creek (~2.2 mi.), in Clear Branch (~ 0.5 mile) and 1.5 in Evans Creek.

Bull trout distribution is blocked at Clear Branch dam (~1 mi.), Eliot diversion (~0.25 mi.), and Coe diversion (~1 mi.). Adult cutthroat trout are blocked at a number of road culverts. About a quarter mile of spawning habitat for steelhead and coho salmon was inundated by the construction of Clear Branch Dam in 1965, eliminating the native coho salmon population in the Middle Fork Hood River.

Powerdale Dam in the Hood Rier (RM 4.5) is suspected to be a barrier to lamprey migration, based on the fact that lamprey have been observed below the dam yet have not been observed above Powerdale Dam in at least the last decade, and were documented as widespread in the subbasin in a 1963 Oregon Game Commission report (USFS, 1996a).

Aquatic Introductions and Artificial Production Programs

Current Fish Introductions

The Oregon Department of Fish and Wildlife (ODFW) stocks legal size rainbow trout and fingerling brook trout into six high lakes on an annual or bi-annual basis to provide sport fishing opportunity (Table 9). Releases of anadromous fish in the subbasin are described under Artificial Production.

Table 9. Current high lake stocking program in the Hood River subbasin.

Release Location	Species	Comments
Lost Lake	Rainbow Trout	17,000 legal sized
Laurance Lake Reservoir	Rainbow Trout	~7,000 legal sized stocked annually with adipose fin-clips
Kingsley/Green Point Reservoir	Rainbow Trout	10,000 legal sized
Black Lake	Brook Trout	bi-annually fingerling
Scout Lake	Brook Trout	bi-annually fingerling
Rainy Lake	Brook Trout	bi-annually fingerling

Historic Fish Introductions

Stocking of trout and salmon into high elevation lakes is documented since the 1950s. Rainbow and sea-run cutthroat trout were released in the Hood River by ODFW for a trout sport fishery from the 1950s through the 1980s, primarily (Appendix B, Table 2). The last release rainbow trout occurred in 1996 (ODFW Fish Propagation, Portland as cited in Cramer et al. 1997), although unfed rainbow trout fry were liberated in Odell

Creek in 1997 by Wyeast Middle School as part of the ODFW STEP program (ODFW, 1997). Salmon and steelhead releases to streams are described under Artificial Production in the next section.

Artificial Production: Current

Two separate and distinct artificial production programs are cuurently ongoing in the Hood River subbasin (1) the BPA-funded Hood River Production Program (HRPP) and (2) the ODFW Skamania stock summer steelhead program. An overall description of these programs is provided below followed by program information by species. The current artificial production program represents a 33% total reduction in hatchery releases made above Powerdale Dam, and a 10% overall reduction compared to previous hatchery releases in the subbasin (BPA, 1996). Current release targets are shown in Table 12.

Table 10. Current target anadromous fish releases in the Hood River. Adapted from Underwood, K.D, 2003.

Species	Number	Size	Stock	Stream	Sites/Type	Release Duration
Spring Chinook	95,000	Smolt	Deschutes	West Fork Hood R	2 sites, acclimation	1996 - present
Spring Chinook	30,000	Smolt	Deschutes	Middle Fork Hood R	1 site, acclimation	1997 - present
Summer Steelhead	30,000	Smolt	Skamania	Mainstem RM 4.5	1 site, direct release	1998 - present
Summer Steelhead	40,000	Smolt	Hood River	West Fork Hood R	2 sites, acclimation	1998- present
Winter Steelhead	25,000	Smolt	Hood River	East Fork Hood R	1 site, acclimation	1996 - present
Winter Steelhead	25,000	Smolt	Hood River	Middle Fork Hood R	1 site, acclimation	1999 - present

Hood River Production Program (HRPP)

The HRPP began in 1991 and is jointly implemented by ODFW and CTWSRO. The HRPP is currently composed of 7 inter-related BPA funded contracts: Hood River Production Program PGE: O&M (Proj. No. 1988-053-06), Hood River Production Program - CTWSRO M&E (Proj. No. 1988-053-03), Hood River Production Program - ODFW M&E (Proj. No. 1988-053-04), Hood River Fish Habitat (Proj. No. 1998-021-00), Parkdale Fish Facility (Proj. No. 1988-053-07), Powerdale/Oak Springs O&M (Proj. No. 1988-053-08), and Hood River Steelhead Genetics Study (Proj. No. 2003-054-00). These contracts provide funding for hatchery supplementation, habitat restoration, and monitoring and evaluation (Olsen, E. 2004). Hatchery practices have been adaptively managed since the program began. A 10-year comprehensive review of the HRPP was recently completed by S.P. Cramer and Associates for BPA (Underwood, K.D. et al, 2003). This review recommended further program modifications including smaller fish release targets based on revised carrying capacity estimates, more changes in hatchery practices, and additional research.

The HRPP is intended to mitigate for fish losses related to the operation of federal dams in the Columbia Basin, and to contribute to the recovery of salmon and steelhead.
Its goals are to:

- Re-establish a natural self-sustaining spring chinook salmon population in the Hood River subbasin;
- Rebuild naturally self-sustaining runs of summer and winter steelhead;
- Maintain the genetic characteristics of wild anadromous populations;
- Protect high quality habitat and restore degraded fish habitat; and
- Contribute to tribal and non-tribal fisheries, ocean fisheries and NW Power Planning Council interim goal of doubling Columbia River salmon runs.

While harvest is a program objective, the supplementation goals and methods of the HRPP differ from those of a traditional hatchery program (BPA, 1996). Fish release numbers are small compared to traditional hatchery programs. Broodstock are collected from indigenous or naturally-spawning local stock (steelhead), or from nearby similar systems (spring chinook reintroduction). Rearing occurs at low densities in ponds or raceways that mimic natural environments. Smolts are acclimated in ponds to imprint on potential spawning waters and leave the ponds on a volitional basis. Adult fish return to natural spawning areas.

During the 1990s, the use of domesticated out-of-basin origin hatchery stocks of steelhead was phased out. A DNA sample from every fish passed above Powerdale Dam has been collected since 1991and analyzed to estimate the relative reproductive success of hatchery and wild steelhead.

HRPP Facilities: Facilities in both the Deschutes and Hood subbasins are used in the HRPP. The ODFW Round Butte and Oak Springs hatcheries, and the Pelton Ladder in the Deschutes Basin, are used for incubation and/or rearing. HRPP facilities in the Hood River are sbown in Appendix B, Figure 3. The Powerdale Dam Adult Fish Trap the Hood River at RM 4.5 is a major support facility for the program, and is operated by ODFW. The trap is used for brood stock collection, for monitoring hatchery and wild adults, and for controlling entry of hatchery fish into spawning grounds above the dam. The trap is operated as a complete barrier to upstream passage. This enables counts of all adult fish returns, genetic sampling, and other data collection, and allows ODFW to prevent all out-of-basin stock hatchery strays from spawning upstream of Powerdale Dam. The protocol used states that no more than 50% of the total run allowed upstream to spawn can be composed hatchery-origin fish (from Hood River stock), and no more than 25% of the wild run can be taken for eggs. Juvenile rotary screw traps are operated at 5-6 sites to monitor fry and smolt migration from different parts of the subbasin. Smolt acclimation occurs in temporary ponds including fiberglass circular tanks, rigid lined raceways, and concrete bays in the East Fork Irrigation District sand trap facility. All HRPP hatchery steelhead have coded-wire tags and/or fin clips to facilitate evaluations and harvest management. The Parkdale Fish Facility in the Middle Fork Hood River is to for adult holding, spawning, early incubation, and smolt acclimation, and is operated by the CTWSRO.

Spring Chinook Reintroduction: It is believed that the native spring chinook run became extirpated from the Hood River by the 1970s. In 1996, an effort was initiated to reintroduce spring chinook to the Hood River using Deschutes River stock. The objective has been to create a locally-adapted naturally-reproducing population. The annual release goal is 125,000 age-2 smolts. Broodstock are taken at Powerdale Dam and are held and spawned at the Parkdale Fish Facility. The Pelton Ladder in the Deschutes Basin is used for rearing. Smolts are acclimated and released in the West Fork and Middle Fork Hood River. Adults returning to the Hood River and allocated to the hatchery program are a mix of hatchery and wild/natural-origin fish. The brood collection goal is 110 adults and 5-10 jacks to represent the percent of jacks in the wild run. Except in 1997, too few adults have returned to the Hood River to meet production goals for the program. As a result, eggs from adults returns to the Deschutes River were taken to make up the difference. Program success has been hampered by disease incidents (IHN virus, bacterial kidney disease, fungus and Ceratomyzosis), high level of mini-jack or jack returns, loading injuries at Pelton Ladder, and high straying rates back to the Deschutes. The stray rates of Deschutes stock spring Chinook released from the 1993-1997 brood years averaged 18% and were as high as 35%. Recommendations to address these problems were made as part of the HRPP Program Review (Underwood, K.D. et al, 2003). With regard to disease, the Program Review recommended moving spring chinook production to another hatchery facility if the problems cannot be resolved.

Winter Steelhead Supplementation: The objective of the HRPP winter steelhead supplementation has been to increase natural production without changing the genetic makeup of the wild or naturally spawning population. The first releases of smolts from the progeny of wild winter steelhead collected from the Hood River began in 1993. Based on information available thus far, this program appears to be successful in meeting its objectives (Underwood, K.D. et al, 2003; Blouin, M. 2003). The current brood stock collection goal is 70 adults for the production of 50,000 smolts. In accordance with wild fish protection policies, no more than 25% of the wild run is taken for broodstock. During the first 3 years of the indigenous winter steelhead program, 98% of the brood were from wild-origin fish, after which hatchery-origin fish were allowed as brood stock. Since 1995, wild-origin fish have composed 51% to 99% of the brood stock. Adults are collected at Powerdale Dam and are held and spawned at the Parkdale Fish Facility. Smolts are acclimated and released in the Middle and East Fork of the Hood River.

Summer Steelhead Supplementation: In 1999, the summer steelhead program moved from releasing a non-indigenous Skamania hatchery stock to releasing the progeny of wild/natural origin summer steelhead collected in the Hood River at Powerdale Dam. The goal has been to collect 160 adults to produce 150,000 smolts, with an interim goal 40,000 smolts and an interim adult collection goal of 40 wild adults. After 4 years of relying entirely on wild brood returning to the Hood River, no hatchery-origin fish have been used as broodstock. According to protocol, no more than 25% of the wild run can be exploited for broodstock. It was too early in the indigenous summer steelhead program to gage its success (Underwood, K.D. et al., 2003).

ODFW Skamania Summer Steelhead Program

ODFW makes annual direct releases of 30,000 Skamania stock summer steelhead smolts to the Hood River below Powerdale Dam. The purpose of this program is to support tribal and sport fisheries in the subbasin and Columbia River. The current Skamania program was initiated in 1998. No Skamania stock steelhead are allowed upstream from Powerdale into potential spawning areas.

Artificial Fish Production: Historic

Hatchery releases of adult and juvenile hatchery steelhead, spring chinook, and coho salmon have occurred in the Hood River subbasin since the 1950s using both non-indigenous and Hood River stocks. These activities are discussed below and summarized in Table 11. Information sources include Oregon Game Commission Report, 1963; 1965 Summary Report; Hood River Steelhead Project, 1990; Hood River Subbasin Salmon and Steelhead Protection Plan, 1995; Draft Report of the Hood River Production Plan; USFS 1996a and 1996b.

Summer Steelhead: The release of non-indigenous summer steelhead to the Hood River upstream of Powerdale Dam were made until 1998. Annual releases of about 10,000 juveniles were made from 1958 to 1966 from Hood River stock. A total of 812 adult summer steelhead from Big Creek, Hood River, Cascade and unknown stock, were released in the East and West Fork Hood River in 1968 and 1969. From 1967 to 1974, and in 1977, Washougal stock releases occurred. Since 1975, Skamania stock was used, including the annual direct release of 75,000 Skamania smolts to the West Fork Hood River from 1988–1997.

Winter Steelhead: Releases of non-indigenous winter steelhead were made up until 1993, when the first group of Hood River stock was released. From 1962 to 1976, releases of Nestucca and Alsea fingerlings were made periodically (ODFW, 1998). Big Creek smolts were released from 1978 to 1986 into the East and Middle Fork Hood River. A total of 427 adult Big Creek winter steelhead were released into Bear Creek and the East Fork Hood River in 1966 and 1967. Releases of Klaskanine and Big Creek hatchery fry were made by through the ODFW STEP program between 1985-86. Direct annual releases of up to 30,000 Big Creek smolts were made from 1988-1992. In 1992, Big Creek and Hood River steelhead were hybridized, producing 4,595 smolts that were directly released to the Hood River in 1994.

Spring Chinook: The indigenous Hood River spring chinook population became extinct by the 1970s. Fry releases from Carson and Clackamas stocks were made by the ODFW STEP program between 1985-86. From 1988 to 1992, 140,000 Carson Hatchery smolts were directly released into the West Fork Hood River annually. Between 1993-1995, direct releases of 125,000 Deschutes stock smolts were made annually.

Table 11. Historic releases of anadromous fish in Hood River subbasin streams.

Release Location	Species	Years Released	Comments/Stocks
West Fork Hood River	Spring Chinook	1984-1992	Carson, Clackamas, Deschutes
	Summer steelhead	1958-87	Hood River, Cascade, unknowns, Washougal
	Winter steelhead	1962	Unknown
Clear Branch	Coho salmon	1966	Unknown
	Winter steelhead	1963, 1985-87	Unknown, Klaskanine, Big Cr
	Coho salmon	1968 1967	Unknown Little White Salnon
	Winter steelhead	1962-63, 1985-88	Unknown, Big Cr, Klaskanine
Bear Cr	Winter steelhead	1966, 1986	Unknown, Big Cr
Tony Cr	Winter steelhead	1962, 1985-87	Unknown, Klaskanine, Big Cr
East Fork Hood River	Coho salmon	1968, 1970 1967, 1971, 1977	Unknown, Sandy R Little White Salmon, Cascade, Washougal
	Winter steelhead Sea run cutthroat	1962-63, 1967, 1978 1973-1978,1985-1987	Unknown, Big Cr Nestucca R, Alsea R,
	Summer steelhead	1957, 1968	Hood, Big Cr
Dog River	Winter steelhead	1985-86	Klaskanine, Big Cr
Evans Cr	Winter steelhead	1986-87	Big Cr, Klaskanine R
Lenz Cr	Coho salmon	1967, 1971, 1977	
Neal Cr	Coho salmon Sea run cutthroat	1968 1973-1978, 1985-1987	 Nestucca R, Alsea R,

Fall Chinook and Coho: No hatchery releases of fall chinook are documented in the Hood River. No releases of coho salmon have occurred since 1977. Hatchery coho juveniles were released in 1967,1971, and 1977 in numbers ranging from 230,000 to 970,000 fish. An early release was made in 1958 in Lost Lake. Between 225 to 1,480 adult coho from the Bonneville Hatchery were released into Clear Branch and Neal Creek and the East and Middle Forks of the Hood River in 1966, 1968, and 1970.

Artificial Production/ Introduction: Ecologic Consequences

Among the potential consequences of hatchery and introduced fish are 1) elevated predation upon and competition with natural populations; 2) interbreeding and adverse genetic changes in populations; 3) disease introduction; 4) increased harvest on non-target populations; and 5) alteration of trophic structure in stocked lake ecosystems.

The Hood River Production Program (HRPP) review addressed several of these issues (Underwood, K.D. et al, 2003). An HRPP goal has been to minimize predation and competition between hatchery and wild fish by releasing only smolt-stage fish that would emigrate quickly from the Hood River, and by preventing the release of smolts that do not volitionally migrate from the acclimation ponds. The review found that emigration of hatchery steelhead smolts was rapid and competition with wild fish appeared minimal. However, the actual extent or affect of predation or competition from hatchery fish in the Hood River could not be determined since monitoring has not included the behavior or stomach content analysis of hatchery fish. The largest potential source of predation from the HRPP was from residualized steelhead. The residualism rates for winter steelhead remained below the goal of 5% in three of five years monitored, rising to 12% and 9% in the other two years. Predation may also exist in the lower Hood River from precocial hatchery spring chinook. The proportion of precocial spring chinook returns since the 1991 brood year has averaged 12% compared to a 5% average in wild spring chinook since the 1987 brood. Evaluation of the extent of predation by spring chinook was considered unnecessary if actions, such as reducing smolt size at release, are taken in the hatchery program to reduce the precocial rate. Hatchery summer steelhead smolts captured at the mainstem screw trap were significantly larger than wild smolts. Larger hatchery smolts may negatively impact wild smolts through competitive interactions throughout the migration, however, the degree of impact was unknown. Competition between HRPP smolts and bull trout or cutthroat trout was considered unlikely because most cutthroat and bull trout populations are located upstream of anadromous populations (BPA,1996).

Genetic studies in the HRPP steelhead program thus far confirm the theory that the use of indigenous stocks in hatcheries produces greater fitness for natural production than introduced stocks (Blouin, M. 2003). Samples show that fish that bred in the early to mid 1990s from old domesticated hatchery stocks had a much lower total fitness than wild fish, but that “new” or Hood River-origin hatchery stocks have a fitness similar to that of wild fish, and are producing substantial numbers of wild-born offspring. The similar fitness of Hood River-origin hatchery and wild fish suggests that wild-born offspring of Hood River-origin hatchery fish are unlikely to have negative genetic effects on the population when they in turn spawn in the wild. This hypothesis will be tested once enough offspring of the progeny of hatchery fish have returned (Blouin, M. 2003).

Given the low numbers of adult returns, the straying of Deschutes stock hatchery spring chinook from the Hood River was found not likely to have had a significant genetic influence on other populations, especially since 86% strayed into the Deschutes River. Data suggested that straying of hatchery winter steelhead from the Hood River is low, although summer steelhead were not coded wire tagged and their stray rate is unknown. A potentially large source of stray hatchery steelhead is from the sport fishery “recycle” program, where non-native or excess hatchery fish captured at Powerdale Dam are trucked back to the Hood River mouth to provide additional sport harvest opportunity (Underwood, K.D. et al, 2003).

Steelhead were diagnosed with diseases common to the region and therefore were not believed to transmit exotic diseases to fish populations in the Hood River subbasin. The incidence of illness was low. In 2 out of 8 years, the HRPP released spring chinook smolts with high BKD levels, which could have served as a reservoir of disease transmittable to wild fish.

Eastern brook trout stocked in Rainy, Black, and Scout lakes in the West Fork Hood River watershed have distributed downstream into Gate, Cabin, and Dead Point creeks. Brook trout are found in Lake Branch, Rogers Spring, and Tilly Jane creeks and in Cold Springs Creek upstream of Tawanamas Falls (S. Pribyl, ODFW, pers. comm). These fish may be reproducing naturally and competing with or predating upon native trout. By replacing amphibians as the dominant predator, introduced fish likely have altered the food chain in historically fishless high elevation lakes (USFS 1996a). The illegal introduction of smallmouth bass into Laurance Lake has led to a reproducing smallmouth population which may predate upon bull trout, cutthroat trout, and other native species.

The hatchery program increases angling opportunity in the lower Hood River and therefore may increase incidental hooking or harvest mortality in non-target populations, particularly bull trout and possibly steelhead smolts. Bull trout is a highly catchable species. While low numbers of bull trout pass Powerdale Dam annually, their timing overlaps with the peak of angler effort (Underwood, K.D. et al, 2003). Very little harvest occurs on natural fall Chinook or coho in the lower Hood River, so increased harvest on HRPP fish did not adversely affect these species. Furthermore, run timing of these coincided with the least amount of harvest effort in the lower river.

Relationship Between Natural & Artificially-produced Fish Populations

The majority of the summer steelhead and spring chinook adults returning to the Hood River are hatchery fish. Since 1991, all steelhead passed upstream of the Powerdale Dam have been sampled for scales and genotyped using extracted from the scale samples. Monitoring of juvenile production in the HRPP has focused on trapping outmigrants, so information was not adequate to detect changes in resident cutthroat trout or rainbow populations, nor on other native populations including whitefish, dace, sculpin, and suckers (Underwood, K.D. et al, 2003). Genetic studies indicated that breeding with either resident rainbow or residual steelhead likely accounted for up to half of all steelhead adults returning to Powerdale Dam (Underwood, K.D. et al, 2003). Up to half of the winter steelhead spawning above Powerdale Dam are hatchery fish of Hood River hatchery stock origin. The indigenous winter steelhead hatchery program initiated in 1993 appears to have benefited the wild winter steelhead population by increasing population size (Blouin, M. 2003) (Figure 11).

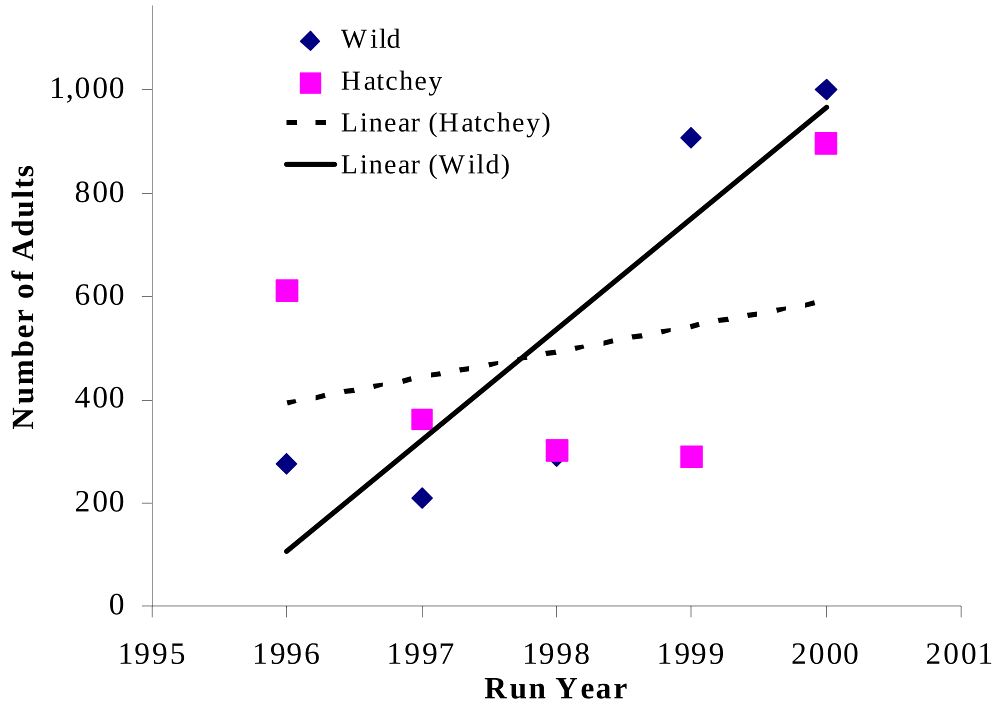

Figure 11. Wild and hatchery winter steelhead adult return to Powerdale Dam (Olsen July 2002).

The non-indigenous Skamania stock of summer steelhead exhibit a different adult return timing than the wild summer steelhead. A majority of the Skamania stock and wild adults entered the Hood River in May through June, but unlike the Skamania stock, wild adults also showed a strong return in October and November.

Current Direct and Indirect Harvest in the Subbasin

The Hood River continues to maintain popular steelhead fisheries particularly for summer steelhead. Steelhead harvest would not have been possible without the hatchery program due to low numbers of wild fish and strict ESA conservation measures in place. (Underwood, K.D. et al, 2003). ODFW regulations have banned the harvest of wild steelhead and bull trout in the subbasin since 1998. The Hood River has been closed to all salmon and steelhead fishing above Powerdale Dam since 1998. The West Fork Hood River is closed year round to all angling in order to protect juvenile steelhead. The CTWSRO holds off-reservation fishing rights at its usual and accustomed fishing sites in the Hood River pursuant to the 1855 Treaty with the Tribes of Middle Oregon (12 stat. 963). Tribal harvest occurred in only two years, 2001 and 2002, and was primarily directed at spring chinook. Tribal harvest of steelhead in the subbasin is very low. Very little harvest occurs on either natural fall Chinook or coho in the lower Hood River (Underwood, K.D. et al, 2003). No data is available for incidental harvest mortality from catch and release or other angling. ODFW “recycles” or transfers non-native or excess hatchery steelhead captured at Powerdale Dam back to the Hood River mouth for release.

The released fish are expected to migrate back upstream to the dam, exposing themselves to anglers a second time to increase the number of fish harvested. The recycling program accounted for 9% to 48% of the fish harvested in the years 1996-2001. The spring chinook harvest, including in the ocean and Columbia River, averaged 53 adults from 1997- 2001. Wild fish comprised about half of all spring chinook harvested until 2001, \when angling regulations were changed, and virtually all of the harvest was hatchery fish. Tribal harvest of spring chinook above Powerdale Dam from 1999-2001 did not exceed 100 fish per year (Underwood, K.D. et al, 2003).

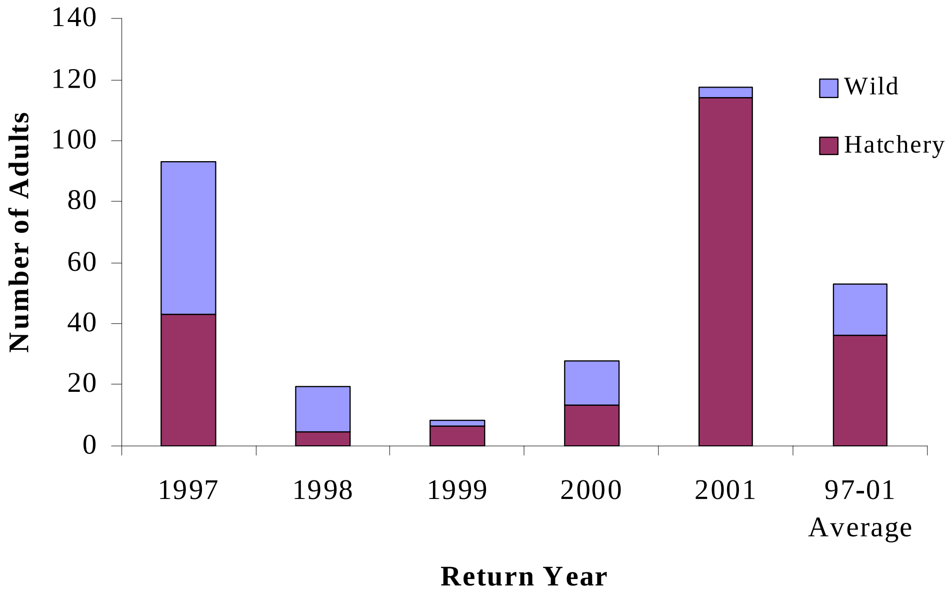

Figure 12. Total harvest of spring chinook in the Hood River subbasin, including ocean and Columbia River harvest (from Underwood, K.D. et al, 2003).

The summer steelhead harvest in the Hood River during 1996-2001 was determined by creel survey and ranged from 226 to 727 fish annually with an average of 474 fish (Table 12). The vast majority of winter steelhead harvest during this period was on hatchery fish. In-basin harvest accounted for roughly half the total harvest in freshwater.

Table 12. Hatchery summer steelhead Columbia and Hood River harvest, 1996-2000. Based on the ODFW/WDFW Status Report: Columbia River Fish Runs and Fisheries, 1938 – 2000 and Olsen (July 2002)

	Harvest		**Adult Return**	**Hood River**
Year	**Columbia R.**	**Hood R.**	**Powerdale**	**Harvest Rate**
1996	321	727	1,296	0.3594
1997	142	335	564	0.3726
1998	139	352	524	0.4018
1999	109	226	460	0.3294
2000	259	486	1,158	0.2969
2001 (part)	390	719	2,131	0.2522

Average	227	474	953	0.3353

The winter steelhead harvest in the Hood River from 1996–2000 ranged from 172 to 351 adults, with an average of 257 adults (Table 15). The vast majority of winter steelhead harvest during this period was on hatchery fish. Tribal harvest of steelhead in the subbasin is very low (ODFW and CTWSRO, 1990).

Table 13. Annual estimates of harvest rate on hatchery winter steelhead in the Hood River (Olsen July 2002).

Run Year	Harvest		Hatchery PD Returns	Harvest Rate
	Columbia R.	Hood R		
1996	19	317	613	0.3409
1997	12	231	363	0.3889
1998	10	172	303	0.3621
1999	10	214	290	0.4246
2000	25	351	897	0.2813
Average	**15**	**257**	**493**	**0.35956**

Incidental hooking mortality of bull trout may occur in Laurance Lake and the lower Hood River. While few adult bull trout pass Powerdale Dam each year, their timing overlaps with the peak of angler effort in the lower Hood River (Underwood, K.D. et al., 2003). In the Rapid River, Idaho, an estimated 12.3% of steelhead anglers incidentally caught adult bull trout (Elle 1994). Since only 2-28 bull trout pass Powerdale Dam per year, one kept fish could be a significant loss.

Historic In-basin Harvest Levels

Estimates of in-river sport catch of salmon and steelhead were obtained from punch card returns from Streamnet.org and from ODFW and CTWS, 1990.

Table 14. Estimates of in-river sport catch of salmon and steelhead obtained from punch card returns.

Species or Race	Run Years	Annual Harvest Range (average)
Summer steelhead	1969 - 1993	899 to 4,455 (2,290)
Winter steelhead	1976 - 993	358 to 2,451
Steelhead – unknown	1956 - 1969	642 to 1647 (1,312)
Coho	1969 - 1994	0 to 52 (12)
Fall chinook	1977 - 1994	0 to 116 (15)
Spring chinook	1963 - 1971	0 to 15
Spring chinook	1977 - 1994	0 to 984 (144)
Salmon – “mixed”	1956 - 1968	6 to 189 (79)

Historic Environmental Conditions for Aquatic Focal Species

The time period of around 1880 was selected to represent “historic”, “template” or “reference” conditions in this assessment for the purposes of EDT model development and general discussion. The landscape at that time was often described as majestic expanses of timber as far as the eye could see (e.g., Winans, E. 1991). One of the major differences between current and historic conditions is believed to be a much greater historical potential for large instream wood due largely to riparian forest composition (USFS, 1996a & b). Riparian areas produced substantial quantities of large-diameter trees that were available to the stream channel. Large whole trees were transported into the stream by natural processes of channel meander and avulsion, bank undercutting or erosion, windfall, landslides, debris flows, floods and other pathways. These trees mixed with other materials, formed numerous logjams and obstructions, trapped gravel, created pools and hiding cover for fish and a substrate for fungi, bacteria and invertebrates. Alder, willow and cottonwoods dominated gentler gradient floodplains while conifers dominated the riparian zone in higher gradient areas. The lower East Fork Hood River consisted of a series of wide wetland complexes within a braided stream network where downed logs, side channels and continuous riparian forest stands were common (USFS, 1996b). This area would have provided abundant rearing and refuge habitats for fish.

Streams in depositional areas had high levels of interaction with floodplains. Three main depositional areas of low gradient, broad floodplain in the East Fork were likely to collect large woody material and allow development of high quality fish habitat. These areas in the East Fork mainstem were (1) between Baldwin and Tilly Jane Creeks; (2) a half-mile upstream of the Pollallie Creek mouth; and (3) from Cold Spring to Robinhood Creek. Two areas of the Middle Fork watershed had similar potential for high quality fish habitat development – (1) the lower mainstem between Tony and Bear Creeks; and (2) the reach of Clear Branch inundated by Laurance Lake. Tributary streams believed to have had large volumes of instream wood and heavy salmonid use were Tony Creek, lower Dog River and the lower East Fork tributaries (USFS, 1996b). Reaches in the West Fork Hood River and other tributaries that were likely to have had higher wood densities and more extensive floodplain interactions were identified in the Hood River EDT model, as well as the Hood River Watershed Assessment (1999) and the US Forest Service Watershed Analysis (1996a).

April- September stream flows were higher prior to being substantially diverted for agriculture. Peak flows were probably lower in the West Fork under historic conditions prior to road construction and removal of wood from channels. Closed-canopy (i.e., mature) stands intercept more snow from falling to the ground and insulate the snowpack, resulting in less accumulation and a slower melt than in open areas or deciduous stands (USFS 1996a). Large forest openings historically were caused by fire, and fire-caused canopy openings had a high snag density, which retards the development of a large snowpack and in turn leads to a smaller contribution to peak flow than would be experienced by a clear cut of equal size (Newberry, D. 1996, Hydrologists report WF).

Natural disturbance types that occur in the Hood River subbasin include rain on snow floods, glacial dam break floods, fire, mudflows, landslides, beaver ponding, and insect and disease epidemics. Evidence suggests that most natural disturbance processes in the West Fork watershed are driven primarily by climate. Stand-replacing fire historically was a large-scale but rare event. Below 4,000 feet, fire return was and is driven by seasonal drought combined with prolonged drought. A rain-on-snow flood was documented as early as 1887 in Neal Creek (Krussow 1989). Most streams in the West, Middle and East Fork Hood River lie entirely within the rain-on-snow elevation zone, which usually is under 4500 feet, but due to its orientation and the influence of Mt Hood, the entire East Fork watershed is subject to rain on snow flooding (USFS 1996b). Catastrophic landslides and debris flows are common in several upper East Fork and Middle Fork Hood River tributaries. These events were a major force in shaping riparian and aquatic habitat conditions. Mudflows in Ladd Creek in the West Fork are a large-scale and semi-frequent to rare disturbance event.

Current Environmental Conditions for Aquatic Focal Species

The Powerdale Hydroelectric Project and irrigation withdrawals are the most significant hydro-modifications in the subbasin. Powerdale Dam impedes upstream and downstream migration, and both the dam and the irrigation withdrawals remove water from the stream channels, altering flow and temperature and reducing rearing habitat. An estimated 40% of the natural flow of the Hood River is withdrawn by consumptive water withdrawals in the basin, and up to 80% of flow has been withdrawn from a 3-mile bypass reach in the Hood River below Powerdale Dam. However, some flow restoration below irrigation diversions has occurred in recent years through voluntary efficiency efforts by several irrigation districts. A June 2003 multi-agency settlement agreement was signed by Pacificorp concerning an interim operations and dam decommissioning plan (Pacificorp et al, 2003). Prior to dam removal in 2010, a substantial set of interim mitigation measures were instituted in April 2003. The interim measures are believed to significantly improve upstream and downstream migration conditions for anadromous fish and bull trout in the subbasin. Measures include instream flow increase in the bypass reach and an April15-June 30 annual diversion shutdown to protect downstream migrants in lieu of fish screen replacement.

The upstream migration of salmon, steelhead, and resident trout is blocked or impeded at several locations by diversion dams and other structures, resulting in the failure to seed historical spawning and rearing habitat. Direct mortality of downstream migrant salmonids still occurs at unscreened or inadequately screened water diversions. However, new fish screens have been installed since 1996 at major irrigation diversions in the East Fork mainstem, the Hood River mainstem, West Fork mainstem, and at 2 small diversions on East Fork tributaries. Most recently, the Farmers Irrigation District diversion fish screen on the mainstem Hood River (RM 11.0) was replaced in 2002. Testing indicates a much reduced, if not eliminated, entrainment (G. Asbridge, USFS pers. comm. 2004). The remaining adult and/or juvenile passage barriers and/or fish screening needs are at water diversions in the subbasin are in Neal Creek, Tony Creek, Eliot Branch and Coe Branch.

Habitat diversity is believed to be lower compared to historic conditions. Given its rapid runoff and confined channel characteristics, the lack of instream habitat structure is believed to be an especially significant limitation. Historic riparian timber harvest, splash dams, and stream clean-out has resulted in simplified channels, and riparian zones with low or reduced large wood recruitment potential. Pool area, pool complexity, and pool frequency is very low in most streams. Flood refuge, hiding cover, over-wintering and productive early rearing habitats (i.e. shallow lateral habitats, side channels) are lacking. Most channels lack structure to retain gravels for spawning and invertebrate production and are instead dominated by coarse boulder and rubble substrates. Sediment deposition and meander processes have been disrupted causing channels to downcut and disconnect from their floodplain, while others have widened and aggraded.

Streamflow levels are significantly reduced (i.e., 10% or greater depletion of natural low flow) at Powerdale Dam, Farmers Canal Diversion, Greenpoint Creek, Dee Diversion, City of The Dalles diversion, Coe Branch, Eliot Branch, Clear Branch, Lake Branch, and the East Fork Hood River. Low flow conditions below water diversions in summer and fall reduce aquatic habitat and may impede anadromous or resident fish migration. Low summer flows contribute to warm water temperatures and water quality impairment.

Summer and early fall water temperatures exceed reported preferred ranges for salmonid life stages in a number of stream reaches. Elevated nutrients, high pH episodes and pesticide contamination have been measured. Road construction, power lines, livestock, forestry and agricultural land use have removed riparian vegetation decreasing shade, bank stability and water retention capabilities; and raising summer water temperatures.

Channelization, road fill, bank armoring has narrowed stream channels and limits meander along the East Fork Hood River and in a few other places. This has created shorter channels, steeper gradients, higher velocities, bed armoring, entrenchment, and other effects. Channel modifications interact with each flood event to further aggravate these channel changes. The construction and maintenance of State Highway 35 is considered a significant and chronic impact to the East Fork Hood River and its floodplain (USFS, 1996a). Road construction, bank stabilization, and channelization has also altered Neal Creek, confining the stream in places and isolating it from its floodplain (ODEQ 2001a).

The Forest Service postulated that forest management in the West Fork, especially roads and removal of wood from channels, has increased peak flows over natural conditions, although flow records are not available for confirmation (USFS 1996a). Timber harvest and high road density place Long Branch, Divers Creek and Lake Branch at high risk of increased peak flow in 1 to 10- year events. Upland harvest has likely elevated peak flows in 2 to 5 year events changing them to a chronic habitat disturbance (USFS 1996a).

Sediment input to streams due to human activity occurs due to roads, undersized culverts at road crossings, and irrigation ditches. Roads and management-related debris flows account for the majority of fine sediment production in the West Fork of Hood River watershed (USFS 1996b). Bear, Evans, Tony, and Trout creeks, and the East Fork of

Hood River have relatively high road densities that expand the drainage network by intercepting subsurface and overland flow, resulting in increased erosion and delivery of fine sediment to area streams.

Potential Conditions for Long-term Sustainability

The Hood River is heavily influenced by frequent natural disturbances and limitations attributable to its geology. Glacial recession and rain on snow events cause a dynamic hydrograph and high summer turbidity especially the East and Middle Fork mainstems (Underwood, K.D et al, 2003). Channel morphology limits salmonid production, with most gradients exceeding 2.5%. Glacial sediment loads are high, and debris flows are a frequent occurrence. According to the scientific literature, glacial turbidity levels in the Hood River are sufficient to depress primary production and macroinvertebrates, fish growth and survival. Given these natural conditions and disturbances, the long-term sustainability of the focal species depends on alleviation of chronic human disturbances and restoration of natural physical and biological processes in the aquatic environment where such opportunities exist.

The removal of the dam and Powerdale Hydropower Project decommissioning is scheduled for June 2010. It is assumed that this action will greatly improve the potential for sustainability for Hood River fish populations. At that time, the dam will be completely removed and the dam site restored to its pre-dam morphology, eliminating a significant source of mortality and impact to downstream migrants affecting the entire subbasin. The 500 c.f.s. hydroelectric water right will be transferred back instream consistent with state statutes. After dam removal in 2010, the cessation of sediment sluicing into the bypass reach, elimination of impacts including the delay and pre-spawning mortality associated with adult passage at the fish ladder, improved passage and reduced predation associated with low bypass reach flows, entrainment of fry and fingerlings into the power canal, and elimination of any pre-spawning mortality or reduced reproductive success are expected to contribute to an increase in focal species abundance in the Hood River. The Powerdale Hydroelectric Project Interim Operations and Decommissioning Settlement Agreement (Pacificorp et al, 2003) also provided for a substantial set of interim mitigation measures that were initiated in April 2003. These include substantial April-November instream flow increases in the bypass reach and an April 15-June 30 annual diversion shutdown to protect downstream migrants in lieu of fish screen replacement.

The potential exists to partially restore streamflows below major irrigation diversions for improved spawning, incubation, rearing and migration conditions exists in the subbasin. This would be achieved through voluntary improvements including ditch to pipe conversion and increased use conservation or waste elimination. Some streamflow restoration has already been initiated using these approaches by 3 irrigation districts.

The potential exists to restoring fish passage connectivity at Clear Branch Dam and at other barriers and diversions.

Half of the subbasin is within National Forest-managed lands. Current management of these lands is specified by the Mt Hood Forest Plan and the Northwest Forest Plan. The latter plan established an aquatic conservation strategy including large riparian reserves that apply in addition to allocation-based standards and guidelines. The guidelines are intended to maintain the ecological health of watersheds and aquatic ecosystems on the National Forest and will enhance the potential for long-term sustainability of the focal species.

Commercial forest operations on non-federal land continues as a major land use on non-Federal lands in the subbasin (NPPC 2000). Improvements in road maintenance and riparian standards are being achieved on these lands, sometimes exceeding requirements of the Forest Practices Act. Objectives such as low road densities and maintenance of a high percentage of closed-canopy forest cover are subordinate in commercial forest operations to economic objectives, and opportunities to minimize peak flow impacts are probably limited.

The potential exists to increase habitat diversity in the short term through LWD additions where LWD would have accumulated under reference conditions. Riparian protection measures have been established on all land ownerships, the most protective on federal lands, but all represent an improving trend in riparian vegetation stands.

Characterization of Future with No New Actions

The benefits of the Powerdale Hydroelectric Project Interim Operations and Decommissioning Agreement, which were described above, are likely to be implemented with no new actions required as a result of FERC proceedings.

Downstream fish passage connectivity has been improved at 3 major diversions since 1996 through fish screen installation or replacement. The benefits of these projects will continue. However, downstream fish passage will remain compromised at 5 other diversions in the subbasin. Upstream fish passage for focal species will continue to be impeded at dams and diversions in Tony, Evans, Neal, the West Fork Hood River (Dee) Coe, Eliot, East Fork Hood River (EFID push up dam) and at several road culverts. Bull trout and steelhead passage will remain blocked in upper Clear Branch and bull trout local population exchange prohibited by Clear Branch Dam. The Laurance Lake reservoir will continue to accumulate and discharge heat to Clear Branch below Clear Branch Dam during the bull trout spawning period.

Neal Creek will continue to experience unnatural turbidity and sediment loading due to East Fork Irrigation District’s 100-year old delivery system, blocked steelhead passage to 2.5 miles, and entrained and stranded juvenile salmonids each year in the Eastside Lateral Canal.

The West Fork Hood River streamflows will be reduced as municipal water diversions increase along with population in the urban growth area of Hood River. Streamflows will continue to be limited from April 15 - October below irrigation diversions in Green

Point Creek, Clear Branch below the dam, and in the East Fork Hood River below the EFID diversion.

A lack of riparian function and instream LWD will continue to keep key habitat quantities for focal species life stages very low compared to historic conditions. Channels are likely to continue to degrade and entrench. Habitat diversity will continue to be limited. Floodplain and fluvial sediment transport and deposition processes will continue to be altered and lateral habitats will continue to be constrained in the Est Fork Hood River along State Highway 35 and at narrow bridge span crossings.

Japanese knotweed will invade and become established in fish habitats, reducing the amount of gravel for spawning and interfering with natural riparian and sediment transport processes. As of May 25, 2004, a total of 28 sites have been identified in Hood River County. Heavy infestations are not yet known to occur in the Hood River, but it is just a matter of time if no action is taken. Knotweed threatens salmon habitat because it colonizes gravel bars in mainstem riparian areas, creates dense monocultures that preclude the establishment of woody shrubs and trees, and can survive high stream flows. Stillaguamish Implementation Review Committee, May 14th, 2003
www.co.snohomish.wa.us/publicwk/swm/salmon/StillyPlan

Pesticides will continue to contaminate tributary streams bordered by orchards, reducing macroinvetebrate production and limiting fish growth and survival from these streams. Riparian losses will continue unless educational efforts on private land are maintained and the ordinances enforced. Recreational trail erosion and proliferation of trails and stream crossings may degrade riparian areas and wet meadows and increase sediment delivery to streams.

3.2.4 Terrestrial Focal Species Population and Characterization

Present Distribution

A map of land cover types and associated focal wildlife species are provided in Appendix A, Maps 16. It is assumed that these land cover types approximate the distribution of the focal species.

Black-tailed Deer and Elk: The cover types and distribution of deer and elk in the subbasin were not mapped in this assessment. Deer and elk will opportunistically utilize all forest types and mixed environs in the subbasin (Keith Kohl, ODFW, pers comm.). Instead, the emphasis of this assessment for deer and elk was on the status of winter range, migration corridors, habitat fragmentation including disturbance from increasing recreation trail and backcountry use levels (Appendix A, Map 2 and Map 18).

Northern Spotted Owl: Maps of spotted owl habitat on federal lands is provided in Appendix A, Maps 16 and 17. The spotted owl distribution includes all coniferous forest types that occur at low to middle elevations. The land cover types associated with this species include Western lowland conifer-hardwood forest and Montane mixed conifer forest. Spotted owls are most abundant in old-growth or mature forest, but are often associated with residual patches of old trees in burned or logged areas (Marshall et al, 2003).

Clark's Nutcracker: The nutcracker is associated with whitebark pine stands that grow at high elevations at or above the timberline in the Mt Hood and Cooper Spur area. Land cover types where the bird is found are Subalpine Parkland and Alpine Grasslands and Shrublands (Appendix A, Map 16). The distribution and seasonal movements of the nutcracker may be broader where these forests are lost or damaged by the fungus. East of the Cascade crest, white pine is found within both the subalpine forest and treeline zone (Katherine C. K.,U.S. Geological Survey http://biology.usgs.gov/)

Lark Sparrow: The lark sparrow generally inhabits open prairies, grasslands, and other other open lands, preferring open dry areas with scattered brush and trees. It also inhabits forest edges, cultivated areas, orchards, fields, and savannahs. It is associated with the land cover types Eastside Interior Grasslands, Ponderosa Pine Dominant Forest, and Westside oak and dry Douglas fir (Appendix A, Map 16).

Western Gray Squirrel: Ponderosa pine dominant, westside oak and dry Douglas-fir forests comprise the cover type for this species (Appendix A, Map 16). This type of habitat is most abundant in the lower eastern part of the subbasin, but small scattered patches exist at low to mid elevations. A combination of grasslands, wetlands, oak woodlands, and continuous cover in variable-aged conifer forests are all beneficial to this species by providing diversity in food sources, escape cover, and travel ways between stands.

Current Population Data and Status

Black-tailed Deer and Elk: A summer population of 1,400 deer and 400 elk is estimated for the Hood Management Unit by ODFW. The Hood Management Unit encompasses the Lower Oregon Columbia Gorge Tributaries watershed and extends from Highway 35 in the Hood River Subbasin to the Cascade crest north of Mt Hood. The current deer and elk populations meet management objectives for this unit (Kohl, 2004). Past timber harvest on summer ranges have increased the amount of forage for deer and elk in the Hood Unit, leading to an increase in deer and elk numbers compared to reference conditions (Keith Kohl, ODFW, pers. comm.).

Northern Spotted Owl: Thirty owl activity centers are identified by the Mt Hood National Forest in the subbasin. Demographic data from northern spotted owls in 14 study areas in Washington, Oregon, and California for the time period 1985-2003 indicate that spotted owl populations have experienced a 6.6% annual decline on non-federal lands, compared to a 2.5% decline on federal lands (Anthony, et al. 2004).

Clark's Nutcracker: Because occurs in specialized high elevation habitat, Breeding Bird Survey population trend information is not available for this species (C.J. Flick, USFS, pers. comm.).

Lark Sparrow: Population data in the subbasin is not available for this species. The Oregon Breeding Bird Survey trends show a 9.8% decrease in lark sparrow statewide for 1966-2000.

Western Gray Squirrel: Population data in the subbasin is not available for this species

Locally Extirpated and Introduced Species

The following species are known to be extirpated from the Hood River Subbasin.

- Grizzly bear
- Gray wolf
- California condor
- Fisher

The wolverine is a rare species documented as present in Hood River County in the 1980s, and is probably at risk of extirpation. A wolverine was reported as killed in the watershed on Interstate 84 in 1990 at Starvation Creek (NPPC, 2000). Although wolverine habitat suitability and survival requirements are not completely understood, the critical component of modern day wolverine habitat is the absence of human activity and development (Verts, 1998). The wolverine is most at home in regions with snow on the ground throughout winter. They are morphologically suited to hunting in the snow and may rely heavily on this advantage during severe winters (Wilson, 1982). Winter recreation pressures and increasing human presence in backcountry areas may limit the capacity of the Mt. Hood National Forest area to support wolverine (Thurman, 2004 and Fiedler, 2004).

The barred owl has expanded its range from southeast Canada, eastern United States, and eastern Mexico moving into Oregon in 1974. Its range now nearly overlaps that of the northern spotted owl. Barred owls are larger than and aggressive toward spotted owls. Surveys suggest that spotted owls are more likely to abandon a site if barred owls take up residence close to that site (Pearson and Livezy, 2004). Barred owls appeared to be most abundant in riparian and lowland forests and less common in upland forests. They may negatively affect dispersing juvenile spotted owls by creating a hostile environment. Besides direct competition for space, it appears that these two species may also compete for prey, although barred owls have a wider prey selection than the spotted owl. Competition with the barred owl aggravates recovery efforts for the spotted owl.

The Eastern Gray Squirrel is arboreal in habit and well established in the towns within the Hood River subbasin. Eastern gray squirrels compete for habitat and displace native western gray squirrels. They may also transmit disease to native squirrels (WDF&W, 1994). This species, in conjunction with land development and the loss of oak woodlands with contiguous cover, has likely influenced the decline of western gray squirrel populations in the subbasin.

Table 15 Partial list of introduced non-native animal species in the Hood River subbasin (Marshall et al., 2003; Davis, 2004; Maser, 1998).

Species	Level of Occurrence
Bullfrog	
Barred owl	uncommon, range expansion, competes for territory with spotted owl
Eastern gray squirrel	common in Hood River, competes for territory with native western gray squirrel
brown-headed cowbird	common, range expansion, lays eggs in host birds' nests
Corbicula species (bivalve mussel)	widespread and here to stay
domestic and feral cat	widespread
domestic dog	common, associated with humans
eastern cottontail	widespread
eastern fox squirrel	common in Hood River
house mouse	common around human habitation
Norway rat	common around human habitation
nutria	possible but unknown locations
opossum	widespread
rock pigeon	widespread, prey for peregrine falcon
European starling	widespread
House sparrow	widespread
California quail	widespread

Some native wildlife populations are elevated compared to historic conditions due to land use changes that favor those species. Examples include deer, elk, and Canada geese. Deer readily adapt to timber, agricultural and rural residential lands with openings for favorable forage growth, shrubs, and forest edges and riparian habitat for cover. Deer and elk damage to orchards, residential gardens or landscaping are common in parts of the watershed.

Historic and current habitat distribution

Historic and current habitat cover data was obtained from the Northwest Habitat Institute Interactive Biodiversity Information System (IBIS). In consultation with NWHI, available IBIS map layers were used to analyze changes between historic and current distribution of wildlife habitat or cover types for focal species (Appendix A, Maps 16 and 16A). Two factors confounded our analysis. First, there were significant differences in the data resolution and scale between the current and historical data sets. Second, the small size of the subbasin magnified the problem. The 1:1,000,000 scale at which the historic habitat data was available for this subbasin does not lend itself well to analysis in relatively small basins like the Hood River. For example, smaller areas of key land cover types for 2 focal species were not included in the historic maps. These are Westside Oak and Dry Douglas-fir Forest and Woodlands (876 acres) and Eastside Interior Grasslands (1,538 acres). Standard change detection procedures are not well suited for analysis of disparate data cell resolutions between the Historic (1 km) and Current (80 m) wildlife habitat layers (M. Garner, Natural Resources Consulting, Inc., pers. comm.). Representing the results of this analysis by 6 HUC subwatersheds adds to the problem by greatly overstating the actual change at the scale at which this assessment was conducted. This can be readily seen in the "Land Cover Change" maps provided at the end of Appendix A. The map legends were changed from the IBIS suggested format to a more readily interpreted version that conveys the same message.

Table 16. Current and historic land cover types for focal wildlife species in the Hood River Subbasin as indicated by the IBIS map data.

Focal Species	Cover Type	Current Acres	Historic Acres
--	Agriculture, pasture and mixed environs	33,392	-
Clark's nutcracker	Alpine grassland and shrublands	4,469	233
Lark sparrow	Eastside (interior) grasslands	1,538	--
Northern spotted owl	Eastside (interior) mixed conifer forest	23,189	16,4197
Northern spotted owl	Montane mixed conifer forest	47,889	6,620
Lark sparrow	Ponderosa pine forest and woodlands	4,738	26,073
Clark's nutcracker	Subalpine parkland	4,394	--
--	Urban and mixed environs	763	--
Northern spotted owl	Westside (Mesic) lowlands conifer-hardwood forest	95,370	18,366
Lark sparrow Western gray squirrel	Westside oak and dry Douglas-fir forest and woodlands	876	--

According to a GIS anaylsis of map data provided by Hood River County and ODFW, 39% or 45,752 acres of historic big game winter range largely in the Hood River Subbasin have been lost by human development. About 66% of the remaining available winter range is on non-federal land. Currently, approximately 72,254 acres are designated by ODFW as big game winter range in Hood River County. Land outside of urban, residential, and agricultural areas that are below the normal snow elevation level is designated as available winter range. The approximate boundaries of designated winter range were informally mapped to assist the County Planning Department. The actual extent of winter range varies widely with snow levels (K. Kohl, ODFW, pers. Comm.) Of the remaining designated winter range, about 5,057 acres or 7% of undeveloped land are at medium (Forest F-1 zoning) or high risk of development (Residential and Exclusive Farm Use zoning) (Appendix A, Map 18).

Condition, Trend, Connectivity and Spatial Issues

Planning to retain or improve habitat connectivity, dispersal routes, and access to big game winter range is a critical need. In addition to the Hood River canyon and other intact riparian buffers throughout the subbasin, an important mid-elevation east west wildlife migration corridor is believed to exist through the Middle Mountain area (Keith Kohl, ODFW, pers comm.). This corridor consists of undeveloped forest and residential zoned lands (Appendix A, Map 18). Another important migration corridor at low elevation exists in the Whiskey Creek drainage and the lower east boundary of the subbasin. Undeveloped forest, residential, and EFU lands at in this area facilitate big game and other wildlife movement westward into the lower Hood River canyon and south away from the Hood River urban area and I-84 transportation corridor to re-access forest lands.

The available big game winter range is now mostly on or adjacent to private property and has reached its capacity (Hood River County, c. 1986). Future residential development in winter range will further limit its capacity.

The absence of fire as a major natural disturbance has changed the condition and quality of wildlife habitat especially in the Montane Mixed Conifer Forest and Lowlands Conifer-Hardwood Forest cover types (Johnson and O'Neil 2001). Past or continuing timber practices in accessible lower and middle elevation forest areas have produced uniform Douglas-fir plantations in these areas, reducing the habitat quality for the spotted owl and marten. Forest fuels are at elevated levels because of fire suppression practiced since the turn of the century. If uncharacteristic conditions continue to worsen, habitat conditions for native wildlife will continue to deteriorate and the watershed may experience a catastrophic high-intensity fire. On the other hand, fuels reduction efforts that do not consider the needs of wildlife or forest diversity will lead to negative effects on focal species and habitats. The supply of damaged live trees, standing dead trees, and large-diameter downed trees that provide nesting cavities, scanning perches, and insect-feeding substrate for birds and other wildlife is increasingly limited in and around most agricultural and residential areas, especially given growing concern about fire fuels in urban-interface areas.

Limiting factors for deer and elk in the Hood Unit include conflicts with agricultural crops, mainly fruit orchards, diminished wintering range due to encroachment of residential development and agriculture; harassment or disturbance due to increased use of humans on roads, bike trails (motorized and non-motorized), hiking trails and backcountry uses (Keith Kohl, ODFW, *pers. comm*).

Overall year round recreational trail and backcountry use levels on public and private forest lands by hikers, snowshoers, mountain bikers, off road vehicles, etc. has sharply increased in the last 10 years. This trend is likely increasing habitat fragmentation, degradation, and disturbance-related impacts to wildlife. Unauthorized trail development is also an increasing trend, especially in the 6 HUC watersheds Neal Creek, Hood River/Odell Creek, and Dead Point Creek. Trail inventories on private and county-owned timber lands in these and other areas are not available at this time to characterize the potential impacts (Appendix A, Map 2). Map 2 in Appendix A shows mapped human travel corridors in the subbasin overlain with deer and elk winter range, and highlights areas of recent unauthorized trail development where trail inventory and other actions are needed.

An estimated 237 miles of trail within the subbasin are mapped on Forest Service lands, amounting to an average trail density of 1.3 miles per sq. mile. The Bonneville Power Administration high-voltage Big Eddy-Ostrander transmission line right-of-way travels 17 miles across the subbasin from Bald Mountain to Lolo Pass and averages 425 feet in width. Trees and tall shrubs in the right of way are not allowed except in canyons between towers. Power line corridors on National Forest are infested with dense scotch broom. Travel and powerline corridors have served as avenues for dispersal of invasive plants, altering native plant communities and degrading wildlife habitat. Table 15 shows the miles and density of human travel corridors in the subbasin that are mapped to date. The table underestimates the miles of trail in the subbasin because only those trails mapped on mostly federal lands are shown, and high density trail areas exist on private and county forest ownerships.

Tansy ragwort, Canada thistle, scotch broom, and knapweed have become well established in the County. Knapweed aggressively displaces pasture and native grasses and plants. Purple loosestrife is found along streams near Odell and parts of the East Fork Irrigation District canals. Scotch broom has proliferated and has infested 6% of the County (Dean Guess, Hood River County Weed and Pest Department, pers comm.). Himalayan blackberry competes with native plants for moisture in open riparian areas, and more alarming, Japanese knotweed was discovered in the subbasin in 2004.

Table 17. Mapped human travel corridors in the Hood River subbasin by 6 HUC watersheds. Trails include only those on Forest Service GIS map data layers.

6 HUC Watershed	Type	Miles	Density (miles/sq. mi.)
CAMP CREEK		**128.4**	**3.4**
	Road	95.3	2.5
	Trail	33.1	0.9
DEAD POINT CREEK		**148.5**	**4.2**
	Road	138.3	3.9
	Trail	10.2	0.3
DIVERS CREEK		**138.7**	**4.8**
	Road	112.0	3.9
	Trail	26.7	0.9
DOG RIVER		**45.2**	**3.6**
	Road	33.5	2.6
	Trail	11.8	0.9
HOOD RIVER/ODELL CREEK		**160.3**	**4.9**
	Railroad	6.9	0.2
	Road	152.3	4.6
	Trail	1.1	0.0
LOWER EAST FORK HOOD RIVER		**199.1**	**4.7**
	Railroad	6.9	0.2
	Road	181.9	4.3
	Trail	10.3	0.2
LOWER HOOD RIVER		**112.2**	**6.8**
	Railroad	9.7	0.6
	Road	102.5	6.2
MIDDLE EAST FORK HOOD RIVER		**78.6**	**3.0**
	Road	40.8	1.5
	Trail	37.8	1.4
MIDDLE FORK HOOD RIVER		**122.0**	**4.9**
	Road	112.3	4.5
	Trail	9.7	0.4
NEAL CREEK		**136.9**	**4.5**
	Railroad	2.2	0.1
	Road	133.2	4.3
	Trail	1.5	0.0
PINNACLE CREEK		**55.4**	**2.8**
	Road	25.7	1.3
	Trail	29.7	1.5
UPPER EAST FORK HOOD RIVER		**137.3**	**4.4**
	Road	71.8	2.3
	Trail	65.5	2.1

Habitats Currently Protected on Public and Private lands

According to a GIS analysis using the Northwest Habitat Institute IBIS Land Protection Status data, Alpine and Subalpine cover types have the greatest percent protection followed by Montane Mixed Conifer habitat type. A map of Land Protection Status is provided in Appendix A, Map 5. Spotted owl is protected by federal land ownership and management objectives in the subbasin. Mt. Hood National Forest Plan includes sensitive animal nest-site and rare plant protection buffers. Late Successional Reserves allows for timber harvest in younger-aged forests provided that the specific long-term objective of the harvest is to promote healthy late-successional forest conditions (C. Flick, USFS-NSA, 2004). The Northwest Forest Plan provide for riparian reserves, retention levels for snags /dead trees, and coarse woody debris following timber harvest. The State Forest Practices Act also has riparian vegetation and snag retention standards.

Potential and Projected Future Condition with no Future Actions

The projected condition without action is likely to be one of further loss and degradation of habitat cover types for lark sparrow and gray squirrel, loss and degradation of winter range, including further habitat fragmentation and simplification on almost all cover types, and increasing conflicts between wildlife, recreation, and development. Increasing residential or recreational development in forest habitat types and interior grasslands will result in further fragmentation and loss of wildlife habitat. Some of the impacts to wildlife associated with land development in wildlife habitats include mortality by domestic pets, avoidance of suitable habitat due to the presence of pets, conflict between humans and wildlife especially bear, cougar, deer, elk, and gophers; mortality of resident and migratory birds colliding with large uncovered windows; forest fragmentation that leads to penetration by songbird-nest-parasitizing birds such as cowbird; and clearing of downed wood, snags, and brush cover to reduce fire hazard around homes and buildings. The clearing of ladder fuels, snags, downed wood, and standing trees in urban interface forest areas and rural residential areas is expected to rise in the watershed. Without approaches that leave patches of snags, shrubs, downed wood and other elements, urban interface fuels treatment is likely further reduce the already scarce supply of structural habitat elements in the treated areas.

The absence of fire will lead to continued encroachment of fir and other trees into oak and white-bark pine stands. Invasive nonnative plants will continue to encroach upon and displace native plant communities and degrade wildlife habitat.

Conflicts between wildlife needs and recreation are expected to rise as a result of an increasing year round human presence in backcountry areas, trails, and shorelines. The promotion of recreation and tourism in the Columbia Gorge is supported by a broad range of economic and governmental interests. Without a plan to identify and meet the spatial and temporal needs of wildlife, along with adequate public education and enforcement, species sensitive to disturbance are at risk of displacement from or avoidance of available habitats in forest and shoreline areas. Intolerant species may become extirpated, reducing the biodiversity of the watershed. Deer and elk may increasingly move to areas such as rural residences or orchards where their presence is often not tolerated.

3.3. Out-of-Subbasin Effects

3.3.1. Aquatic Species

Anadromous fish including focal species chinook and steelhead spend a large fraction of their lives in the Pacific ocean after varying amounts of time in the Columbia River and its estuary. The subbasin planning process must account for mortality effects that occur outside of the Hood River. These effects are likely to vary from year to year, and are either natural, human-caused, or both (Roger, P. 2004). The Ecosystem Diagnosis and Treatment model was used to assess the effects of out-of-subbasin subbasin conditions on anadromous salmon populations (TOAST, 2004). Model parameters roughly represent a 1990 – 1999 base period, and represent the effects of the hydropower system, estuary and ocean conditions, and harvest regimes during the base period. Additional parameters represent the biological effects of density-dependent interactions in the mainstem Columbia River and genetic effects of hatchery fish inter-breeding with naturally-produced adults (Roger, P. 2004). The EDT model incorporates out-of-subbasin effects by applying an average survival rate for each population from when juveniles enter the Columbia River to when adults return back to the Hood River. This rate was computed using the total number of adult returns divided by the total number of juvenile outmigrants for each population. The major sources of out-of-basin impact were aggregated into a single smolt-to-adult-return rate or SAR (Table 18).

Table 18. Bonneville Pool Point of Entry SARs assumed for use in the EDT model (TOAST,2004).

Species (age)	Average	Low	High
steelhead	4.13	2.54	11.44
Chinook yearling	2.2	0.73	7.26
Chinook subyearling	1	.33	1.33

Mainstem Columbia River Survival: The major factors affecting the survival of Hood River focal species during their juvenile and adult migrations through the Bonneville reservoir and Dam include water temperature, river flow, juvenile travel time, juvenile migration timing, passage survival at the Dam (juvenile turbine and bypass-related mortality, upstream migration delay or injury), predation, harvest, habitat quality, and competitive interactions with hatchery and other fish. The EDT applied an average survival rate past the Bonneville Dam hydroelectric project of 88% for yearling and ~85% for sub-yearling chinook. Adult chinook survival past the Bonneville Dam was assumed to average 93% (PATH 2000).

Harvest and Hatcheries: Ocean harvest on fish produced in the Hood River is believed to be minimal. The harvest rate in the Columbia River on hatchery Hood River summer steelhead for the years 1996-2001 ranged form 109 to 390 with an average of 227 fish, while the winter steelhead harvest in roughly the same period was approximately 15. However, out of basin harvest could be considerably higher than this estimate, as it does not include incidental catch in commercial spring chinook fisheries, and very limited data available from winter zone 6 fisheries. Besides the potential for genetic effects incorporated as an EDT model parameter, releases from large production hatcheries may overwhelm the food supply in the Columbia River and estuary at the expense of wild fish, but may also buffer wild fish from avian and other predators.

Climate Patterns: In addition to the steady state conditions represented in the EDT model, three complex interacting climatic patterns affect ocean and freshwater conditions and, consequently, salmon production. These are the Pacific Decadal Oscillation (PDO), the El Nino/Southern Oscillation (ENSO), and climate change. Studies show that Pacific salmon experience large year-to-year fluctuations in survival rates of juvenile fish making the transition from freshwater to marine environment (Hare et al. 1999). Climate-related changes have the most affect on salmon survival very early in the their marine life history (Pearcy 1992, Francis and Hare 1994).

The Pacific Decadal Oscillation is a recurring pattern of ocean-atmospheric variability that alternates between climate regimes every 20-30 years (Hare et al. 1999). The PDO affects water temperatures off the Oregon and Washington coast and has cold (negative) and warm (positive) phases. A positive PDO phase brings warmer water to the eastern North Pacific, reducing upwelling of nutrient-rich cooler water off the coast of North America and decreasing juvenile salmon survival (Hare et al. 1999). The negative phase has the opposite effect, tending to increase salmon survival. PDO and ENSO also affect freshwater habitat of salmon. Positive PDO and ENSO events generally result in less precipitation in the Columbia Basin. Lower stream flows result in higher water temperatures, a longer outmigration period, and a likelihood that less water will be spilled over Columbia and Snake river dams to assist smolt outmigration (Hare et al. 1999).

Climatic effects are manifested in both fish returns and harvests. Mantua et al. (1997) found evidence that the negative PDO phase resulted in larger harvests off Oregon, Washington, and in the Columbia River, and lower harvests in Alaskan waters. In the positive phase, warmer water off Oregon and Washington were accompanied by lower harvests (and runs) in the Columbia River, but higher harvests in Alaska. Phase reversals occurred around 1925, 1947, 1977, and possibly 1999. The periods from 1925-1947 and from 1977-1999 were periods of low returns to the Columbia River, while periods from 1947-1977 and the current period are periods of high returns.

Like the PDO, the El Nino-Southern Oscillation (ENSO), commonly referred to as El Nino and La Nina, affects water temperatures off the coast of Oregon and Washington and has both a cold (negative) and warm (positive) phase. ENSO events are much shorter than PDO events, typically occurring every 2-7 years and lasting 12-18 months. Positive ENSO events occur more frequently during positive PDO phases and less frequently during negative PDO phases (Hare et al. 1999). ENSO events either intensify (during congruent negative or positive events) or moderate (when one cycle is positive and the other negative) the effects of the PDO cycle on salmon survival. A positive ENSO (El Nino) event also results in higher North Pacific Ocean temperatures, while a negative ENSO (La Nina) results in lower temperatures.

Climate change on a longer term than the PDO could have a large impact on the survival of Columbia Basin salmon. Computer models generally agree that the climate in the Pacific Northwest will become, over the next half century, gradually warmer and wetter, with increased precipitation in winter and warmer, drier summers (USDA Forest Service 2004). The general outlook of increased winter flooding and decreased summer and fall streamflows, along with elevated stream and estuary temperatures, are especially problematic for salmon habitat. For salmon runs that are already under stress from degraded freshwater and estuarine habitat, these changes may cause more severe problems than for more robust salmon runs that utilize healthy streams and estuaries. The main question appears to be how long the present favorable PDO period will last and the timing and intensity of the subsequent unfavorable period. Prudence suggests planning for a shorter favorable period and a subsequent longer, if not more intense, unfavorable period (Roger, P. 2004).

Assumptions About Effects on Productivity and Sustainability

Hood River steelhead must pass only one mainstem Columbia River dam (Bonneville) compared to many Basin populations. Ocean harvest is believed to be minimal, and terminal harvest is mostly on hatchery fish. Consequently, it is assumed that populations can at least maintain themselves (natural summer steelhead) or are capable of increasing their numbers (natural and hatchery winter steelhead). The base period used for these comparisons was one of relatively poor ocean environmental conditions and could be considered a worst-case scenario (Roger, P. 2004). Returns in recent years are significantly greater and can be used to reach subbasin goals more rapidly, support more fisheries, or a combination of these actions.

It is assumed that improved survival within the Hood River subbasin will have larger positive impacts on the naturally spawning populations than any likely changes outside the subbasin. Considering that anticipated future climate changes are likely to make summer rearing conditions less favorable than during the base period, strategies which improve summer rearing areas should receive higher priority than other restoration strategies.

These assumptions are based on life cycle estimates of within-subbasin and out-of-subbasin survival or performance of three Hood River steelhead populations using direct observations from the Hood River Production Program monitoring and evaluation studies. Data for hatchery summer steelhead, spring and fall chinook were not considered sufficient for a life-cycle analysis of mortality (Roger, P. 2004).

Within the Hood River subbasin, naturally spawning winter steelhead had a higher average egg-smolt survival rate (0.97%) than did naturally spawning summer steelhead (0.56%). Hatchery winter steelhead had the highest egg-smolt survival of all three steelhead populations (60.74%), reflecting the known survival advantages of the protected hatchery environment (Appendix B, Table 3). Survival during residence outside of Hood River shows a different pattern (Appendix B, Table 4). Naturally spawning winter steelhead have the highest smolt-to-adult-return survival (7.5%), followed by naturally spawning summer steelhead (4.8%) and hatchery winter steelhead

(1.0%). Repeat spawning adults are a small but important proportion of both naturally spawning populations. Over the entire life cycle, all three populations had a positive return rate (returns per female spawner, Appendix B, Table 5). The hatchery winter steelhead population was most productive (22.48 returns per female) followed by naturally spawning winter steelhead (2.89 returns per female) and naturally spawning summer steelhead (1.17 returns per female).

With regard to out of basin effects on spring chinook, captures of spring chinook juveniles in smolt traps in the lower Hood River for the last ten years suggest that wild spring chinook predominantly migrate out of the Hood River in the fall as subyearlings The fate and contribution of these fall migrating spring chinook juveniles to adult returns is considered a critical uncertainty by area fish managers. Out of basin effects on adfluvial bull trout including in the Columbia River and Bonneville Dam passage are not understood well enough to make any specific assumptions. Sea run cutthroat trout are believed to spend 8-9 months in the estuarine or marine environment. Survival and return rates are extremely depressed, including in populations below Bonneville Dam. Sea-run cutthroat trout behavior and survival in the Lower Columbia River and estuary is under investigation by the USFWS (http://columbiariver.fws.gov/programs/cutthroat) and others.   Poor survival of sea run cutthroat trout is a concern throughout the lower Columbia region, including populations in streams below Bonneville Dam. Out-of-subbasin factors, including conditions at the Bonneville Dam and in the estuarine or near shore marine environment, are assumed to be affecting the survival of sea-run cutthroat from the Hood River Subbasin. However very little life history information is available specific to Hood River fish. It is assumed that there are negative fish passage impacts to lamprey at the Bonneville dam.

3.3.2. Terrestrial Species– Out of Subbasin Effects

It is assumed that out of subbasin effects currently have a minimal effect on deer and elk populations in the watershed. Population and harvest objectives for elk and black-tailed deer appear to be met. However, ODFW radio-tracking data show that some deer and elk move in and out of the watershed, although most movement is associated with finding winter range. The need to maintain habitat connectivity and adequate winter and summer range in adjacent subbasins is important for healthy gene flow and population dispersal. Climate change may affect the distribution and abundance of deer and elk populations forage base by changing the distribution and composition of vegetation.

3.4. Environment/Population Relationships

3.4.1. Aquatic

Important Environmental Factors for Species Survival by Life Stage

Appreciation is expressed to Gary Asbridge, U.S. Forest Service, Hood River Ranger District, who compiled the sections of the assessment to help summarize and interpret the EDT baseline diagnostic and restoration scenario reports for the Hood River Subbasin for the planning team.

Hood River subbasin planners used the Ecosystem Diagnostic Treatment model (EDT), developed by Mobrand Biometrics Inc., to identify and analyze potential limiting factors affecting production of chinook and steelhead focal species. The species "rules" in EDT that are required to run the model have yet to be finalized for bull trout or cutthroat trout however, these reaches were included in the modeling and EDT will be run when the rules are completed.

The Hood River watershed was broken into 147 distinct reaches representing the known or potential distribution of focal species in the watershed. Reaches were delineated based on geomorphology and barriers to fish passage (both natural and anthropogenic). Twenty- nine reaches were considered obstructions to fish passage. For each reach, various habitat and biological attributes were rated by a team comprised of area fish biologists and hydrologists familiar with the watershed for both the current and template (i.e. historic) conditions[3].

EDT uses this reach information, along with focal species life history information and out of subbasin effects to estimate adult and juvenile focal species productivity, capacity, and abundance for both the current and template conditions. The model produces summary and diagnostic reports that outline the above parameters and limiting habitat factors by stream and reach. Reaches are prioritized for both protection and restoration based on their potential response to future degradation or improvement (provided later in this section).

Based on known adult escapement at Powerdale Dam and estimated smolt outmigration from ten years of screw trap data collected for the Hood River Production Program, the EDT model appears to overestimate the current numbers of adult and juvenile focal species in the subbasin (Tables 1 and 2). Another production model recently developed for the Hood River (Underwood, K.D. et al., 2003) also estimated lower carrying capacity numbers of adults and juveniles. Fall chinook estimates are the most disparate with current EDT projections. Powerdale Dam trap counts indicate that for the period from 1992 –2003, the annual return of fall chinook to Powerdale Dam has averaged 26 fish,

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[3] Our team decided the template condition would be the late 1800's. We estimated habitat and species conditions to the best of our ability based on existing conditions, experience and professional judgment.

with a range from 6 to 70. It is also believed that the Hood River never supported large numbers of fall chinook historically, certainly not as large as the EDT estimates below. Area fisheries managers are unclear as to why the model is overestimating fall chinook. Summer steelhead are currently much less abundant than estimated by EDT although not to the extent that fall chinook are. Adult returns of wild/natural origin summer steelhead ranged from 79 to 650 fish for the years 1992 to 2003 with an average of 261 fish. The number of wild summer steelhead smolts migrating past the screw trap ranged from 550 to 2,000 per year for the period 1991-2001. Although the adult and juvenile numbers estimated for spring chinook and winter steelhead appear somewhat high they are much closer to the current reality based on available adult and juvenile trapping data.

Table 18. EDT estimates of adult focal species population metrics based on current and template conditions in the Hood River Subbasin. Harvest effects occur out of subbasin.

Population	Scenario	Diversity index	Productivity	Capacity	Abundance
Hood River Fall Chinook	Current without harvest	44%	1.5	3,489	1,111
	Current with harvest	8%	0.6	1,565	-
	Historic potential	99%	6.1	8,360	6,979
Hood River Spring Chinook	Current without harvest	44%	1.2	1,779	309
	Current with harvest	39%	1.1	1,664	197
	Historic potential	99%	6.2	4,772	4,002
Hood River Summer Steelhead	Current without harvest	69%	2.8	2,338	1,495
	Current with harvest	69%	2.8	2,338	1,495
	Historic potential	99%	8.9	3,568	3,168
Hood River Winter Steelhead	Current without harvest	37%	1.6	2,742	1,046
	Current with harvest	37%	1.6	2,742	1,046
	Historic potential	97%	7.6	5,117	4,446

Table 19. EDT estimates of juvenile focal species population metrics based on current and template conditions in the Hood River Subbasin.

Population	Scenario	Productivity	Capacity	Abundance
Hood River Fall Chinook	Current without harvest	72	298,820	63,408
	Current with harvest	67	299,725	-
	Historic potential	221	592,785	428,422
Hood River Spring Chinook	Current without harvest	27	54,090	7,311
	Current with harvest	27	54,093	4,920
	Historic potential	105	111,337	87,933
Hood River Summer Steelhead	Current without harvest	81	77,728	47,411
	Current with harvest	81	77,728	47,411
	Historic potential	236	109,340	95,409
Hood River Winter Steelhead	Current without harvest	53	102,562	35,975
	Current with harvest	53	102,562	35,975
	Historic potential	201	164,279	138,794

Key Limiting Factors

As expected by local biologists, the key factors identified by EDT that limit anadromous salmonid production were similar throughout the subbasin and for all focal species. The five primary limiting factors (called level 3 survival factors in EDT) in the subbasin were channel stability, flow, habitat diversity, sediment load, and key habitat quantity. Other factors having lesser effects included obstructions, chemicals and food.

Each limiting factor has different effects on the various focal species depending on the life stage in question (Table 19). For example, channel stability is assumed not to have an effect on chinook salmon spawning whereas habitat diversity and key habitat quantity (in this case spawning habitat) has a potentially large effect. For each limiting factor and life stage there are one or more attributes that "drive" model results. Key habitat quantity is a good example: for the egg incubation life stage the primary attribute driving key habitat is the amount of pool tail habitat (where the eggs are incubating, in other words) whereas for the fry colonization stage the primary attribute is the amount of backwater pool habitat.

Table 20. Summary of the primary limiting factors or key environmental correlates identified by EDT for focal species by life stage. Those listed below were indicated most frequently in the reach diagnostic reports.

Spring chinook	
Life Stage	**Key Limiting Factors**
Spawning	Key habitat quantity, habitat diversity
Egg incubation	Channel stability, sediment load, key habitat quantity
Fry colonization	Habitat diversity, key habitat quantity
0-age active rearing	Key habitat quantity, habitat diversity
0-age migrant	Habitat diversity, key habitat quantity
0-age inactive (winter inactivity)	Habitat diversity, key habitat quantity, sediment load
1-age active rearing	Key habitat quantity, habitat diversity
1-age migrant	Habitat diversity, obstructions (Powerdale Dam)
1-age transient rearing	
2+ -age transient rearing	
Pre-spawning migrant	Obstructions, habitat diversity
Pre-spawning holding	Key habitat quantity, habitat diversity, flow

Fall chinook	
Life Stage	**Key Limiting Factors**
Spawning	Key habitat quantity, habitat diversity
Egg incubation	Channel stability, sediment load, key habitat quantity
Fry colonization	Habitat diversity, key habitat quantity
0-age active rearing	Key habitat quantity, habitat diversity
0-age migrant	
0-age inactive (winter inactivity)	
1-age active rearing	
1-age migrant	
1-age transient rearing	
2+ -age transient rearing	
Pre-spawning migrant	Flow, key habitat quantity, obstructions
Pre-spawning holding	Key habitat quantity, habitat diversity, flow

Table 20, continued. Summary of the primary limiting factors or key environmental correlates identified by EDT for focal species by life stage. Those listed below were indicated most frequently in the reach diagnostic reports.

Summer steelhead	
Life Stage	**Key Limiting Factors**
Spawning	Key habitat quantity, habitat diversity
Egg incubation	Channel stability, sediment load, key habitat quantity
Fry colonization	Habitat diversity, flow, channel stability, sediment load
0-age active rearing	Flow, habitat diversity
0, 1-age inactive (winter inactivity)	Flow, habitat diversity, channel stability, sediment load
1-age migrant	Key habitat quantity, habitat diversity
1-age active rearing	Habitat diversity, flow
2+ -age active rearing	Habitat diversity, flow
2+ -age migrant	Habitat diversity (minimal effect)
2+ -age transient rearing	
Pre-spawning migrant	Obstructions (Powerdale)
Pre-spawning holding	Key habitat quantity

Winter steelhead	
Life Stage	**Key Limiting Factors**
Spawning	Key habitat quantity, habitat diversity
Egg incubation	Channel stability, sediment load, key habitat quantity
Fry colonization	Habitat diversity, flow, channel stability, sediment load
0-age active rearing	Flow, habitat diversity
0, 1-age inactive (winter inactivity)	Flow, habitat diversity, channel stability, sediment load
1-age migrant	Key habitat quantity, habitat diversity
1-age active rearing	Habitat diversity, flow, key habitat quantity
2+ -age active rearing	Habitat diversity, flow
2+ -age migrant	Habitat diversity (minimal effect)
2+ -age transient rearing	
Pre-spawning migrant	Obstructions (Powerdale), key habitat quantity
Pre-spawning holding	Key habitat quantity

Note: In Lenz and Neal Creek chemicals were a significant negative effect for winter steelhead.

For most life stages all of 5 primary limiting factors (channel stability, flow, habitat diversity, sediment load, and key habitat quantity) played a role. The primary limiting factors outlined below are those that consistently appeared to limit production of one or more life stages of all focal species throughout the subbasin. In some streams or reaches other factors were certainly limiting and the most prevalent will be discussed as well.

Channel Stability

Channel stability affected all focal species from the egg incubation life stage through juvenile rearing. Channel stability is tied primarily to the bed scour attribute – the more bed scour the larger the effect[4] on the various life stages for each focal species. The most

[4] In EDT the limiting factors, or survival factors, are described in terms of the relative loss or gain compared to the template condition. In the case of channel stability, which is driven primarily by bed

deleterious effect appeared to be during the egg incubation stage with moderate effects on the fry colonization and inactive rearing (i.e. overwintering) stages. These effects are not surprising due to the glacial nature of the mainstem tributaries in the subbasin (where much of the spawning occurs), as well as the flashy hydrograph and relatively frequent occurrence of rain on snow events that likely lead to relatively high levels of bed scour.

Channel instability is largely the normal state in this subbasin – the Hood River is a dynamic and volatile system. However, area managers do believe that past land management has led to increases in channel instability. Timber harvest, roads, and other impervious surfaces have likely increased the flashiness of the system and the frequency and occurrence of peak flows. This has, in turn, increased bed scour in the subbasin.

Flow

Flow effects ranged primarily from small to moderate for all focal species. Life stages affected varied but were primarily the juvenile portion of the overall species life histories although adult migrating and pre-spawning holding chinook were often affected. Flow effects depend on the time of year and life stage, for example, the chinook fry colonization life stage is affected by high flows (as they are colonizing in late winter or spring) whereas 0-age rearing chinook are affected by low flows in summer and fall.

Virtually every stream modeled was affected by flow. High flows have been exacerbated relative to the template condition by an increase of impervious surfaces, increases in the drainage network (more roads and ditches), and timber harvest. The primary impact to low flows has been water withdrawals for irrigation and power production. In some areas past timber harvest may have also reduced base flow levels by increasing runoff rates with a concurrent reduction in infiltration resulting in less water stored for the summer and fall. The fact that flow rarely had a high affect on any given species or life stage, and was in fact often a low affect, indicates that despite past land management and withdrawals the impact in any given reach may not be as important to species survival compared with other limiting factors such as channel stability and habitat diversity. However, although sometimes small, flow effects were widespread across the subbasin and are an important contributor to the decline of focal species since the template condition.

Habitat Diversity

Habitat diversity, as defined by EDT, is the effect of the extent of habitat complexity within a stream reach on the relative survival or performance of the focal species. Essentially, the more diverse the habitat in any given reach the greater the chance the species will survive and flourish in that reach. Habitat diversity was a limiting factor in most streams modeled and it affected both chinook (to a greater extent) and steelhead (to a lesser extent). Virtually all life stages were impacted although in most reaches it was the younger life stages (fry colonization until smolt outmigration) that were affected most.

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scour, a "loss" of stability actually means there is more bed scour currently than historically and hence the effects are more deleterious.

Habitat diversity is a function of gradient, channel confinement, riparian function, and large woody debris. Large wood levels are lower today than historically due to logging and stream clean out. This is one of the primary reasons habitats are less complex today compared to the template condition. In some reaches the stream is more confined due to roads, railroads, or other infrastructure. Other reaches are more confined because of past splash damming, which incised the channel, or the stream has downcut due to confinement and wood removal.

Sediment Load

Sediment load is defined as the effect of the amount of fine sediment present in, or passing through, the stream reach on the relative survival or performance of the focal species. The EDT model treats focal species life stages differently in terms of the sediment load attribute[5] that is most limiting. Turbidity and/or embeddedness are more important in terms of survival or performance (i.e. they "drive" the model results) than the overall amount of fine sediment in streambed for all life stages except egg incubation when eggs and sac-fry are in the gravel. Embeddedness is more of a factor during inactive life stages when juveniles need to find refuge in the substrate and turbidity is more limiting during active life stages.

Sediment load was a limiting factor in virtually all streams and reaches modeled and it affected all focal species. By far the largest impact was on the egg incubation stage, usually rating as a high or even extreme impact on survival in the EDT reach diagnostic summary. Juvenile life stages, most notably age 0 and 1 inactive (overwintering) and fry colonization were often negatively impacted as well, which relates primarily to the level the larger substrate particles are embedded by fine sediment. Older life stages were impacted in some stream reaches and high levels of turbidity appear to decrease survival or performance but not nearly to the degree younger life stages are affected.

The sediment load in the Hood River subbasin is naturally high due primarily to glacial streams that feed the three main forks of the system. Volcanic ash soils, which are highly erosive, also contribute to the overall sediment load. Our template ratings in the EDT model reflect this naturally high sediment load and this is likely one of the reasons the subbasin is not as productive in terms of fish numbers compared to other subbasins of similar size in the Pacific Northwest. Despite this we believe the sediment load is currently higher than the template condition due to land management practices that have increased runoff and erosion rates including high road densities in some areas, removal of large wood and riparian vegetation from stream systems, and in some portions of the watershed large timber harvest units.

Key Habitat Quantity

A key habitat is the primary habitat used by a particular focal species life stage; quantity is expressed the percent of the wetted surface area of the stream channel. For example, the key habitats for adult spawning are pool tails and small cobble riffles whereas pools

[5] The three attributes that make up the sediment load limiting factor are fine sediment (as in the amount of fine sediment), turbidity, and embeddedness.

and glides are the key habitats for age 0 and 1 rearing. The EDT model compares the current amount of the various habitat types against the template condition, tracks whether there has been a loss or gain, and alters survival and performance of particular life stages accordingly. Although linked with habitat diversity, key habitat quantity is a focused assessment of those habitats particularly important to various life stages.

Key habitat quantity was likely the most prevalent limiting factor across the subbasin as it affected all focal species and impacted at least one life stage in virtually every reach modeled. Primary impacts (those most often rated high) for all focal species were tied to the following life stages: pre-spawning holding (primary pools), spawning and egg incubation (pool tails and small cobble riffles), fry colonization (backwater and primary pools), and 0-age active rearing (primary and backwater pools). The latter life stage effect was primarily for spring and fall chinook. Impacts to 1 and 2-age juveniles were often, but not always, either absent in a given reach or rated as a low impact, particularly for steelhead. It is interesting to note that there has been a gain of steelhead key habitats compared to the template condition in some reaches. The gains were often small and they were across the board in terms of life stages affected. When looking at habitat preference and use steelhead are more of a generalist, or opportunistic, species compared to chinook. Model results reflect this as some life stages will use a variety of habitats and in some cases those habitats have increased in area since the late 1800's. An example is an increase of both small and large cobble riffles. Although this is usually accompanied by a loss in pool habitat there are some steelhead life stages that use these habitats such as adults during spawning (small cobble riffles) and juveniles for rearing or overwintering (large cobble riffles).

The loss of key habitat is very likely due to similar factors that have contributed to the loss of habitat diversity – reductions in the amount of large wood and increased channel confinement due to infrastructure and/or down cutting as a result of land management or channel alteration. Natural events, such as debris torrents and floods, have certainly contributed to key habitat loss (and gain) but we believe in many cases the negative effects of natural events has been exacerbated by land management.

Other Limiting Factors

Other factors that appear to limit survival and performance of focal species include obstructions and chemicals. Obstructions, such as culverts and irrigation diversions, are located primarily in tributaries to the three forks and the mainstem Hood River. Collectively they completely or partially block access to upstream habitats or, in the case of some irrigation diversions, entrain downstream migrating fish into irrigation canals. These obstructions, although certainly of importance to survival and life history diversity, would have a greater impact if more were located on the major forks and mainstem as this is where the majority of the focal species reside. One obstruction, however, that was a major limiting to all focal species was Powerdale Dam on the mainstem Hood River. This facility has a major impact on downstream migrating juveniles and is also a partial impediment to upstream migrating adults.

Chemicals (toxic substances or conditions that effect the relative survival or performance of the focal species) were not considered much of an impact over the subbasin as a whole with one exception – Neal Creek. Only winter steelhead utilize Neal Creek so the impacts are restricted to that focal species. From the confluence of West Fork Neal Creek downstream chemicals had a moderate to high impact on virtually every winter steelhead life stage. There were some minor chemical effects in the mainstem Hood River below Powerdale Dam few other reaches where chemicals were considered a problem in the EDT model. Both Neal Creek and the mainstem Hood River have been the most extensively studied streams in regards to pollution, primarily agricultural related pesticides and herbicides. Given the wide area in the low Hood River Valley where these chemicals are used it is possible chemicals have a wider impact than displayed in EDT.

Aquatic Protection and Restoration Priorities

EDT uses the attribute information comparing current to template conditions to prioritize geographic areas (i.e. streams) for protection and restoration. Tornado diagrams are generated to display these priorities for each focal species (Figures 13 . In many cases any given stream is rated high for both protection and restoration. These may seem at odds with each other but they are not because of the way the terms are defined in EDT. A stream or reach with a high preservation value is a prime candidate for protection because its degradation would have a disproportionately severe impact on focal species production. A stream or reach with a high restoration value, on the other hand, means that a given restoration treatment applied there would result in considerably more benefit to the focal species population than if the same treatment were applied on a stream with a lower restoration value. Therefore many streams, due to their importance to the various focal species, rate high for both protection and restoration.

In general, the larger streams were ranked higher from both a protection and restoration standpoint. The focal species modeled spend much of their life cycle in these streams as opposed to the smaller tributaries so this result is not surprising. However, note that there are generally many streams that show up in the diagrams that have some protection and/or restoration potential (especially for steelhead). This is an important factor in regards to life history diversity because it is an index of the streams that are either known to support the focal species or have the potential to do so. The more streams that show up the more widespread the actual or potential species distribution and the more diverse the population – a valuable trait given the volatile nature of the Hood River subbasin where a single flood event could conceivably wipe out one or several year classes in any given stream.

Figure 13 - Hood River Winter Steelhead
Relative Importance of Geographic Areas for Protection and Restoration Measures

Geographic Area	Protection benefit rank	Restoration benefit rank
East Fork Hood River	1	1
Mainstem Hood River	2	2
Middle Fork Hood River	2	3
Evans Creek	9	5
Green Point Creek	8	6
Cold Spring Creek	3	12
Robinhood Creek	7	8
Tony Creek	5	10
Neal Creek	12	4
Polallie Creek	6	11
Bear Creek	4	14
Baldwin Creek	16	7
Clear Branch	11	13
Dog River	9	18
Tieman Creek	18	9
Rogers Springs Creek	10	19
West Fork Hood River	15	14
Whiskey Creek	13	16
Crystal Spring Creek	14	17
Culvert Creek	17	14
Coe Branch	21	11
Lenz Creek	19	16
West Fork Neal Creek	20	15
Eliot Branch	22	18

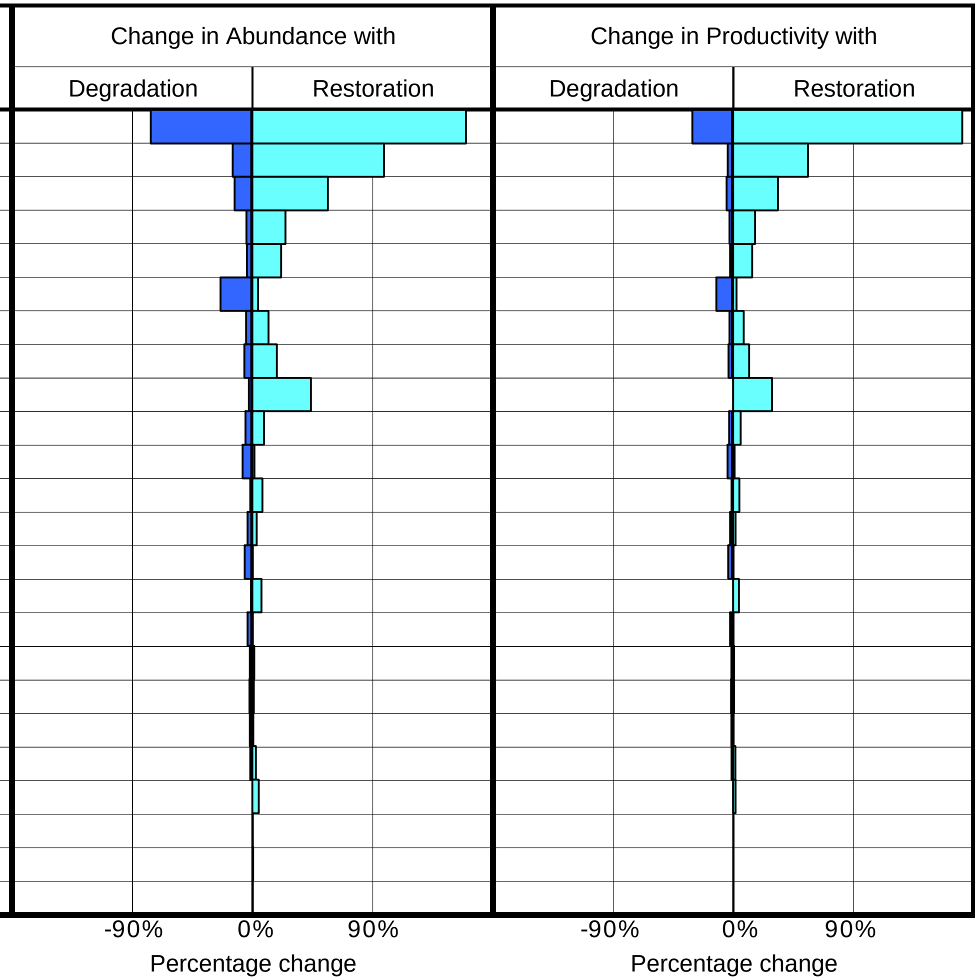


Figure 14- Hood River Summer Steelhead
Relative Importance of Geographic Areas for Protection and Restoration Measures

Geographic Area	Protection benefit rank	Restoration benefit rank
Lake Branch	1	2
West Fork Hood River	2	1
McGee Creek	3	3
Mainstem Hood River	6	2
Elk Creek	5	4
Jones Creek	4	6
Red Hill Creek	6	5
Divers Creek	7	7
Whiskey Creek	8	8

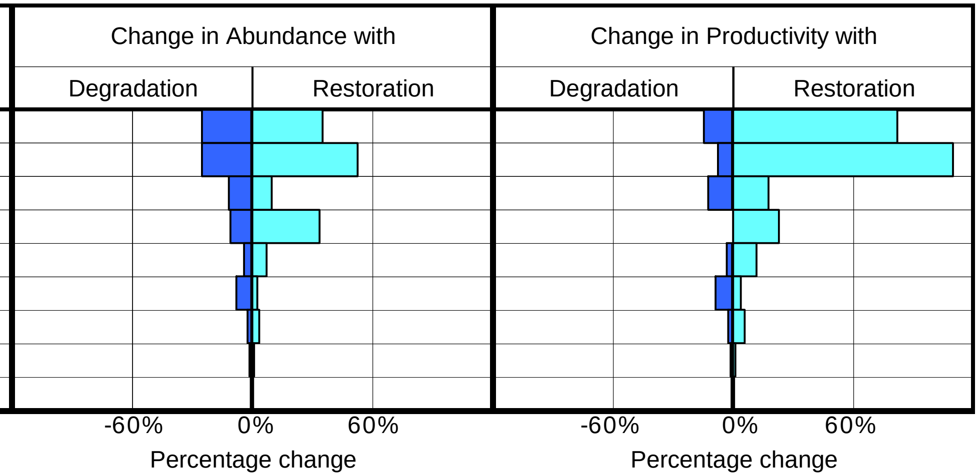


Figure 15- Hood River Spring Chinook
Relative Importance of Geographic Areas for Protection and Restoration Measures

Geographic Area	Protection benefit rank	Restoration benefit rank
West Fork Hood River	1	1
Mainstem Hood River	2	2
McGee Creek	3	3
Lake Branch	4	4
East Fork Hood River	7	3
Tony Creek	5	5
Middle Fork Hood River	6	6
Rogers Springs Creek	6	7

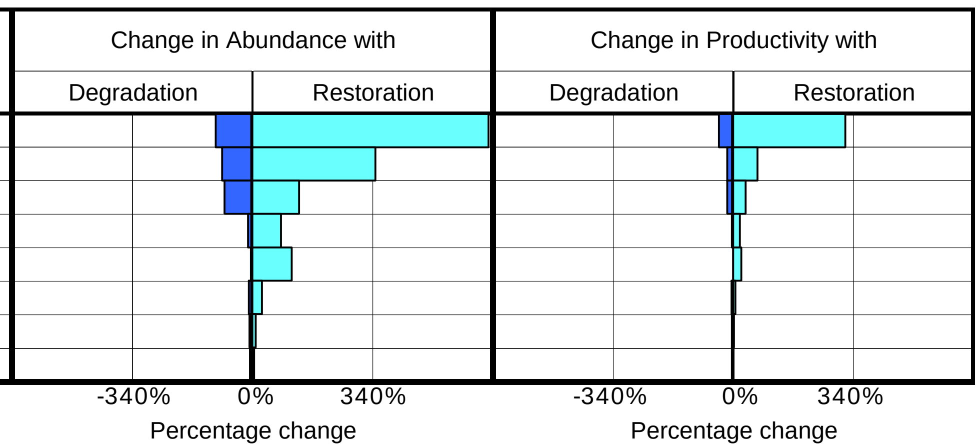
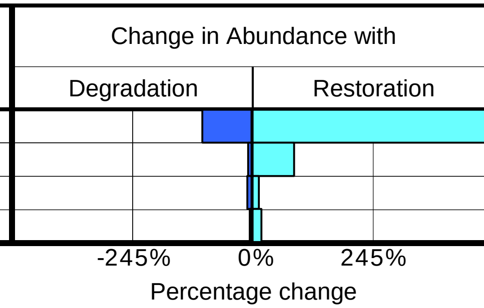


Figure 16 - Hood River Fall Chinook
Relative Importance of Geographic Areas for Protection and Restoration Measures

Geographic Area	Protection benefit rank	Restoration benefit rank
Mainstem Hood River	1	1
East Fork Hood River	3	2
Whiskey Creek	2	4
West Fork Hood River	4	3



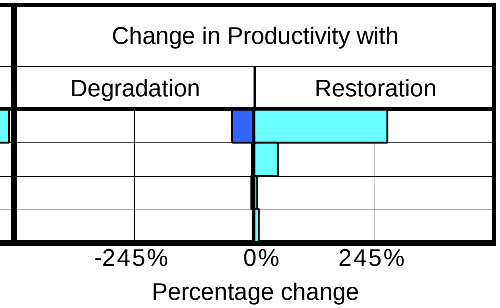


Fig. 17- Hood River Summer Steelhead Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability/landsc.1/***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
Divers Creek	○ (A)	○ (A)	● (C)				● (C)		● (C)									
Elk Creek	○ (A)	○ (A)	● (C)				● (C)		● (C)						● (B)			● (B)
Jones Creek	○ (A)	○ (A)					● (C)											● (B)
Lake Branch	○ (A)	○ (A)	● (B)				● (C)		● (C)						● (B)			● (B)
Mainstem Hood River	○ (A)	○ (A)	● (B)				● (C)		● (C)		● (B)				● (B)			● (B)
McGee Creek	○ (A)	○ (A)	● (C)				● (C)		● (C)						● (B)			● (B)
Red Hill Creek	○ (A)	○ (A)	● (C)				● (C)		● (C)						● (B)			● (B)
West Fork Hood River	○ (A)	○ (A)	● (B)				● (C)		● (C)						● (B)			● (B)
Whiskey Creek	○ (A)	○ (A)	● (C)	● (C)			● (C)		● (C)						● (B)			● (B)

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

	A	B	C
	○ / ● High	○ / ● Medium	○ / ● Low

Fig. 18- Hood River Winter Steelhead Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	*Channel stability/landsc.1/*	*Chemicals*	*Competition (w/ hatch)*	*Competition (other sp)*	*Flow*	*Food*	*Habitat diversity*	*Harassment/poaching*	*Obstructions*	*Oxygen*	*Pathogens*	*Predation*	*Sediment load*	*Temperature*	*Withdrawals*	*Key habitat quantity*
Baldwin Creek		○ A	● C	● C			● C	● C	● C	● C					● A			● B
Bear Creek	○ A	○ C	● C				● C		● C									● C
Clear Branch	○ C	○ C					● C		● C						● B			● B
Coe Branch		○ C	● B				● C				● A				● B			● B
Cold Spring Creek	○ A	○ C					● C		● C									
Crystal Spring Creek	○ C	○ C					● C								● B			
Culvert Creek		○ C					● C								● A			● B
Dog River	○ A	○ C					● C											● B
East Fork Hood River	○ A	○ A	● B				● C		● C						● B			● B
Eliot Branch		○ C	● B				● B		● C						● B			● B
Evans Creek	○ A	○ A	● C				● C		● C		● A				● A			● B
Green Point Creek	○ A	○ A	● B				● B		● B						● B			● B
Lenz Creek		○ C	● C	● B			● C		● C						● B			
Mainstem Hood River	○ A	○ A	● B				● C		● C		● B				● B			● B
Middle Fork Hood River	○ A	○ A	● B				● C		● C						● B			● B
Neal Creek	○ C	○ A	● C	● B			● C		● B	● C	● A				● B			● B
Polallie Creek	○ A	○ C	● C				● C		● C						● B			
Robinhood Creek	○ A	○ A	● C				● C		● C						● A			
Rogers Springs Creek	○ A																	● B
Tieman Creek		○ A	● C	● C			● C		● C						● A			● B
Tony Creek	○ A	○ A	● C				● C		● C		● A				● B			● B
West Fork Hood River	○ C	○ C	● C				● C		● C						● C			● C
West Fork Neal Creek		○ C	● C				● C		● C						● B			● A
Whiskey Creek	○ C	○ C	● C	● C			● C		● C						● B			● B

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C	
○ / ●	High	○ / ●	Medium	○ / ●	Low

Fig. 19- Hood River Spring Chinook Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration																
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability/landsc.1/***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
East Fork Hood River	◯	◯	●				•		●						●	•		●
Lake Branch	◯	◯	●				•		●						●	•		●
Mainstem Hood River	◯	◯	•				•		●		●				●			●
McGee Creek	◯	◯	•				•		●						●			●
Middle Fork Hood River	◯	◯	•				•		●						•			●
Rogers Springs Creek	◯	◯							•									●
Tony Creek	◯	◯	•				•		●						●			●
West Fork Hood River	◯	◯	●				•		●		•				●			●

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C	
◯ / ⬤	High	○ / ●	Medium	∘ / •	Low

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

Fig. 20- Hood River Fall Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority			Attribute class priority for restoration															
Geographic area	**Protection benefit**	**Restoration benefit**	***Channel stability/landsc.1/***	***Chemicals***	***Competition (w/ hatch)***	***Competition (other sp)***	***Flow***	***Food***	***Habitat diversity***	***Harassment/poaching***	***Obstructions***	***Oxygen***	***Pathogens***	***Predation***	***Sediment load***	***Temperature***	***Withdrawals***	***Key habitat quantity***
East Fork Hood River	○ (A)	○ (A)	● (B)				• (C)		● (B)						● (B)			● (B)
Mainstem Hood River	○ (A)	○ (A)	● (B)				● (B)		● (B)		● (B)				● (B)			● (B)
West Fork Hood River	○ (A)	○ (A)	● (B)				• (C)		● (B)						● (B)			● (B)
Whiskey Creek	○ (A)	○ (A)	• (C)	• (C)			• (C)		● (B)						● (B)			● (B)

Key to strategic priority (corresponding Benefit Category letter also shown)

A	B	C
○ / ● High	○ / ● Medium	○ / • Low

1/ "Channel stability" applies to freshwater areas; "channel landscape" applies to estuarine areas.

EDT RESTORATION SCENARIO SUMMARY

This section presents a summary of the results of 6 restoration scenarios tested using the EDT model in order to determine the relative benefits of different restoration actions for the focal populations. Each scenario addressed one or more limiting factors for the various species and life stages. A "full restoration build-out scenario" was included that combined all the major restoration actions identified and assumed their full implementation. Scenarios were based on EDT results for the baseline population and known limiting factors in the subbasin that have been documented by fishery managers. These scenarios included the following action

- Powerdale Dam Removal: This scenario modeled the removal of the dam and its effects on fish populations from both a flow restoration and fish passage improvement perspective. Passage survival was assumed to be 100% and flow was restored to 65-70% of the natural base level upon removal of the dam.
- Passage Obstruction Removal: Full passage restoration was modeled at irrigation diversions and culverts throughout the watershed except for Powerdale Dam. Culverts that were at the upper range of anadromy were not included, nor were natural barriers.
- Flow Restoration at 20%: Modeled the increase of low stream flows by reducing irrigation withdrawals by 20% at selected diversions, and also included flow benefits from Powerdale Dam removal. Twenty percent is a reasonable estimate of maximum water savings expected given current and future agricultural and hydropower demand. Municipal diversions were not included as these are expected to, at best, remain steady through a conservation effort, or increase due to increasing demand in the absence of a conservation program including rate reform.
- Flow Restoration at 10%: Same as above except irrigation withdrawals were reduced by 10% as opposed to 20%.
- Basin-wide LWD Addition: Modeled the restoration of large wood levels in and along streams to levels approximating the template condition. For the most part only depositional reaches where wood normally would have accumulated were modeled although a few other reaches with steeper gradients were included based on local professional experience.
- "Full Restoration Build Out": This scenario combined Powerdale Dam removal, passage obstruction removal, flow restoration at 20%, and basin-wide LWD addition. This scenario reflects anticipated improvements from basin-wide restoration.

The results of these model runs are summarized below. For details of the assumptions and methods used, please refer to Appendix B, *Hood River Basin EDT Actions and Scenarios.* For the future scenario spawner and juvenile outmigrant population performance reports, please refer to Appendix B, *Report 3*.

Not surprisingly the full build out scenario resulted in the largest increases in adult and smolt numbers, followed by LWD addition and Powerdale Dam removal (Tables 21 and 22). Addition of LWD was predicted to affect a wide variety of attributes across a widespread area in the subbasin. Since the positive effects were both widespread with a large degree of change the model predicted a corresponding large increase in population numbers, especially for spring chinook. Large wood should improve several conditions related to habitat diversity and key habitat quantity, both limiting factors that affected all focal species and most life stages. These are the changes that likely drove much of the increase in fish numbers. For spring chinook the creation of more pool habitat would do much to improve habitat conditions for both adults and juveniles. It is also worth noting that the LWD addition scenario resulted in the greatest improvement in life history diversity (loosely defined as the breadth of suitable habitat across the watershed) of the scenarios modeled except for the "full restoration build out" scenario.

Table 21. Current adult abundance (estimated by EDT) and the estimated percent increase in abundance for the 6 scenarios modeled for four focal species in the Hood River subbasin. The estimates assume no harvest outside the subbasin.

Population*	Current	Powerdale	Obstructions	Flow10%	Flow20%	LWD	Full
ChF	1,111	55%	0%	55%	57%	69%	140%
ChS	309	65%	5%	3%	4%	379%	493%
StS	1,495	10%	0%	2%	2%	38%	51%
StW	1,046	28%	3%	2%	3%	60%	104%

Table 22. Current juvenile outmigrant abundance (estimated by EDT) and the estimated percent increase in abundance for the 6 scenarios modeled for four focal species in the Hood River subbasin. The estimates assume no harvest outside the subbasin.

Population*	Current	Powerdale	Obstructions	Flow10%	Flow20%	LWD	Full
ChF	63,408	54%	0%	63%	65%	62%	130%
ChS	7,311	53%	4%	3%	4%	375%	435%
StS	47,411	4%	0%	1%	1%	39%	43%
StW	35,975	15%	1%	1%	2%	58%	81%

*ChF – Fall chinook
ChS – Spring chinook
StS – Summer steelhead
StW – Winter steelhead

Powerdale dam removal had mixed effects among focal species although all species responded favorably. Increases were much larger for chinook than steelhead. For fall chinook the increase in flow in the lower 4.5 miles of stream would greatly increase the amount of available spawning and rearing habitat and thus the model likely assumed an increase in fish numbers as well. For spring chinook the increase in numbers relates primarily to the fact that most of the smolt outmigration occurs in the fall when survival would be enhanced by both higher flows and the assumed 100% passage survival. Increased steelhead numbers were lower than anticipated but reflect primarily passage improvements for adults and juveniles as well as some increases in available habitat for various life stages and water quality improvements.

What was somewhat surprising was the small estimated increase in fish populations associated with flow restoration, with the exception of fall chinook. Both flow restoration scenarios included flow improvements as a result of Powerdale dam removal as the intent was to model improvements in flow across the entire watershed. Since fall chinook spawned and reared in the lower Hood River the benefits resulting from increased flows include increased available habitat and better water quality throughout the year. What is somewhat unclear is why flow increases did not have the same impact on steelhead, especially given that they are believed to spawn and rear below Powerdale Dam as well (spring chinook were the only focal species that did not have spawning habitat identified below Powerdale Dam). Further, the EDT predicted a lower benefit for flow restoration than a UCM life cycle model effort performed for the Hood River subbasin focal species, and, more significant, a regression analysis based on actual streamflow and fish data from the Hood River as part of the Hood River Production Program (E. Olsen, 2004).

The very small increase in numbers associated with obstruction removal besides Powerdale is not surprising. Most of these diversion or culverts are in smaller tributaries that have relatively low production potential compared with the mainstem forks. Since fewer fish use these tributaries to begin with the increase associated with improving passage is low. This is compounded by the fact that many of the barriers are located near the headwaters so the habitat gain is not great.

3.4.2. Terrestrial Environment - Population Relationships

A great deal more information is available for each of the wildlife focal species than the information that is presented here. Time and staffing limits has not allowed for more than a partial treatment of this section.

Important environmental factors for species survival

Black-tailed deer and elk: Winter range, summer range, and connectivity

Clark's nutcracker: The nutcracker is associated with old- growth white-bark pine and dependent on its pine cone seeds. It will undergo extensive movements when seeds are unavailable. There are declines in white-bark pine, especially in early succession, from fire suppression, replacement by competing conifers, lack of regenerating young trees, and more recently due to disease (white pine blister rust).

Lark sparrow: A balance between shrubs, grassland, and even some bare ground is a requirement for this species (Marshall et al., 2003). They are associated with oak savanna and oak-pine stands where fire is an integral part of the ecosystem

Northern spotted owl: Mixed-conifer forest cover types with late-succession structural characteristics (snags, coarse woody debris, and multiple vegetative layers) in large, contiguous blocks are critical to the spotted owl's successful reproduction and survival. Nests are on moss, mistletoe brooms, old nest platforms of other species, or in cavities.

Western gray squirrel: A combination of grasslands, wetlands, oak woodlands, and continuous cover in variable-aged conifer forests are all beneficial to this species by providing diversity in food sources, escape cover, and travel ways between stands. Fire is an integral part of the ecosystem for this species and helps control invasive plant species and retain native plant species (Ryan and Carey, 1995).

Long-term Viability Based on Habitat Availability and Condition

Northern Spotted Owl: The outlook for long-term viability for spotted owl in the subbasin is favorable based on habitat. Mature and old-growth forest is broadly distributed in contiguous blocks with an opportunity for nearly continuous occupation and population interactions by the spotted owl and its associated prey species. However, competition with the barred owl is a threat to this species.

Black Tailed Deer and Elk: Continued land development in winter range may limit the size of the population compared to current levels. Increasing year round recreation in the forest zone may affect deer populations. If these issues can be addressed, and habitat connectivity is retained to provide migration corridors, the outlook for this species is good because of its adaptability, and because of its status as a managed game species.

Lark Sparrow: Uncertain outlook due to limited habitat availability and future land development.

Western Gray Squirrel: Uncertain outlook due to limited habitat availability, lack of fire, encroachment of oak woodlands by Douglas fir, competition from non-native squirrels, and future land development.

Determination of Key Ecological Functions

A table is provided in Appendix C that identifies key ecological functions of the focal wildlife species. The table was generated by the NWHI for the focal species within the Columbia Gorge Ecological Province.

3.4.3. Selected Interspecies Relationships

Fish

Limited information exists in the subbasin to characterize the inter-species relationships among fish populations. Most cutthroat trout populations were located upstream of anadromous populations (BPA 1996), but do occur along with bull trout and rainbow trout or steelhead in several tributaries. Bull trout, cutthroat, rainbow trout, and smallmouth bass occur together in Laurance Lake reservoir. Snorkel surveys have found all of these species using the littoral zone at the same time (D. Morgan, USFS pers comm.). Steelhead juveniles have been observed to distribute themselves in different microhabitats than coho and chinook when these species are present (Everest and Chapman, 1972). Steelhead and salmon are known to be more aggressive and displace cutthroat to less preferred, i.e., higher elevation or higher gradient habitat areas. Interactions between young of the year cutthroat and steelhead in spring and early summer may limit the size of cutthroat populations in streams where they occur together (Trotter et al, 1993).

Wildlife

The barred owl competes with the spotted owl for nesting and foraging territory. The extent of competition between these two species in the watershed is not known in the subbasin, however, the number of barred owls in Oregon is reportedly rising.

Key Relationships Between Fish and Wildlife

Some of the key relationships between fish and wildlife include direct predator-prey relationships, similar food resources taken, and habitat developers. The beaver is a key player in developing pools used by fish, insects, amphibians, birds, and other mammals. Beaver ponds create diverse aquatic ecosystems including runways that are also used by black-tailed deer, aerating soils, creating standing dead trees and down logs (IBIS, 2004). Salmon and steelhead carcasses, steelhead and lamprey carcasses are known to provide food for a variety of wildlife both directly and as a source of nitrogen to riparian vegetation. Species noted as critically linked with fish on the IBIS system are provided in Appendix C.

3.5. Identification and Analysis of Limiting Factors/Conditions

3.5.1. Historic Factors for Decline of Focal Species and Ecosystem Function and Process - Aquatic

The EDT model results for the Hood River Subbasin suggest that the environmental attributes that have had the greatest effect on the focal species chinook and steelhead are channel stability, flow, habitat diversity, sediment load, and key habitat quantity. Obstructions were most important overall to winter steelhead, and a lessor factor for spring chinook and summer steelhead. In general, the EDT model results are consistent with earlier assessment results with regard to limiting factors. The principal historic factors identified in earlier assessment work believed to inhibit the focal species' populations were associated with historic forest management, agriculture, transportation, and land development activities (HRWG, 1999; USFS, 1999 a&b). These include:

- Impairment of upstream juvenile and adult fish passage at dams, water diversions, and road crossings;
- Inadequate or absent fish screens at water diversions;
- Streamflow reduction at irrigation and hydropower diversions;
- Water quality degradation including temperature, pesticides, sediment, nutrients;
- Reduced riparian-floodplain function and instream habitat diversity;
- Increased peak flows

We postulate that fish passage was not identified in the EDT as a higher priority restoration need for all species compared to prior assessments because a) bull trout were not modeled in the EDT and bull trout are severely impacted by Clear Branch Dam; and b) recently completed fish screens and other fish passage improvements were included as the current condition in the model. Pesticides and temperature were identified as by the EDT as influential limiting factors in certain tributary reaches, as expected by subbasin planners, but not as a subbbasin-wide limiting factor.

Factors limiting natural fish production focusing on steelhead and spring chinook were also identified in the recent HRPP Review which modeled subbasin habitat conditions. This review identified natural subbasin characteristics of turbidity, glacial fine sediment loads, rain on snow floods, cold rearing temperatures in the West Fork, and channel morphology as limiting natural production. Analysis of habitat data and UCM modeling showed that a lack of pool habitat, combined with low wood complexity, high fines, and high turbidity were key factors limiting freshwater capacity and survival. This analysis identified habitat restoration, water withdrawals, and fish screening and fish passage at diversions as priorities for restoration activities.

The single most important fisheries issue identified in the U.S. Forest Service watershed analysis for the Middle and East Forks of Hood River was the loss of large wood from streams, and the future large wood recruitment potential from the adjacent riparian areas (1996a).

Historic Factors Leading to Decline of Bull Trout

In general, the same factors and conditions discussed above have limited bull trout populations in the subbasin. However, dams and road density impacts may have had particularly severe effects on bull trout. Existing and abandoned dams have contributed to the reduced migration and isolation of bull trout and other species and are believed to be a major limiting factor (Buchanan et al. 1997). The Clear Branch Dam was constructed in 1969 without fish passage, inundating a mile of bull trout, coho, and steelhead spawning habitat (USFS 1996a). The dam isolates the upper 2.75 miles of the Clear Branch and all of Pinnacle Creek from the rest of the Hood River, forming a barrier between the Clear Branch Local Population and the Hood River Local Population. An upstream fish trap was installed in 1997 but has not yet functioned effectively. The dam outlet may entrain bull trout into the pressurized pipe system due to inadequate screening (Pribyl et al. 1996). The dam prevents natural movement of stream sediments important to maintain spawning habitat in lower Clear Branch and the Middle Fork Hood River. Reservoir impounded waters increase stream temperatures below the dam beyond those suitable for bull trout at certain times of the year (Buchanan et al., 1997). The Laurance Lake reservoir is currently is the subject of a thermal study.

Road density appears to be a limiting factor for bull trout. Road networks paralleling stream channels are commonly associated with increased sediment loading from gravel or native surface roads, intercepting surface and subsurface water flow and altering runoff patterns, and constraining stream channels from natural movement and adjustment patterns (USFWS, 2003). A landscape analysis correlating road density and population status among four non-andromous salmonid species indicated that increasing road densities had a strong negative correlation with the status of the species (Lee et al. 1997). In this analysis, bull trout were generally found to be absent where the mean road density of all upstream subwatersheds was 1.71 miles per square mile. These findings are highly consistent with those in the Hood River subbasin. The Pinnacle Creek Subwatershed encompasses the habitat of the Clear Branch Local Population of bull trout. Coincidentally, the Pinnacle Creek 6 HUC Subwatershed has the lowest mean road density of all Hood River subwatersheds at 1.3 miles per square mile, and provides the only known breeding habitat for bull trout in the Recovery Unit.

Conditions That Can be Corrected by Human Intervention

Human intervention can have a beneficial effect on most of the above factors by actions aimed at restoring natural physical and ecological functions and processes where it is possible and feasible to do so. Conditions likely to respond to human intervention include the active and passive restoration of riparian function including large woody debris supplies, restoration of streamflows closer to natural flow levels as opportunities allow, screening water diversions, removing culverts, enlarging or bridge replacement, enlargement or removal of culverts to allow passage of fish, water, sediment, wood and other organic matter. Enhancement of riparian areas, reduction in road densities in priority subwatersheds, removal of artificial sediment sources, moving roads or road segments out of floodplains can help correct some of the conditions mentioned above.

The spread of harmful invasive or noxious plants into natural areas can be prevented for species that have not yet gained a foothold in the watershed, and controlled in special habitat areas where infestation already occurs and control is determined to be important.

3.5.2. Historic Factors for Decline of Focus species/ecological function-process - Terrestrial

Deer and Elk: Limiting factors for deer and elk in the Hood Unit include conflicts with agricultural crops mainly fruit orchards, diminished wintering range due to encroachment of residential development and agriculture; harassment or disturbance due to increased use of humans on roads, bike trails (motorized and non-motorized), hiking trails and other backcountry uses (K. Kohl, ODFW, *pers. comm*).. The available winter range which is now mostly on and adjacent to private property has now reached capacity which will limit further increase in deer and elk numbers.

Clark's Nutcracker: The loss of white-bark pine stands in the alpine and subalpine elevations are the main limiting factor for this species. The causes of decline in white-bark pine are blister rust disease, and the absence of fire which has led to encroachment of white-bark pine stands by other conifer species.

Northern Spotted Owl: Habitat loss on non-federal lands and competition from the barred owl appear to be the major limiting factors for this species.

Gray Squirrel: Major limiting factors for these species include the absence of fire leading to encroachment of oak stands by Douglas fir, habitat loss, and competition from non-native squirrels.

Conditions That Can Be Corrected by Human Intervention

The needs of wildlife in terms of wildlife corridors, habitat connectivity, and access to winter range, can be determined and actions taken to insure that big game movements and dispersal of other wildlife can occur in the future. The spatial and temporal needs of wildlife in shoreline and forest areas can be better understood so that actions are taken to insure that increasing recreation and development does not limit use of available habitats or interfere with breeding. Fire fuels reduction plans in the urban interface area can beneficially integrate the need for wildlife habitat diversity, and mimic some of the results of natural fire processes. Further losses of winter range, which include habitats for lark sparrow and gray squirrel, can be prevented or minimized.

3.6. Synthesis and Interpretation

3.6.1. Subbasin-wide Working Hypothesis – Aquatic

Overall Working Hypothesis: ***Chronic habitat disturbances have intensified and prolonged the effects of frequent natural disturbances leading to fish population declines. Removing or minimizing these chronic disturbances can lead to population recovery.*** We hypothesize that the populations have not naturally recovered in the last century to historic abundance because chronic anthropogenic habitat disturbances have occurred on top of the short-term impacts of natural events – contributing to a persistent decline in the abundance and productivity of the focal fish species. Chronic human disturbances have included unscreened and inadequately screened water diversions, fish passage barriers, flow depletions, decreased stream habitat complexity and floodplain interactions due to past riparian harvest, removal of LWD, transportation and land use-related channel modifications, and water quality impairment. The release of hatchery fish from non-native domesticated hatchery stocks has led to lower reproductive success and other genetic changes in some stocks.

<u>Evidence for Hypothesis</u> The Hood River is a dynamic environment in which fish population abundance is naturally variable over time and fluctuates in response to large-scale natural disturbances such as droughts, floods, and debris flows originating on Mt. Hood. Natural mass wasting events may cause direct losses of multiple age classes of fish, as well as create adverse habitat conditions over periods of weeks, months, or years. Impacts can be restricted to local areas or affect large portions of the subbasin. In the absence of chronic environmental disturbances, the depression in populations from natural events is temporary and is followed by increased abundance levels as fluvial processes re-create high quality habitat. Artificial channel confinement in the East Fork Hood River from highway fill and revetments, and narrow bridge spans encroach heavily into the floodplain and restrict channel development and habitat recovery after debris flows and floods. Periodically, natural dams created by moraines at receding glaciers on Mt. Hood break causing floods and debris flows. Landslides originating on the slopes of Mt Hood are common. Ladd, Coe, Pollalie, Eliot, Clark and Newton Creeks have a history of these events, which can be triggered by intense rainstorms. On December 25, 1980, a landslide and massive debris dam break in Pollalie Creek caused one fatality, obliterated sections of Highway 35, and damaged the East Fork Hood River for miles. Effects of the 1980 flood on the East Fork channel are still readily observed. A major washout in Ladd Creek occurred September 1, 1961. Newton Creek experienced a similar event in November 1991. A large mudflow in Eliot Branch occurred Thanksgiving 1999, wiping out a bridge and a diversion dam. The most recent event was the massive Newton Creek debris flow on September 30, 2000, which resulted from the failure of pyroclastic sediments on Mt Hood at the foot of the Newton Glacier. This event carried large volumes of sand and sediment all the way to the Hood River delta with sand movement and turbidity lasting for several months. A wide range of adult

returns have occurred over the last 10 year period. The subbasin experienced drought in 1987,1992,1994, and 2001 and 2003.

Working Hypothesis A: *The scheduled dam removal at the Powerdale Hydroelectric Project, and restoration of physical habitat connectivity for adult and juvenile life stages at other dams and diversions will substantially increase the survival of focal species in the Hood River.*

Evidence for Hypothesis A: The benefits of adding fish screens at major diversion sites were evaluated in the recent HRPP Review (Underwood, K. D. et al, 2003) by estimating the number of mortalities that were prevented with screens of various efficiencies. Estimates of entrainment (fish loss) at Powerdale Dam indicated that up to 85,000 wild and hatchery juvenile steelhead and spring Chinook would be lost if there were no screen at the diversion. Screens of progressive efficiencies in increments of 20% decreased the number of lost juveniles by 17,000. The number of juveniles lost in each group (origin, life stage, or species) was relative to their abundance passing the diversions. Losses were highest among hatchery spring Chinook smolts, with significant losses also occurring among hatchery and wild steelhead smolts. Entrainment losses at the East Fork Irrigation Diversion were comprised solely of wild steelhead juveniles. Under a no screening scenario, an estimated 7,200 wild steelhead juveniles were lost each year. Increased screen efficiencies of 20% decreased entrainment by 1,400 steelhead at each level of efficiency. Many of those lost were steelhead fry. Losses from entrainment at the Dee Irrigation Diversion were relatively minor with an estimated 86 juveniles lost annually. Diversions at the Farmers Irrigation Diversion were estimated to loose approximately 13,000 juveniles under no screen conditions. Additions of screens with increments of 20% efficiency decreased the loss by 2,600 juveniles for each increment. The removal of the dam and Powerdale Hydropower Project decommissioning is scheduled for June 2010. It is assumed that this action will greatly improve the potential for sustainability for Hood River fish populations. At that time, the dam will be completely removed and the dam site restored to its pre-dam morphology, eliminating a significant source of mortality and impact to downstream migrants affecting the entire subbasin. The 500 c.f.s. hydroelectric water right will be transferred back instream consistent with state statutes. After dam removal in 2010, the cessation of sediment sluicing into the bypass reach, elimination of impacts including the delay and pre-spawning mortality associated with adult passage at the fish ladder, improved passage and reduced predation associated with low bypass reach flows, entrainment of fry and fingerlings into the power canal, and elimination of any pre-spawning mortality or reduced reproductive success are expected to contribute to an increase in focal species abundance in the Hood River.

Working Hypothesis B: Flow restoration at Powerdale and below major irrigation diversions will increase the survival and production of the focal species in the Hood River.

Evidence for Hypothesis B: A regression analysis based on empirical data collected in the HRPP M& E program found a strong positive relationship (R-squared = 0.69) between mean summer and early fall streamflow in the Hood River and the production of age 2 steelhead smolts (Figure 21). The HRPP Program Review recommended flow restoration as a habitat priority in the subbasin based on a modeling estimate of a 10,000 to 20,000 increase in summer and winter steelhead parr (3,500 to 7,000 smolts at 35% parr-to-smolt survival) and 7,500-12,500 increase in spring chinook parr (or 2625 to 4375 smolts) in the subbasin by restoring 10 c.f.s. of streamflow at each major irrigation diversion and 250 c.f.s. at below Powerdale Dam. While the modelers cautioned that given the methods used, these estimates of increased rearing capacity were likely inaccurate, but were useful as an order of magnitude reference for flow restoration benefits (Underwood, K.D. et al, 2003). The EDT model scenario returning stream flow found only a small benefit to flow restoration except for a 65% increase in juvenile outmigrant abundance for fall chinook.

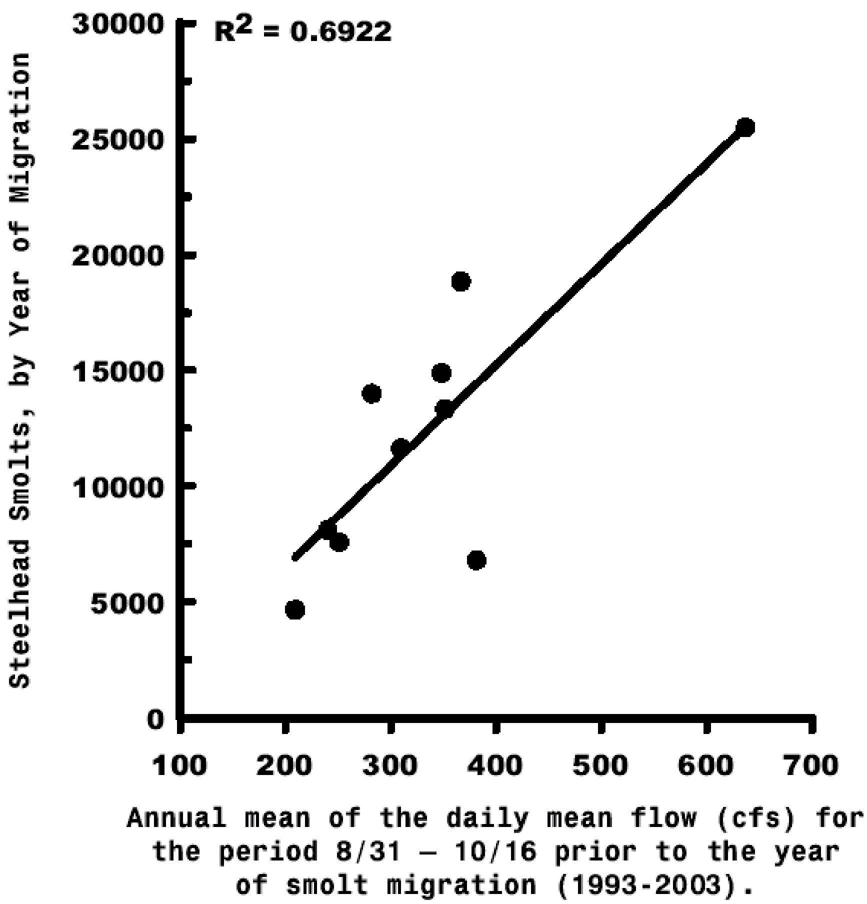


Figure 21. Number of steelhead smolts versus streamflow at Tucker Bridge during late summer and early fall rearing in the year prior to outmigration (E. Olsen, 2004, unpub)

Working Hypothesis C*: Restoration of habitat diversity and improving floodplain-riparian function will increase focal species abundance by increasing channel stability and the amount of key habitats and habitat complexity available for focal species life stages including pools, spawning gravels, and slow water lateral habitats.*

Evidence for Hypothesis C: Most channels in the Hood River are lacking in pools, LWD, backwaters, side channels and habitat diversity as a result of past timber management practices and in some cases, artificial channel confinement, or natural geomorphology. The EDT model results indicated that habitat diversity and key habitat quantity was particularly important for spring and fall chinook. Mature riparian forests, large woody debris in channels and riparian areas, and high levels of floodplain interaction promote increased habitat diversity and development of key habitat areas. Channel stability affected all focal species from the egg incubation life stage through juvenile rearing. Channel stability is tied primarily to the bed scour attribute – the more bed scour the larger the effect on the various life stages for each focal species. The most deleterious effect appeared to be during the egg incubation stage with moderate effects on the fry colonization and inactive rearing (i.e. overwintering) stages. High levels of bed scour are not surprising given the glacial nature of the major tributaries where most spawning occurs, a flashy hydrograph, and frequent rain on snow events. However, area managers do believe that past land management has led to increases in channel instability and bed scour (e.g., USFS 1996a; 1996b). Timber harvest and roads have likely increased the flashiness of the system and the frequency and occurrence of peak flows. Historic large woody debris is believed to have moderated the effects of small to medium sized peak flows (USFS 1996a; 1996b). Historic levels of large wood created backwater and other lateral flood refuge areas, as well promoted gravel retention and stability in smaller events. The EDT model predicted increases in smolt abundance from 39% and 58% for summer and winter steelhead to 62% and 375% for spring chinook, respectively.

3.6.2. Subbasin-wide Working Hypotheses - Terrestrial

Hypotheses: Preventing further losses of big game winter range, which include oak and grassland habitats for lark sparrow and gray squirrel is important to maintaining the health and persistence of these focal species. Support for this hypothesis is derived from the fact that a large percentage of winter range is already lost, and oak and grassland habitats are geographically limited at risk and at risk of degradation and/or loss due to development or other impacts. If prescribed fire is unsafe or infeasible, then efforts to control Douglas fir and other plant invasions into oak stands will reduce competition for water and nutrients, improving the survival and health of remaining oak stands, and hence benefiting gray squirrel in terms of acorn production. The needs of wildlife in terms of wildlife corridors, habitat connectivity, and winter range, summer range, and access to winter range, can be determined and actions taken to insure that big game movements and dispersal of other wildlife can occur in the future.

The spatial and temporal needs of wildlife in shoreline and forest areas can be better understood so that actions are taken to insure that increasing recreation and development does not limit use of available habitats or interfere with breeding. Fire fuels reduction plans in the urban interface area can beneficially integrate the need for wildlife habitat diversity, and mimic some of the results of natural fire processes.

3.6.3. Desired Future Conditions – Aquatic

In general terms, desired future conditions are those that will ensure the maintenance of biological diversity and sustainability of harvestable natural resources (FEMAT 1993). In this desired future condition, the development and distribution of a diversity of aquatic and riparian habitats generated by natural processes that meet adapted life history requirements. Natural disturbances, e.g., floods and debris flows, are an important part of the ecology of PNW watersheds. They create and maintain diverse aquatic environments to which salmonids and other native fish have adapted over time (Bisson, PA et a.1997).

The desired future condition for the Hood River subbasin is one where the dynamic natural cycles of disturbance and recovery are allowed to occur as naturally as possible. In the desired future habitat condition, riparian and instream recovery processes involving the transfer of sediment, wood and organic matter between terrestrial and aquatic habitats are not altered or are only minimally impeded by artificial structures or maintenance activities. Specifically, stream channels are fully able to interact with and connect to their floodplains, and the adjacent riparian forest has a natural distribution of vegetation age and type, and the periodic input, movement and deposition of coarse sediment and organic material occurs at natural rates, streamflow regimes are as natural as possible, and wherever possible, beaver activity is allowed to occur. (Naiman et al, 1992, Stanford and Ward 1992). Channels are moving towards historical levels of large woody debris and increased habitat diversity and complexity.

Achievement of these desired future conditions is not possible everywhere the subbasin because of existing land use or because of natural geomorphic constraints. However, opportunities may exist to make land use or management activities more compatible with natural disturbances or processes to the extent possible. For example, stream flows can be restored by ditch conversion and other activities, culverts enlarged or replaced with bridges to allow water, sediment and debris to flow more freely under road crossings, riparian vegetation can be protected and enhanced, road densities can be reduced in some areas, and it may be possible in some locations to remove road fill out of stream channels or floodplains.

Population objectives for steelhead are to maintain the abundance and life history diversity to withstand dynamic events. A wide range in carrying capacity reflects the variation in habitat productivity, and the ability of the population to withstand or cope with natural events.

3.6.4. Desired Future Conditions – Terrestrial

In general terms, the desired future conditions for wildlife habitat in the subbasin include retention of winter range, including cover types such as interior grasslands and pine-oak woodlands, and connectivity across cover types. The desired future condition is for greater connectivity of forest stands across cover types, and the minimization or control of invasive plants in important habitat areas. The desired future condition includes the retention and enhancement of snags and other important natural habitat structural elements on all cover types, and the reintroduction of fire where feasible and safe, or the ability to manage forest cover types to mimic some of the effects of fire consistent with fuels treatment and forest disease treatment approaches.

3.6.5. Opportunities

Note: Opportunities are explained in greater detail in the Hood River Management Plan, Chapter 5.

Westside oak and dry Douglas fir, interior grasslands, and ponderosa pine dominant forests. Much of this is winter range for big game as well as habitat for western gray squirrel and lark sparrow. Opportunities exist to acquire lands, conservation easements, or promote development standards that are effective in preventing additional losses of important habitat areas for wildlife.

Opportunities exist to acquire or purchase easement or other approaches to maintain the existing lower mid elevation east-west migration corridor from the Neal Creek drainage through middle mountain to the Green Point drainage, and the existing corridor from the whiskey creek drainage (and north to the Old Columbia Highway) west to the Hood River canyon.

Habitats that are currently in good condition and are used by focal species should be the priority for protection. An example is the West Fork Hood River which includes important spawning reaches for summer steelhead and spring chinook that are geographically limited and vulnerable to disturbance.

Habitat restoration needs and opportunities for the Hood River Subbasin have been discussed in earlier sections, many are identified in the 2002 Hood River Watershed Action Plan, which is available at http://www.oweb.state.or.us/publications/ws_assessments, and will be summarized in the Management Plan for the Hood River Subbasin.