TUCANNON ECOSYSTEM ANALYSIS

Umatilla National Forest
Pomeroy Ranger District

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INTRODUCTION

Document Purpose

Ecosystem Analysis at the Watershed Scale is the process used by the Umatilla National Forest to characterize the historic and current biotic and abiotic conditions for individual watersheds. It is a systematic way of organizing ecosystem information to better understand the impact of management activities and disturbance processes within a watershed. The understanding gained from ecosystem analysis is critical for helping to sustain the health and resilience of natural resources administered on behalf of the American people (Regional Ecosystem Office 1995).

This document presents the results of the Tucannon Ecosystem Analysis. The purpose of the analysis was to collect, analyze and synthesize existing information about the Tucannon watershed to: 1) provide a picture of historic and current watershed conditions; 2) determine what changes have occurred since the arrival of Euro-Americans and how those changes have affected ecosystem sustainability; and 3) to determine what activities could or should be undertaken in order to restore ecosystem function and resiliency in these particular watersheds.

Document Organization

This document contains four major sections. Section 1 provides a brief overview and characterization of the watershed and highlights special features that may occur within specific subwatersheds. Section 2 identifies issues and key questions, especially in relation to management. Section 3 summarizes current and reference conditions and consists of 7 chapters from individual specialists where detailed information is presented on current conditions of major resources, based on analysis of quantitative and qualitative data, and professional experience. Reference conditions are taken from old maps, historical society information, early Forest Service records, old journals, and oral histories. The document concludes with Section 4, where recommendations for management, both at the subwatershed and watershed level, are described.

The document addresses primarily Umatilla National Forest lands within the watershed. The primary exception is the aquatics analysis, which was based heavily on an extensive subbasin summary of the entire Tucannon subbasin completed by the Northwest Power Planning Council (Gephart and Nordheim 2001). This report provided an excellent characterization of the subbasin, and an in-depth analysis of aquatic resources and a significant portion of the aquatics report in this documents uses this material to analyze the aquatic resources in the entire Tucannon watershed.

(footnote to first page Editors note: In order to include color maps and selected color figures with the Tucannon ecosystem analysis, we created a separate map appendix. Color maps are referenced to the Map Appendix).

Summary of Findings

The following summary of findings pertains primarily to the Umatilla National Forest portion of the Tucannon watershed. Exceptions are noted in the text. Significant findings in this analysis include the following:

Upland Forest Vegetation

- Moderate to high levels of forest damage from tussock moth occurred in the Tucannon watershed during the late 1980s and the early 1990s, primarily from bark beetles and tussock moth.
- Fifty-five percent of upland forest in the Tucannon watershed has forest tree densities that exceed the recommended levels.
- Substantial reductions in the area of early-seral species (particularly ponderosa pine) have contributed to declining vegetation diversity in the Tucannon watershed since 1935.
- Several analysis indicators show that dry-forest sites in the Tucannon watershed currently have conditions that are inconsistent with high levels of ecosystem integrity and resilience (e.g., multi-layered rather than single-layer stand structures; late-seral rather than early-seral tree species).
- Wildfire risks are severe in a significant portion of the watershed
- Encroaching vegetation due to fire suppression has significantly reduced a large grass/shrub component of the watershed.

Aquatic Resources

- The Tucannon River has become wide and shallow, causing increased exposure of water surface to solar radiation and high summer air temperatures.
- Large woody material is lacking in stream channels and on streambanks. Large woody materialis important for pool formation and fish cover. The majority of the deficiencies are on non-Federal lands.
- The stream has been shortened from a meandering river, narrow and deep channel to a straighter, sometimes braided and/or wider and shallower channel, with an overall increased water velocity. These changes have resulted in the loss of quality fish habitat.
- Streambank stability has been diminished due to the loss of root systems of woody material growing on the streambank and an increase in streambank erosion.
- Fish habitat below the Forest boundary has been degraded as a result of farming, grazing, logging, road development, concentrated recreation, and catastrophic floods, which have occurred with greater frequency in recent years.

Hydrology

- Roads continue to contribute sediment and create some channel instability.
- Water quality varies across the analysis area and is generally good in headwater streams and wilderness areas.
- The larger valleys with roads and other development lack streamside shade, stable streambanks, and diverse riparian vegetation communities. The majority of the deficiencies are on non-Federal lands.
- Stream temperatures are borderline in meeting state standards. Fine sediment may be elevated above background conditions.
- Bacteria levels are a concern on Pataha Creek, primarily on non-Federal lands. .
- Water quality is regulated by the State of Washington by: beneficial use, water body classification, water quality criteria, and identification of impaired water bodies (Table 3-1).

- Streams on the National Forest are generally classified as Class AA (excellent).
- Water quality criteria of primary concern in the analysis area (assigned by beneficial use and classification) include fecal coliform organisms, dissolved oxygen, temperature, pH, and turbidity. The majority of the problems are on non-federal lands.
- The following streams are on the state 303(d) list of impaired water bodies: Pataha Creek for fecal coliform bacteria, and the Tucannon River for fecal coliform bacteria and temperature. This designation pertains to all stream segments.
- TMDLs are not scheduled at this time; the state has other priority watersheds for TMDL development in the main Snake River and Walla Walla subbasins.

Noxious weeds

- Twelve invasive weed species are present on Forest Service lands in the Tucannon watershed. Of greatest concern are the 17 yellow starthistle sites, the 132 spotted/diffuse knapweed sites, and the 4 sites infested by tansy ragwort.
- Roads are a significant vector for the dispersal of noxious weeds.

Botanical Resources

- Approximately 83 percent of the Tucannon watershed has been surveyed for sensitive plants.
- The clustered lady slipper is the only species on the Forest Sensitive Plant list that is found within the Tucannon watershed. Additional surveys could locate additional species.
- The Tucannon watershed contains about 67 percent of all plant taxa currently found on the Pomeroy Ranger District and 46 percent of all plant taxa currently identified on the Umatilla National Forest.

Heritage Resources

- A total of 173 historic properties have been located, for an approximate ratio of one property for every 461 acres. This site ratio is slightly higher than other areas of the northern Blue Mountains with similar diverse topographic conditions.

Terrestrial Vertebrates

- Some 192 terrestrial vertebrates species have the potential to occur in the area including 123 birds, 56 mammals, 8 reptiles, and 5 amphibians. In terms of relative abundance, 88 species are common, 91 uncommon, and 13 are rare.
- There are 5 Forest Plan management indicator species or groups, 1 endangered, 2 threatened species, 1 candidate species, and 6 Regional Foresters' sensitive species. There are 2 endangered, 2 threatened, and 13 State candidate species that are on the Washington State list that have the potential to occur in the watershed.
- There are numerous species of "interest" or "concern to the public, groups, or organizations that could occur in the watershed.
- In terms of habitat, the total amount of late-old structure is below "desirable levels" for terrestrial wildlife in the watershed.

- Patch size and arrangement of old forest stands has changed from historic conditions. The majority of change is attributed to harvest and fire suppression since the 1940's.
- Restoration should focus on maintaining current late old structure (LOS) levels, expanding the size of old forest patches, and increasing LOS in deficient PAG.
- There have been significant adverse impacts to riparian, wetland, and aspen communities from elk and livestock utilization, invasive conifers, recreation, and fire suppression in the watershed for the last 60 years.
- Snag densities and green replacement trees far exceed Forest Plan standards at the watershed scale. With the "high" tree mortality in the watershed, there is high likelihood that downwood densities will soon be at adequate levels at the watershed scale.
- While snag and green-replacement tree densities may appear to be above standards and guidelines across the watershed, densities may be far below standards in many site-specific locations and at the project level.
- Acres of elk forage has increased approximately 6 percent when compared to 1935. The forage component appears to be plentiful in the summer but limited in the winter because of the moderate amount of winter range available in the analysis area. Prescribed burning should be performed periodically to maintain forage quality, and reduce foraging impacts on private lands.

KEY QUESTIONS AND ISSUES

Overview

Identification of issues and key questions is the second step in the six-step process for ecosystem analysis at the watershed scale. The purpose of this step is to focus the analysis on key elements of the ecosystem that are most relevant to the management questions and objectives, human values, or resource conditions within the watershed. Key questions are formulated from indicators commonly used to measure or interpret the key ecosystem elements (Regional Ecosystem Office 1995). Key questions were used to focus the analysis. The Federal Guide stresses that watershed analysis is an informational undertaking, not a decision process (Federal Guide for Watershed Analysis 1995).

Development of issues in this analysis was guided by input from the Pomeroy Ranger District and Forest staff (see Appendix A). Additional issues were developed by the Watershed Analysis team based on preliminary field review, overview of GIS information and further conversation with District personnel. “Issues” concerning related topics were ultimately combined into larger groupings to facilitate a more streamlined analysis process. These groupings include: hydrology, aquatic habitat and fisheries, upland forests, botanical resources, heritage resources, terrestrial vertebrates, and noxious weeds. An important factor in the analysis process was the considerable amount of overlap and interplay among issues that were generally considered singly, according to the “dominant” discipline involved. For example, the condition of riparian habitat, addressed under the Hydrology, Aquatic Habitat and Fisheries analysis, has obvious importance for terrestrial plants and animals as well.

Hydrology

The upper Tucannon and Pataha watersheds are major source areas for downstream water supplies. Streams, floodplains, and riparian areas within these watersheds buffer water quality, provide water storage functions, and offer essential habitat for fish and wildlife (including endangered salmon in the Tucannon River). Concerns include: maintaining and improving adequate water supplies, maintaining and restoring water quality, and improving overall conditions of streams, floodplains, and riparian ecosystems.

Information provided in this report will **supplement** information available in the **Draft Tucannon Subbasin Summary, (August 3, 2001)** prepared for the Northwest Power Planning Council (citation).

Key Questions:

- *What are the principle physical characteristics of the upper Tucannon and Pataha watersheds and how are they related to erosion processes, stream conditions, and water quality? Where and to what extent have land uses altered erosion rates, channel processes and water quality?*

- *What are the existing water temperature and instream sediment conditions in the upper Tucannon River and Pataha Creek and major tributaries? What are the current levels of bacteria in upper Pataha Creek?*
- *What are the current and potential distributions of riparian vegetation and stream channel types?*
- *What are the general goals for managing multi-ownership lands in the upper mainstem Tucannon River corridor and what tools are available to reconcile conflicting uses? What management actions should be taken to meet common objectives and reconcile differences?*

Aquatics

The contemporary character of the fish habitat in the Tucannon drainage has been shaped through natural disturbance and human use of the land and water. Road building and maintenance, urban and agricultural development, rural development, grazing, tilling, deforestation, water regulation, and flood control structures have combined to alter vegetation, soil properties, topography, runoff, water temperatures, instream flows, and sedimentation. Changes to the watershed processes have yielded a mosaic of aquatic habitat ranging from high quality in the headwaters to severely degraded lower in the drainage. The most severely degraded fish and wildlife habitat areas tend to be below the Forest boundary in the lower portions of the Tucannon and Pataha watersheds where most development and human alteration of the landscape has occurred

Key Questions:

- *What is the current status of fish populations*
- *How have recent hydrologic disturbances affected instream aquatic habitat*
- *What are the major factors limiting fish habitat*

Upland Forest Vegetation

Over the last 30 years, Blue Mountains forests have experienced increasing levels of damage from wildfire, insects, and diseases. Scientific assessments and studies have documented the high damage levels and speculated about their underlying causes (Caraher and others 1992, Gast and others 1991, Lehmkuhl and others 1994, Powell 1994, Shlisky 1994). Partly in response to the scientific assessments, the Blue Mountains area gained national notoriety for its forest health problems (Boise Cascade Corporation 1992, Joseph and others 1991, Lucas 1992, McLean 1992, Petersen 1992, Phillips 1995, Wickman 1992). In response to high levels of concern about forest health, both from the scientific community and the general public, the primary issue used in this analysis of upland forests was forest sustainability. Forest sustainability is defined as an ecosystem-oriented approach that allows the utilization of forests for multiple purposes (e.g., biodiversity, timber harvesting, non-wood products, soil and water conservation, tourism and recreation) without undermining their availability and quality for present and future generations (Gardner-Outlaw and Engelman 1999). This means that sustainable forests contain insects, diseases and other tree-killing agents, but not to the extent that they jeopardize the long-term integrity, resiliency, and productive capacity of the forest.

Key Questions:

- *How do current forest conditions compare to those that existed historically?*
- *Are current forest conditions considered to be ecologically sustainable over the long term?*
- *If current forest conditions are considered to be unsustainable, how could they be changed in order to create a more sustainable situation?*
- *How have disturbance processes shaped existing forest conditions, and what role might we expect them to play in the future?*

Wildfire Risk

The risk of severe wildfire and associated negative resource effects is a significant problem throughout the Blue Mountains. Past management practices have contributed to live and dead fuel accumulations that well exceed typical conditions in Blue Mountain forests. The primary issue centers on how to mange these fuel accumulations within budgetary and other resource constraints.

Key Questions:

- *What are the current fuel profiles in the watersheds? Have these significantly increased the risk to habitats and water quality? How has this affected our ability to successfully manage wildland fire safely at the least cost?*
- *Can we continue to maintain, preserve and protect the natural resources in the watersheds and meet the goals of the Umatilla National Forest Plan? Can we restore the resilience to the ecosystems? What management practice should be employed to meet the expectations of the Umatilla National Forest Plan?*

Botanical Resources

The primary issue with botanical resources in the Tucannon watershed is continuation of the sensitive plant monitoring and surveying programs. These programs are designed over the long-run to address the key questions below.

Key Questions:

- *What vascular plant species presently occur in the Tucannon analysis area? How does this compare with historic plant community composition?*
- *What is the floristic richness of the Tucannon analysis area in comparison with the rest of the Pomeroy Ranger District, and within the Umatilla National Forest?*
- *How have disturbance processes shaped existing floristic conditions, and what role might we expect them to play in the future?*
- *What are the occurrences of historically-listed or presently-listed sensitive plant species within the analysis area?*
- *What activities occurring in the analysis area affect plant species that have historically been considered sensitive?*
- *What other plant species might be "at risk" in the analysis area?*

- *What are the culturally significant plant species in the analysis area? Are any of them "at risk" because of management activities (including fire suppression)?*
- *What plant species may come under harvesting pressure as "special forest products"?*
- *What native plant species could be important for revegetation/resoration projects within the watershed?*

Noxious weeds

Twelve invasive weed species are present on Forest Service lands in the Tucannon watershed, including diffuse and spotted knapweed, yellow starthistle, Canada thistle, bull thistle, Russian thistle, Scotch thistle, hound's tongue, Scotch broom, toadflax, Klamath weed (St. John's wort), and tansy ragwort. Of greatest concern are the 17 yellow starthistle sites, the 132 spotted/diffuse knapweed sites, and the 4 sites infested by tansy ragwort.

Key Questions:

- *What noxious weeds occur in the analysis area, and what are their affinities for ecological settings?*
- *What activities affect the spread and/or distribution of noxious weeds, and what can be done to mitigate spread?*

Vertebrates

The primary issues and concerns for terrestrial vertebrates include maintaining and enhancing late and old structure forests (LOS) and wetland and riparian habitats in the watershed. Habitat for big game winter range, bighorn sheep habitat, and snags and downwood are also of concern. The habitat needs for land birds in the watershed also need to be assessed.

Key Questions:

Habitat

- *How have habitat types and forest structure changed over the last 67 years (1935-present)?*
- *What is the existing habitat condition in the watershed?*
- *How have size and distribution of habitats changed in the watershed?*
- *How has late and old structure changed over the last 67 years?*
- *How are patches of existing late-old forest distributed across the landscape?*

Species

- *What is the species composition in the watershed?*
- *How has habitat availability for Management Indicator Species (MIS) changed, when compared to 1935?*
- *What TE&S species have the potential to occur in the analysis area?*
- *What is the existing habitat condition for species of "concern" or "interest?"*
- *What is the status of neo-tropical migratory bird?*
- *What is the current condition of bighorn sheep habitat and population trends in the watershed?*

SITE CHARACTERIZATION

Characterization is the first step in a six-step process for Ecosystem Analysis at the Watershed Scale (Regional Ecosystem Office 1995). The purpose of Characterization is to identify the dominant physical, biological, and human processes or features of the watershed that affect ecosystem functions and conditions. Relationships between ecosystem elements and those occurring in the river basin or province are identified. The land management objectives and regulatory constraints that influence resource management in the watershed are also discussed.

Previous watershed analyses completed on the Umatilla National Forest contained extensive site characterization materials. After reviewing these reports it was concluded that the site characterization section was largely redundant with and the description of current and reference conditions later in the report. Hence the site characterization section has been reduced in length and material, and written to emphasize details that are not included in the analyses of individual specialists.

Extensive descriptions of the location and setting of the Tucannon subbasin can be found in Gephart and Nordheim (2001) and much of the following description was obtained from this report. The reader is referred to this subbasin assessment for more extensive characterization of the Tucannon subwatershed.

Location and Physiographic Setting

The Tucannon River subbasin covers about 322,000 acres of Garfield and Columbia counties. Two major streams drain this subbasin, the Tucannon River, which flows into the Snake River, and Pataha Creek, which is the largest tributary to the Tucannon River. Other tributaries to the Tucannon River include Willow Creek, Kellogg Creek, Cummings Creek, Little Tucannon River, Panjab Creek, Sheep Creek, and Bear Creek. The upper portion of the Tucannon subbasin, which is the focus of this report, is contained within the Umatilla National Forest.

Elevations in the subbasin range from 540 feet at the confluence of the Tucannon and Snake Rivers to 6,400 feet at Oregon Butte in the Wenaha-Tucannon Wilderness. The area is characterized by deeply dissected canyons with moderate to steep sidelopes.

The primary towns in the surrounding region are Starbuck, Pomeroy, Dayton, Walla Walla, Clarkston, and Lewiston. An estimated total population of 2,750 people resides within the Tucannon subbasin (Gephart and Nordheim 2001). Agriculture is the largest contributor to the economy, followed by forest products and recreation (Gephart and Nordheim 2001).

The Tucannon watershed is in the far northern-most portion of the Blue Mountains section and within the Maritime-Influenced Zone and Mesic Forest Zone subsections. The influence of marine air flowing through the Columbia River Gorge is particularly strong in this area resulting in relatively higher rain and snowfall amounts. The generally northern aspect of the drainage system likely further favors moisture retention in the watershed as a whole. Annual precipitation, strongly influenced by elevation, ranges from 20 inches in the lower elevations to 70 inches at the highest elevations (Oregon Butte, 6387 feet). Most precipitation (over 70 percent) accumulates from November through April, and much occurs as snow especially in higher elevations. Maximum daily air temperatures average in the mid 80’s (ºF) in the summer and in the mid 30’s (ºF) in the winter.

Settlement History

The Tucannon subbasin is part of the aboriginal range of the Nez Perce, Walla Walla, Cayuse, Umatilla, and Palouse Tribes. The Tucannon River is the western boundary of ceded land to the Nez Perce in the Treaty of 1855. The river is also the northern ceded territory boundary for the Cayuse, Umatilla, and Walla Walla Tribes. The tribes have retained the right to take fish at all usual and accustomed places and to hunt, gather, and pasture livestock on open and unclaimed land.

Homesteading settlement began in the 1860's near the confluence of the Tucannon and Panjab Creek. Diverse agriculture production, sheep and cattle management, and logging were the main means of living, along with low yield mining of gold, silver and copper ore.

Land Use

Recreation

Recreation is a major use and includes all forms of outdoor activities. Gephart and Nordheim (2001) estimates 400,000 visitor days per year, and state that recreation may represent the dominant use of some forested lands, especially in the wilderness area within the Umatilla National Forest and on WDFW lands. Recreational facilities include seven State and five Forest Service campgrounds. Extensive non-motorized and motorized trail systems are contained within the watershed.

Grazing

Gephart and Nordheim (2001) report that heavy grazing pressure and and poor range management, has seriously deteriorated overall rangeland condition (SCS 1991). The upper reaches of the Tucannon within the Pomeroy allotment have not been grazed since 1967 (USFS 1994). Livestock have been excluded from the Tucannon bottomlands since 1996. A number of measures have been taken to improve streamside management on both the upper and lower portions of the subbasin, although there are still many opportunities to reduce effects on streamside vegetation and stabilization (Gephart and Nordheim 2001).

Forest Service Land Management

There are 79,776 acres of Forest Service land administered by the Pomeroy Ranger District on the Umatilla National Forest (Table 1-1). The area is represented by a wide variety of land management emphases in the Umatilla Forest Plan (Table 1-1) ranging from wilderness to timber-wildlife production.

Table 1-1 Acres by Forest Plan management area on the Umatilla National Forest portion of the Tucannon watershed.

Management Area Allocation	Acres
A1: Non-motorized Dispersed Rec.	4,838
A2: OHV Recreation	4
A3: Viewshed 1	959
A4: Viewshed 2	2,231
A6: Developed Recreation	350
A9: Special Interest Areas	559
A10: Wenaha-Tucannon SMA.	3,293
B1: Wilderness	13,043
C1: Dedicated Old Growth	2,020
C2: Managed Old Growth	69
C3: Big Game Winter Range	10,584
C4: Wildlife Habitat	13,154
C5: Riparian	2,273
C8: Grass-Tree Mosaic	4,967
D2: Research Natural Area	64
E2: Timber and Big Game	18,728
Total	77,136

Terrestrial Wildlife

With approximately 70 percent of the Tucannon watershed in forest habitat, "natural fragmentation" is limited to the lower elevations and middle portion of the watershed. The landscape is relatively contiguous with stands of lodgepole pine and sub-alpine fir at the highest elevations, to large stands of mixed conifer and grand fir at mid elevations, to relatively small stands and forested stringers of Douglas-fir, pine and larch in the lower elevations. South-facing slopes are generally drier and grass-dominated, with occasional, shrubby draws, and riparian hardwood communities. The area also consists of wet meadows and a few scattered aspen trees. The area supports large contiguous stands of old forest and mid structural stages in the middle and upper slopes of the watershed. Because portions of the analysis area is in roadless and the Wenaha-Tucannon Wilderness area, many terrestrial species requiring large expanses of habitat or minimal human contact could find refuge in the deep and relatively inaccessible canyons in and adjacent to the watershed.

The predominate forest landscape provides habitat for a diverse group of 192 terrestrial vertebrate species including, birds, mammals, reptiles and amphibians (Appendix A). The area supports several species whose population levels are of concern at a regional, state and national level including, wintering bald eagles, lynx, and goshawk. All Forest Management Indicator Species (MIS) occur in the area or have the potential to occur in the watershed. The majority of species with the potential to occur in the watershed are birds and the smallest group of species in the watershed is amphibians. The wild turkey population has grown, and continues to spread to adjacent watersheds. A relatively moderate population of elk and deer occupy the watershed, however, declines in the elk populations have occurred in the last few years. Critical winter range for elk and deer occur near and adjacent to the Tucannon River. The Tucannon watershed also contains a small bighorn sheep population above the Tucannon River. Other bighorn sheep herds occur in the Wenaha-Tucannon Wilderness.

CURRENT & REFERENCE CONDITIONS FOR SOILS & GEOLOGY

Geology

The Tucannon watershed is in the northern-most part of the steep north flank of the large anticline that is the Blue Mountains. The Tucannon River flows generally northerly towards the Columbia River. The headwater section of the river flows west-northwest before taking a right-hand turn (about 45 degrees) to the north at the junction with Pataha Creek, and a hard right (nearly 90 degrees) at the junction with Little Tucannon. It then gently curves back to the northwest as the river exits the Forest and heads toward the Columbia River. These directional shifts are a result of the structural makeup of the rock members within the watershed, but do not appear to follow faults (Swanson et al 1980).

The upper Tucannon is dominated by Columbia River Basalt group and comprised of the Grande Ronde and Wanapum lava flows (McKee 1972, as cited in Clark and Bryce 1997). Interbedded layers of lava flows of different ages contain fractured rock and old soil surfaces developed during periods of relative geologic inactivity. These can be sources of springs or sidehill seeps where moisture-living plant species may be found in an otherwise drier environment. This may appear in the form of bands of trees and associated understory plant species or as small areas of forbs, grasses or herbs that normally are found in different microenvironments such as the footslope below. Periodic release of soil and rock material is more likely from these less-consolidated interbed areas as well, although rarely in large amounts. General geologic information for the Tucannon watershed is discussed in the Tucannon Subbasin Summary and is discussed in more detail in Clark and Bryce, 1997.

Overall, the watershed is quite stable with relatively little mass movement activity- upland events generally are limited to shallow debris slides. The periodic flush of accumulated rock fragments from side channels during extreme weather events has provided the most dramatic mass movement in recent times. Identified debris-flow areas from the 1996-1997 flood events are shown in the current and reference condition section. There is only one mapped area of recent slump indicated in the Umatilla Soil Resource Inventory consisting of less than 26 acres located about 2 miles south of Camp Wooten in the center of section 33, T9N, R41E. No geologic landslide units are mapped to date, although detailed geologic or ecological (soil, geomorphology, potential vegetation) inventory has not occurred in the watershed.

Land-Type Associations

The land-type associations (LTA) will be the official ecological typing at (that) mid-level scale in the Ecological Hierarchy adopted by the Forest Service. The ongoing Blue Mountains Terrestrial Ecological Unit Inventory (EUI) will provide more detailed soil, potential vegetation and geomorphic information and provide the land-type (and land-type phase in some cases) scale as indicated in the Ecological Hierarchy. The map itself is in final draft form and associated descriptive and interpretation information still in development. However, the mapping and draft information is sufficient to begin to utilize it for characterization purposes here.

The Blue Mountains LTA uses Clark and Bryce's (1997) ecological subdivisions as the basis for the geologic and landform delineations. Added detail, particularly at the LTA phase level, is largely due to use of the Forest's (in this case, the Umatilla) potential vegetation data layers, and some refinement of the landform designations. The LTAs will serve as a refinement, and replacement for, the landscape level ecoregions as shown in Clark and Bryce, 1997. The units shown here are subdivisions or phases (based on vegetation detail) of the land-type association units, which have added detail from the potential vegetation data, grouped at the potential vegetation group level. This level of detail may be of use in smaller analysis areas or where the descriptive value of the vegetation complexes is desirable.

The last component of the land-type association phase (as listed in Table 2-1) is the geomorphic landform descriptor. Terms describe the following for approximate slope steepness:

- Plateau = flat to gently sloping, tops of (rock) flows
- Hillslope gentle = <30%
- Hillslope steep = 30 – 60%
- Canyon = >60%
- Alluvial = flat to gently sloping, floodplain

Table 2-1. Acreage of Land-type association phases in the Umatilla National Forest portion of the Tucannon analysis area.

Land-type Association phase	Acres
Cold forest-cold non-forest/Co. River basalt/hillslope gentle	621
Cold forest-cold non-forest/Co. River basalt/hillslope steep	2,184
Cold forest/Co. River basalt/canyon	1,211
Cold forest/Co. River basalt/hillslope gentle	3,365
Cold forest/Co. River basalt/hillslope steep	417
Cold forest/Co. River basalt/plateau	445
Dry forest-dry grass/Co. River basalt/canyon	12,419
Dry forest-dry grass/Co. River basalt/plateau	357
Dry forest-moist forest/Co. River basalt/	265
Dry forest-moist nonforest/Co. River basalt/canyon	8,179
Dry forest/basalt/alluvial	186
Dry forest/Co. River basalt/hillslope gentle	3,154
Dry forest/Co. River basalt/hillslope steep	2,734
Dry forest/Co. River basalt/hillslope/plateau	1,610
Dry grass/ Co. River basalt/canyon	1,639
Moist forest-dry forest/Co. River basalt/canyon	16,290
Moist forest-dry forest/Co. River basalt/hillslope gentle	2,950
Moist forest-dry forest/Co. River basalt/hillslope steep	4,030
Moist forest-dry forest/Co. River basalt/plateau	1,836
Moist forest-moist nonforest/Co. River basalt/plateau	855
Moist forest/Co. River basalt/canyon	2,686
Moist forest/Co. River basalt/hillslope gentle	3,406
Moist forest/Co. River basalt/hillslope steep	3,188
Moist forest/Co. River basalt/plateau	1,214
Moist nonforest-dry forest/Co. River basalt/canyon	1,888

All of the land-type associations in the Tucannon have Columbia River basalt as the dominant geologic rock type. The one unit of alluvial material is largely made up of eroded fragments of (the) Columbia River basalts. The lava flows in this area tend to fracture into cobble to large stone size materials and is reflected in the colluvium (gravity deposited) and alluvium in the deposition areas, including bedload in the streams in the watershed. Well-weathered basalts of these flows produce silt and clay-fraction fines that either remain in place as residual soils or have been moved out of the area in the stream system or deposited in the alluvial materials throughout the drainage, but seemingly concentrated in the lower reaches.

The largest acreage (16,290) occurs in the Moist Forest-Dry Forest, Columbia River basalt, canyon unit. This is indicative of the large area of very steep/canyon sideslopes in the watershed that support extensive areas of moister (ie. udic soil moisture regime) grand fir types, and drier Douglas-fir and ponderosa pine types mixed in a complex according to soil depths and water holding capacity.

The dry forest-dry grassland, Columbia River basalt, canyon unit is the next largest in acreage at 13,569 acres. These areas are slightly drier (xeric soil moisture regime) than the moist forest-dry forest with a predominance of dry forest types and grassland plant communities, and again reflective of the large acreage of very steep canyon topography.

Third in total acreage is the Dry Forest- Moist Non-forest, Columbia River basalt, canyon association. This association also reflects a xeric (drier) environment encompassing the dry forest and non-tree shrub communities that are fairly common. The next largest acreage is the same potential vegetation group and geologic type as the largest (moist forest-dry forest) but with 'hillslope steep' (30-60%) landform descriptor and, therefore, about the same but not quite as steep as the canyon unit. These three canyon and one steep hillslope units combined comprise over two-thirds of the total acreage of the Forest portion of the watershed. Hydrologic response (runoff) can be expected to be fairly rapid from these landforms. However, the other third of the watershed is comprised of gentle slopes (including alluvial areas), which generally retain precipitation and release it more gently. Shallow 'scab' meadow portions of the plateaus tend to have poor infiltration and rapid runoff, especially during snowmelt, contributing to a more rapid runoff character.

The steeper, dry grass and dry forest associations are located lower in the watershed, with the gently sloping, moist forest associations higher in the watershed. Erosion can be expected to be of greatest concern in the steep, open slopes where vegetation is generally sparser, especially in the bunchgrass communities.

Soils

The geomorphic character of the watershed is a primary determinant of the nature of the soils found there- this is especially true in the Tucannon. The relatively level plateaus on the higher elevations contrast distinctly with the long, steep sideslopes that range from 30- 80 percent and greater. Soils in the Tucannon are predominately shallow, medium-textured and on steep slopes greater than 30 percent slope. The gently sloping plateaus have both deep and shallow soils in a mosaic pattern with vegetative communities reflective that diversity- most of the deeper, more stable soils are found on these upland plateaus. The soils in this watershed are among the most resilient on the Forest, in part due to the favorable maritime-influenced moisture patterns and somewhat cooler conditions as compared to the southern-most areas of the Forest. In addition, the moisture holding capacity of the loess and, especially, volcanic ash serves to retain that moisture for use by plants throughout the long, dry growing season.

The soils in this watershed include some of the more extensive loess deposits (wind-blown glacial outwash material, typically silt) found on the Umatilla National Forest. The loess is overlain by wind-blown volcanic ash (Mazama) in many places. These wind deposited materials overly soils formed in weathered basalt, varying in degree of soil formation. These wind materials have been reworked and relocated over geologic time by erosion processes and have been redeposited in small drainages, footslope positions of large canyons, and alluvial floodplains. The relatively stable plateaus have retained these materials in many areas sufficient to be moderately deep to deep (20 to 40 inches or more) and have distinct layers. These gently sloping plateaus also have extensive areas where the loess and volcanic ash has been relocated (mostly wind action soon after initial deposition) and are primarily shallow (less than 20 inches) with soils developed in basalt/andesitic bedrock.

Field observation of the Mazama ash deposits in this area indicates a tendency to be of finer texture than those closer to the source in the southwestern portions of the Forest. Finer textured soils generally have more favorable water-holding properties- the ash and loess deposits in the Tucannon watershed further favor moisture retention. Deeper deposits of the relocated ash and loess help retain subsurface water and slow hydrologic response. The loess (also) provides more favorable nutrient characteristics than either Mazama ash or residual basalt soils by themselves.

Soils information for the National Forest portion of the watershed may be found in the Umatilla National Forest Soil Resource Inventory (Ehmer 1978). This was an initial reconnaissance survey conducted in anticipation of a detailed survey to occur later. The Blue Mountains Ecological Unit Inventory (EUI) is an ongoing effort to achieve this detailed survey and will provide improved soil, geomorphic, and potential vegetation information as it progresses. There is not yet EUI information available for this portion of the Forest.

Table 2-2. Major soil types in the Umatilla NF portion of the Tucannon watershed.

SRI Map Unit	Soil Depth	Surface Texture	Slope	Moisture Regime	Temperature Regime	Taxonomic Class
912	rock outcrop- mod. deep	gravelly loam	very steep to steep	aridic/none-xeric	frigid-mesic	rock outcrop- Ultic Haplxeroll.
915	rock outcrop- shallow	gravelly loam	very steep to steep	aridic/none-xeric	mesic	rock outcrop- Lithic Argixeroll
14	mod. deep	grav. silt loam	steep	udic	frigid-	Typic Udivitrand
314	deep- very deep	gr. silt loam- silt clay loam	gently sloping to steep	udic- aquic	frigid-cryic	Cumulic Cryaqoll
13	mod. deep	grav. silt loam	gently sloping to mod. steep	udic	frigid	Typic Udivitrand
812	mod. deep	grav. loam	mod. steep to steep	xeric	frigid-mesic	Ultic Haploxeroll & Argixeroll
129	mod. deep	grav. loam- rock outcrop	mod. steep to steep	xeric-aridic/none	mesic	Ultic Haploxeroll- rock outcrop
149	mod. deep-	grav. silt	steep to very	udic-	mesic	Typic Udivitrand-

SRI Map Unit	Soil Depth	Surface Texture	Slope	Moisture Regime	Temperature Regime	Taxonomic Class
	rock outcrop	loam	steep	aridic/none		rock outcrop
919	rock outcrop-deep	silt loam	steep to very steep	none/aridic-udic	cryic	Rock outcrop-Typic Vitricryand
199	deep- rock outcrop	silt loam	steep to very steep	udic-none/aridic	cryic	Typic Vitricryand- rock outcrop

Soil classification groups have changed somewhat in recent years. Some of the soil classifications in Table 2-2 are a best estimate of what the latest classification is based on the original classification as indicated in the SRI.

The watershed has relatively large floodplain acreage with associated alluvial soils. Over 7,860 acres are mapped as predominantly alluvial soil types. Additional areas of alluvial (often in complex with toe-slope colluvial soils) are not mapped in the Umatilla SRI but will be included in the Blue Mountains Ecological Unit Inventory as line-segment units if too small to be mapped out in polygons at the inventory scale.

Erosion Processes

The dominant natural erosion process in the Tucannon analysis area is surface erosion (sheet and gully) with mass wasting occurring infrequently in localized events as talus and debris slides. Highest rates of erosion in the Blue Mountain region are produced by heavy rain on saturated ground or on frozen soils, along with accumulation of a snowpack and rapid warming. These conditions occurred in the winter(s) of 1996-97 and resulted in extensive sheet and rill erosion on moderate gradient, non-forested slopes, shallow landslides in steep headwalls and open slopes at lower elevations, and debris flows in small side valley tributaries. Natural upland erosion rates vary by soil type, slope, aspect, cover, and land use, among other factors. Natural upland erosion rates are generally highest on steep slopes with shallow soils on south-facing slopes in low to mid-elevation areas where rain and rain-on-snow events dominate. Concentrated flow occurs in concave or incised collection areas, and may generate rills or gullies, particularly on steep slopes.

Accelerated erosion occurs in response to climatic conditions and often occurs in association with unstable roads or use of some roads in unfavorable conditions, certain logging situations, heavily grazed areas, and some recreation sites. These types of conditions are very limited in the Tucannon, overall, with a few problem areas of concern associated with road location

Several side drainages that released debris flows during the 1996/1997 flood events are indicated in Map 2-2 (Map Appendix). This information was collected during a post-event monitoring project (Fitzgerald 1998) and coordinated with a larger State-level assessment.

Management Activity

The Tucannon has had typical (for the Blue Mountains) historical activities from grazing, road construction and timber utilization and associated management. The distinct topography of long, steep canyons between gently sloping plateaus on higher elevations and a relatively large floodplain has directed where activity occurred. Road construction is largely limited to the steam corridors and upland plateaus with few sidehill roads, with overall road density quite low. Timber management activity is concentrated on the more accessible plateaus. Aerial yarding systems are required for the long, steep slopes with suitable forest and as such have not experienced extensive harvest activity to date.

Prescribed fire has generally been, until fairly recently, restricted to "activity fuel" treatments, meaning burning of post-harvest slash either in piles or scattered, in-place burning called jackpotting, or broadcast across units. Some larger piles from whole-tree yarding operations also have been burned. While small areas immediately underneath the piled slash have experienced high intensities, overall adverse effects from prescribed fire are minor. Potentially adverse effects from lack of periodic fire include risk of large areas of higher intensity fires sufficient to expose mineral soils and create conditions where soil erosion hazards could be realized. Larger areas are beginning to be considered for landscape level prescribed fires to avoid additional buildup of woody materials and loss of fires traditional role in these ecosystems. Additional discussion of burning effects can be found in the Upland Vegetation section.

Grazing information is not extensive, but it is known that grazing pressure from livestock, primarily late 1800's-early 1900's sheep, and to a lesser extent wildlife, has changed the character of the vegetative community in the grass and shrub communities. Species changes, including invasion of weeds, has occurred and contributed to an overall change from native species, although little in the way of area-specific soils effects is known. Some level of accelerated soil erosion is likely to have occurred during periods of historic overgrazing from domestic livestock, and perhaps in some cases, wildlife as well. Discussion of vegetative conditions may be found in the Botany section of this document. Additional discussion of grazing history is included in the Upland Vegetation section.

Table 2-3 shows harvest history acreage over the last 42 years. The harvest activity in the Tucannon closely mimics the overall harvest history for the Umatilla (see Table 5-2). Harvest activity was relatively low until the mid 1960's when activity began to increase in the Tucannon. The mid 1970's saw the greatest acreage affected by timber harvest activity with total acreage during the 1973-1977 period 3 to 4 times greater than late 50's or from the early 90's to current. The highest total acreage of activity occurred in the Pataha subwatershed. The next four subwatersheds with the most acreage involved include Cummings, Dry Pataha, Tumulan and Little Tucannon.

Regeneration harvest using shelterwood or seed tree prescriptions are associated with 40 percent of the harvest acres across all subwatersheds. An additional 20 percent used regeneration, partial or individual tree selection. Regeneration prescriptions using clearcuts were designated for about 9 percent of the total harvest acreage across the watershed. Yarding methods for ground-based systems before 1990 would likely have utilized rubber or tractor skidders with little systematic trail systems. Additionally, it was not uncommon in regeneration units to tractor pile logging slash for burning in piles. These activities often have higher levels of total soil disturbance and adverse soil effects. Yarding systems since around 1990 have shifted to systematic, designated skid trail systems reducing total soil disturbance. Post-harvest slash treatments have also changed to less disturbing methods. Slash is no longer dozer-piled and retention of greater amounts of slash within units is attempted while balancing concerns with high fire hazards in the first few years after activity.

Details for historical and recent timber harvest activity and road information can be found in the Tucannon Integrated Resources Analysis completed by the Pomeroy Ranger District in 1995. The Hydrology section in this document provides detail on road mileage and harvest history related to canopy cover.

The July 2001 Watershed Prioritization process for the Umatilla National Forest provides an analysis of the relative levels of management impacts across all watersheds on the Forest. The Tucannon is rated as high priority for active restoration activity, one of two so rated on the Forest. This is primarily a result of the high value placed on the aquatic resources in the area. A key watershed-related factor in that process was the extent of high erosion *potential* in the watershed based on interpretations provided in the Umatilla Soil Resource Inventory. Large areas of steep slopes and medium textured soils account for the potential of soil erosion without ongoing care. Overall actual accelerated erosion rates on the Forest portion of the watershed are quite low. Continued vigilance on erosion control measures is particularly warranted given the high values of the aquatic resources.

Table 2-3. Timber harvest historyby subwatershed for the National Forest portion of the Tucannon watershed, 1958-1998.

Subwatershed	1958-1962	1963-1967	1968-1972	1973-1977	1978-1982	1983-1987	1988-1992	1993-1997	1998-1999	Total
Lower Tucannon	75	0	83	414	0	0	1	77	112	762
Hixon	41	0	311	165	3	6	111	63	213	913
Little Tucannon	6	148	986	1664	182	100	266	0	0	3352
Cow	0	0	82	4	0	4	154	199	1	444
Lower Panjab	3	50	200	325	0	0	59	310	0	947
Meadow	200	386	372	334	29	151	376	341	0	2189
Upper Panjab	0	51	0	0	0	22	45	0	0	118
Middle Tucannon	0	0	46	25	0	670	97	0	897	1690
Sheep	0	0	29	2	1	102	3	232	226	595
Upper Tucannon	0	0	0	992	40	59	173	30	0	1294
Cummings	230	117	1474	445	1654	495	536	320	45	5316
Tumulan	200	934	209	222	772	355	327	91	383	3493
Dry Pataha	1590	64	0	1392	187	417	211	69	108	4038
Pataha	128	2555	519	3110	568	1640	203	550	131	9404
Total	2473	4305	4311	9094	3436	3976	2562	2282	2116	34555

CURRENT AND REFERENCE CONDITIONS FOR HYDROLOGY

Hydrologic Mapping

Watershed maps in the Pacific Northwest are currently being updated following new interagency standards for watershed delineation (USDA, 2000). The analysis area falls within two newly designated 5th field watersheds (the upper Tucannon River and Pataha Creek).

The Forest GIS coverage for streams extends off-Forest, but the mapped area is not complete for new 5th field watersheds. Road information is available for Federally managed roads on National Forest lands. Harvest data is also limited to federal lands. We used provisional watershed boundaries, existing subwatershed boundaries, and existing streams, roads, and harvest data in the analysis. Some of the available data for water quality were summarized for the analysis; however, there is an extensive backlog of unanalyzed data. The analysis focused on water quality parameters of greatest concern, specifically water temperature, stream sediment, and bacteria.

Annual Streamflows

Annual streamflow conditions reflect the climatic, topographic, and vegetative character of the watershed, with maximum discharge occurring in spring as result of snowmelt, and minimum flows in late summer. Average monthly discharge on the lower Tucannon River at a U.S. Geological Survey gage shows the pattern of increasing flows in late winter and spring and decreasing flows in summer and fall (Figure 3-1). The higher elevations with greater precipitation supply the majority of water to downstream areas. Shallow aquifer storage and deep groundwater sources support late season baseflows.

The Forest Service established a stream gage on the upper Tucannon River at Panjab Creek in 1983. The gage was operated up until 1996 when flooding damaged the gage and changed the cross section. The gage was reinstalled in 1997, however, there were problems maintaining the site and the gage was discontinued. A stage discharge rating was never developed for this gage and existing gage records have not been analyzed.

Stream Channels and Riparian Areas

Rosgen's (1996) stream classification system was used to characterize streams in the analysis area. The Forest GIS streams layer includes streams in the upper Tucannon (from about 3 miles below Tumalum Creek) and Pataha (upstream from Columbia Center). ARC macro language utilities were used to classify streams using attributes of gradient and sinuosity. The majority of streams in the analysis area are moderate to high gradient/low to moderate sinuosity types (A and B). Lower gradient/higher sinuosity stream types (C and E) represent a small fraction of the total miles (Figure 3-2). These stream types are generally found in the lower elevation main channels of the Tucannon and Pataha (Map 3-1, Map Appendix).

General descriptions of dominant riparian vegetation and Rosgen stream types along the main stream channels were reported in the Tucannon Subbasin summary. Vegetation types ranged from alder/cottonwood (below Tumalum) to grand fir/alder (above Panjab).

Complete maps and classification of existing and potential riparian vegetation are lacking.

Water Quality

Water quality varies across the analysis area and is generally good in headwater streams and wilderness areas. The larger valleys with roads and other development (private and public) lack streamside shade, stable streambanks, and diverse riparian vegetation communities. Stream temperatures are borderline in meeting state standards. Fine sediment may be elevated above background conditions. Bacteria levels are a concern on Pataha Creek. Water quality is regulated by the State of Washington by: beneficial use, water body classification, water quality criteria, and identification of impaired water bodies (Table 3-1). Streams on the National Forest are generally classified as Class AA (excellent). Key beneficial uses in the upper Tucannon and Pataha watersheds include: water supply, salmonid and other fish spawning, rearing and migration, wildlife habitat, and recreation (secondary contact). Water quality criteria of primary concern in the analysis area (assigned by beneficial use and classification), include fecal coliform organisms, dissolved oxygen, temperature, pH, and turbidity.

Washington state water quality criteria for Class AA waters are as follows (WAC 173-201-045):

- Freshwater fecal coliform organisms shall not exceed a geometric mean value of 50 organisms/100mL, with not more than 10 percent of samples exceeding 100 organisms/mL.
- Freshwater dissolved oxygen shall exceed 9.5 mg/L.
- Freshwater temperature shall not exceed 16.0ºC (60.8ºF) due to human activities. When natural conditions exceed 16.0ºC no temperature increase will be allowed which will raise the temperature of the receiving water temperature by greater than 0.3ºC.
- Freshwater pH shall be within the range of 6.5 to 8.5 with a man-caused variation within a range of 0.2 units.
- Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

Changes in state water quality criteria may include the following:

(see: http://www.ecy.wa.gov/programs/wq/swqs/proposed_changes.html for further information).

- "Ecology may change the way it categorizes beneficial uses (swimming, boating, fish habitat, etc.). Uses are now assigned in pre-determined sets, or "classes." The proposed system would allow the flexibility to assign beneficial uses independently of one another."
- "We propose to follow recommendations [for bacteria] from the U.S. Environmental Protection Agency (EPA) and change to using E. coli and enterococci (instead of fecal coliform) to indicate the presence of pathogens in water. E. coli and enterococci have been shown to be very effective indicators of the safety of water for human contact, and

they help ensure that wastewater is properly disinfected before it is discharged to state waters."

- "Some say the existing [temperature] criteria are unnecessarily stringent; others say they are too lenient. After detailed review of our existing criteria, we are proposing five separate temperature standards, depending on the presence of key fish and their life-stages."

Table 3-1. Beneficial uses by waterbody classification (State of Washington Administrative Code, WAC 173-201).

Beneficial Use	Waterbody Classification			
	AA	A	B	C
WATER SUPPLY				
Domestic	X	X	-	-
Industrial	X	X	X	X
Agricultural	X	X	X	-
Stock Watering	X	X	X	-
FISH AND SHELLFISH				
Salmonids				
Spawning	X	X	-	-
Rearing	X	X	X	-
Migration	X	X	X	X
Harvesting	X	X	X	-
Other fish				
Spawning	X	X	X	-
Rearing	X	X	X	-
Migration	X	X	X	X
Harvesting	X	X	X	-
WILDLIFE HABITAT	X	X	X	X
RECREATION				
Primary Contact	X	X	-	-
Secondary Contact	X	X	X	X
NAVIGATION	X	X	X	X

The Regional Forester recently signed a Memorandum of Understanding with the Washington Department of Ecology outlining agency responsibilities for water quality (November, 2000). Expectations include annual accomplishment reporting, coordination, and road-related restoration activities.

The following streams are on the state 303(d) list of impaired water bodies: Pataha Creek for fecal coliform bacteria, and the Tucannon River for fecal coliform bacteria and temperature. TMDLs are not scheduled at this time; the State has other priority watersheds for TMDL development in the main Snake River and Walla Walla subbasins.

The Forest Service is actively implementing a 303(d) strategy outlined in the 1999 Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters including the following activities: Validating the current 303(d) list and listing rationale, working with the State to set priorities and timelines for addressing listed water bodies, implementing a MOU with Washington Department of Ecology, and documenting sufficiently stringent management measures in place. A water quality restoration plan for

Federal portions of the watershed contributing to water quality degradation is a requirement in the 303(d) strategy.

Effect of Management

A variety of land uses in the upper Tucannon and Pataha watersheds have potential to affect hydrology and water resources by accelerating natural erosion and sedimentation rates, reducing streamside shade (increased water temperatures), and altering channel processes (bank erosion, channel widening, and pool filling). The dominant land management activities are roads and timber harvesting, livestock grazing, and developed and dispersed recreation. Very little land disturbance occurs in the wilderness portion of the analysis area, limited to trail use and dispersed camping.

Roads and Timber Harvest

Public roads in the upper Tucannon and Pataha watersheds are largely confined to plateau uplands and major valley bottoms. Total road densities are relatively low with the exceptions of Pataha and Meadow subwatersheds, which have moderate road densities (Table 3-2). Factors influencing the extent and location of roads include topographic relief and wilderness designation. Forest roads located along main stream valleys cause relatively high densities of roads within RHCAs of fish bearing streams; specifically, in the Tucannon River, Hixon Creek, Panjab Creek, and Cummings Creek (Table 3-2).

Slope position of the roads is a critical factor in the interaction between roads and streams. Valley bottom roads have the most direct effect on streams and riparian areas, accelerating erosion, reducing streamside shade, and increasing the number of road-stream crossings. Mid slope roads intercept subsurface runoff, extend channel networks, and accelerate erosion. Ridgetop roads influence watershed hydrology by channeling flow into small headwater swales and accelerating channel development. Adequate drainage reduces the effect of extension of the drainage network by moving water rapidly off roads and allowing infiltration. Roads increase the efficiency of watershed runoff and affect the timing of runoff. In general, roads reduce the amount of time for runoff to reach the stream system, causing peak flows to occur earlier compared to unroaded conditions.

Road restoration efforts in the last 10 years have reduced the miles of road in all subwatersheds on Federal lands (Table 3-3). Reductions range from 1 percent to 25 percent, with an overall drop of 11 percent for the entire area. Reducing the miles of road across the landscape has increased infiltration, reduced runoff, improved vegetation cover, and contributed to overall improvement in watershed conditions. Middle Tucannon-Sheep and Tumalum subwatersheds show significant (>20 percent) reduction in road miles and are most likely to exhibit measurable improvement in hydrologic condition.

Table 3-2. Roads and Timber Harvest on National Forest lands in the Tucannon and Pataha watersheds.

SWS	Category 1 Streams (miles)	Category 2 Streams (miles)	Category 4 Streams (miles)	Total Miles of Stream	Rd.miles Per mile of RHCA (fish bearing)	Rd.miles Per mile of RHCA (all streams)	Total Road Density Mi/sq.mi.	ECA Acres	Total Forested Acres	ECA %
A Lower Tucannon	4.3	14.3	.2	18.7	0.65	0.19	0.35	40	2433	2
B Hixon	3.9	6.4	8	18.3	.53	.16	0.78	86	4035	2
C Little Tucannon	3.1	3.8	7.8	14.7	.48	.14	2.85	128	4173	3
D Cow	2.1	3.1	1.8	7	.9	.3	1.22	40	1666	3
E Lower Panjab	2.2	1.1	3.4	6.7	.81	.31	0.95	91	2183	5
F Meadow	3.1	10.4	3.2	16.7	.32	.08	2.40	254	6036	5
G Upper Panjab	5.1	14.4	1.6	21.1	0	.006	0.28	18	7374	0.3
H Middle Tucannon	4.7	8.1	3.2	16	.4	.13	0.57	496	6232	4
I Sheep	4	12.7	2.6	19.3	.005	.006	0.63	226	6997	3
J Upper Tucannon	5.1	16.3	3.9	25.3	0	.02	0.81	103	9804	1
K Cummings	6.6	7.9	12.8	27.3	.9	.26	1.63	465	7251	7
L Tumalum	9.7	5.5	14.2	29.4	0	.002	1.03	207	2362	10
M Dry Pataha	0	0	7.2	7.2	0	0.04	1.06	121	1624	8
N Pataha	.2	15.9	5.3	21.4	-	0.14	2.58	548	6676	9

Changes in forest stand and canopy density caused by harvest, fire, or insect and disease may alter the distribution of the snow pack, increase the rate of melt of the snow pack, and cause the timing of the melt to be earlier. These factors may lead to changes in peak flow. In addition, reduction of stocking density reduces the overall vegetative use of water, increasing the amount of water available for runoff. Changes in water yield and in peak flow have the potential to destabilize channels, causing increased erosion and sedimentation in channels. Reliable methods for predicting effects of changes in forest cover on water yields and peak flows are not available in large part because the relationship between amount of cover removed and flow change is highly variable (Sherer, 2000). Other factors such as climate, topography, and soils influence watershed hydrology and “confound” detection of effects.

Table 3-3. Summary of road decommissioning in the upper Tucannon and Pataha subwatersheds, 1991 – 2001.

Subwatershed Name	Drainage Area in Square Miles	Total Road Miles	Road Density	Miles Decommissioned 1991-2001	% Reduction in road miles
Cummings	19.90	32.35	1.63	5.1	14
Dry Pataha	10.01	10.66	1.06	2.3	18
Little Tucannon	7.37	21.00	2.85	2.48	11
Lower Panjab	3.44	3.28	0.95	0.62	16
Lower Tucannon	24.15	8.49	0.35	1.05	11
Lower Tucannon Hixon	9.73	7.55	0.78	0.06	1
Meadow	10.04	24.14	2.40	0.15	1
Middle Tucannon	10.74	6.07	0.57	0.95	14
Middle Tucannon Cow	3.98	4.87	1.22	0	0
Middle Tucannon Sheep	11.63	7.35	0.63	2.5	25
Pataha	16.17	41.77	2.58	2.41	5
Tumalum	16.09	16.54	1.03	4.31	21
Upper Panjab	11.89	3.38	0.28	0	0
Upper Tucannon	15.91	12.92	0.81	2.32	15
TOTAL	171.05	200.37	1.17	24.25	11

One method commonly used to evaluate harvest effects on water yield and peak flow is the Equivalent Clearcut Acre analysis (King, 1989). A procedure was developed for the Forest as part of Endangered Species Act (ESA) consultation (Ager and Clifton, 1995). ECAs were calculated following the Forest protocol to determine existing levels of harvest and estimate water yield effects in the analysis area. Percent ECA measures the extent of harvested openings and is used as an indirect measure of the hydrological effects (increases in water yield and peak flow) of harvesting. The procedure to determine percent ECA includes harvest method and vegetative recovery rates developed for the Blue Mountains. Roads were not included in the calculation of ECA as part of this analysis.

Guidelines in ESA consultation documents place an upper limit on ECAs at 15 percent (for concurrence on Not Likely to Adversely Affect determinations). In northeast Oregon, results from the High Ridge Barometer Watershed Study, in the upper Umatilla watershed showed no measurable changes in streamflow until 50 percent of catchments were in a cutover condition (Helvey and Fowler 1995). The High Ridge watershed is between 4700 and 5290 ft, which is above the rain-on-snow zone (2000-3500 ft). The lower portions of the Tucannon and Pataha analysis watersheds fall within the rain-on-snow zone, where harvesting could influence peak flow timing, duration, and quantity. Overall, equivalent clearcut percentages for the Tucannon and Pataha watersheds are low reflecting the land area under Wilderness designation and the limited harvest history of the area (Table 3-4). ECAs range from less than 1 percent in the Panjab subwatershed to 10 percent in the Tumalum subwatershed. Based on this analysis, it is highly unlikely that changes in forest cover on federal lands as a result of harvest are influencing water yield, peaks flows, or channel stability.

Effects of Livestock Grazing

The grazing history of the Tucannon and Pataha watersheds has been described elsewhere in this document. Current use is largely confined to the Pataha watershed, with three pastures, upper Pataha, lower Pataha, and Abels pasture, and 83 cow/calf pairs (446 AUMs) permitted. Ables and Upper Pataha pastures include portions of the Cummins Creek drainage, however, livestock rarely access this area (A. Whitaker, pers. com.). The season of use is June 15 to October 15. Lower Pataha Creek is fenced from livestock. Cattle have limited access to upper Pataha at several water gaps. Overall use is at low levels, with few and generally localized direct impact to streams and riparian areas.

Effects of Recreational Uses

Recreation uses include: developed recreation sites (Tucannon and Pataha campgrounds), and dispersed recreation sites along main Tucannon and Pataha streams. Many are located in Riparian Habitat Conservation Areas (RHCAs). Effects include: loss of vegetation, reduced shade, compaction and erosion, unstable streambanks, and confined stream channels. Recreational residences (Stenz Spring and Rose Springs) with septic systems may be localized sources of bacteria to Pataha Creek.

Water Quality Monitoring

Water quality sampling began in the 1970's. All data prior to 1999 (except water temperature for the last 8 years) are stored in Legacy STORET (Table 3-4). Data for 1999-2001 (3 active stations in the analysis area) was recently imported into the modernized STORET program and is now accessible to the public. The principle water quality parameters are: temperature, bacteria, and sediment.

Water Temperature

Water temperatures on NFS lands are generally low and meet Washington State water quality standards for Class AA (extraordinary). Maximum water temperatures on tributaries and at higher elevation stations are below 61ºF (16ºC) during the warmest time of the year. The exception is Cummins Creek, which exceeded 61ºF in 3 out of 4 years. Interest is growing in temperature conditions during spring and fall spawning periods. With improvement in stream recorders, more sites can be monitored for longer periods.

Table 3-4. Summary of Water Quality Monitoring Stations in STORET (Active stations are in Bold)

STORET #	GIS #	Location Name	Location Description	Legal	Available Data T = temperature ISCO=sediment	Period of record
14030001	4014	Panjab Creek	100 ft above Panjab Campground (near mouth?)	T08N R41E Sec05 SENW	grabs	70-80
14030002	4X18	Tucannon River	100 feet above confluence of Panjab Cr	T08N R41E Sec05 SWNE	grabs	70-78
14030003	**4013**	**Tucannon River**	**At Panjab bridge, FR-47**	**T08N R41E Sec05 NENW**	**ISCO, T, grabs**	**70-80, 83-01**
14030004		Tucannon River	200 yds D/S of Big Four Canyon confluence	T09N R41E Sec15 NWNE	?	?
14030005	**4003**	**Tucannon River**	**At FS Bdry**	**T09N R41E Sec02 NWNW**	**ISCO, T, grabs**	**70-present**
14030006	4X16	Tucannon River	At Marengo Bridge	T10N R40E Sec13 NENW	grabs	72-80
14030007	4006	Pataha Creek	At FS Bdry	T09N R42E Sec02 NENW	T, grabs, few flow	69-78
14030008	4002	Pataha Creek	At Pomeroy	T37N R42E Sec31	ISCO, grabs	73-76, 95-97
14030009	4011	Little Tucannon River	At mouth	T09N R41E Sec30 SENW	T, grabs	73-80
14030010	4010	Little Tucannon River	At end of FR N-902	T09N R40E Sec36 NWNW	3 grabs	73, 76, 80
14030011	4X08	Little Tucannon River	At headwaters	T09N R40E Sec12 NENW	1 grab	8/29/73
14030012	4X04	Cummings Creek	At Highway 12 (at mouth?)	T10N R41E Sec22 SWNW	grabs	73-78
14030013	4X17	Tucannon River	At Highway 12	T12N R39E Sec29 SWSE	3 grabs	74, 80
14030014	4016	Tucannon River	Above Sheep Cr, at road end	T08N R41E Sec12 SENE	ISCO, T, grabs	80-95
14030015	4015	Meadow Creek	At end of road	T08N R41E Sec19 NENW	T, few grabs, few flow	71-80
14030016		Pataha Creek	1/2 mile above FS Bdry	T09N R42E Sec02 NESW	ISCO, T	74-82
14030017	4005	Cummings Creek	Lower end of Cummings timber sale (gage station?)	T09N R41E Sec12 NWSE	ISCO, T	78-95
14030018	**4007**	**Pataha Creek**	**Above campground ISCO site**	**T09N R42E Sec02 NESW**	**ISCO**	**?-current**

Table 3-5. Annual Maximum (7 day average of daily maximums) water temperatures in ºF. Note: State standard is 16.0ºC (60.8ºF) for Class AA waters.

Monitoring Site	Elevation (ft)	91	92	93	94	95	96	97	98	99	00	01
Cummings Creek @ Mouth	2060							55	66	64	M	66
Meadow Cr @ mouth / abv road [POM]	3260		57	X	57			53	56	54	56	59
Hixon Creek	2900							54		58	57	57
Panjab Cr @ mouth /abv campground	2980		63	59	63	59	57	58	60	60	60	60
Pataha CR @ FS Bdy / abv campground	3780		63	58		58		M	62	60	60	M
Pataha Cr @ FS Office in Pomeroy	1700		71	67		69		72	73	70	M	69
Sheep Cr @ mouth	3500							48	60	49	49	49
Little Tucannon Cr @ mouth	2820		61	57	61	58		58	61	58	59	59
Tucannon Rvr @ Panjab Cr / bridge	2970	X		X	67	57		56	59	56	58	58
Tucannon Rvr above Sheep Cr	3500							54	57	53	56	57

M: Missing data for period of maximum stream temperatures
X: 7-day average of daily maximums not calculated

Bacteria

Pataha Creek from mouth to headwaters is listed on the 1998 303(d) list for fecal coliform bacteria. Grab samples taken at the Forest boundary in 1997 met bacteria criteria on 4 sample dates between September 29 and October 14, 1997 (geometric average of 0, arithmetic average ranged from 1-13 organisms/100 ml). A letter was sent to the State Department of Ecology recommending dropping the listing above the Forest boundary (see memo to WDOE, 10-29-97). While samples showed low or no bacteria, potential sources should be evaluated. Livestock grazing is unlikely to be a major source of contamination as the majority of livestock use is off-stream. Wildlife may be a possible source, and septic systems associated with recreational residences.

Sediment Data Analysis

Total suspended solids (TSS) and turbidity data from two monitoring stations on the Tucannon River (Tucannon at the Forest Boundary and Tucannon at Panjab) were analyzed with the general objectives of characterizing regimes in the upper Tucannon River and comparing the two sites. Sediment is one of the important water quality concerns in the analysis area. Excessive levels of fine sediment in streams adversely affect aquatic life, reduce habitat quality, and may cause channel adjustments (wider, shallower channels).

The ISCO water samplers are programmed to collect a daily composite sample (4 samples per day into one bottle at 6-hour intervals). Samples are analyzed TSS, conductivity, and turbidity. A value for total dissolved solids is estimated from conductivity. Suspended sediment data is generally analyzed with discharge data, used to calculate a daily sediment load, however, continuous discharge information was not available so the analysis focused on sediment concentrations (TSS in mg/l) and turbidity (NTUs) over time and between sites.

In a comparison of sediment data over time, complete data sets representing the range of actual values are ideal for analysis. As a result of numerous and inconsistent data gaps, it was difficult to find data that met this goal. Only water years with sufficient data during the low flow period (July – September), and during the high flow period (determined by discharge data from the Starbuck gage downstream) were used to represent the yearly range of data. The period of record was only consistent during the period January 25 through September 6 for the years with compatible time gaps (1984, 1992, and 1998). Therefore, patterns and durations were analyzed on a year-by-year base and not between years.

Both sites show annual and seasonal variability in TSS. Years in which the ISCO captured both the maximum and minimum values were used to show the within-year and annual variability (Figure 3-2, 3-3). The largest within year variability occurred at the Forest boundary in 1982; TSS values range from 0 to 2727 mg/L (Figure 3-4).

Variability in TSS between years was also high. In the 8 years of comparable data from the Forest boundary, maximum TSS ranged from 64 to 2727 mg/L (standard deviation 5 to 403 mg/L). At the Panjab site, maximum TSS ranged from 63 to 678 mg/L (standard deviation 6 to 101 to 6 mg/L). Minimum TSS values were consistently below 3 mg/L at the Forest boundary but ranged between 0 and 11 mg/L at Panjab. This annual variability is consistent with other reports, for example, Harris and Clifton (1999) found annual unit suspended sediment loads (tons/mi2/yr) in the upper Umatilla River varied in order of magnitude.

When the data were compared at the two sites, TSS concentrations were consistently higher at Panjab compared to the Forest boundary during the period January 25 through September 6 for the years 1984, 1992, and 1998, however, the Panjab site was substantially higher only 40 percent of the time and primarily during higher concentrations (Figure 3-5). Possible reasons why Panjab showed higher TSS concentrations include:

- change in the dominant stream type from a higher gradient source/transport reach, using Montgomery and Buffington’s 1996 system (Rosgen, 1997 types A and B), to a lower gradient response reach (Rosgen B/C and C type),
- change in road maintenance levels (paved to gravel),
- local sediment sources (cutbanks or landslide areas) above Panjab.

Dominant peak flow mechanism may be another source of differences between the sites. The timing of maximum TSS concentrations at each site occurred during different runoff periods. The majority (63 percent) of the peak TSS values occurred during the rain-on-snow period at the Forest boundary, while 57 percent of peak TSS values occurred during the spring melt period at the Panjab site. The Forest boundary, at a lower elevation, may be subject to more rain-on-snow-generated flooding. These floods do not occur every year. Panjab, at higher elevation, is more subject to a snow-melt dominated flood regime, a phenomenon that occurs every year.

BMP Monitoring

The principle mechanism for protecting water quality during activities is through the use of Best Management Practices (BMPs). In 2001, the Forest began systematic monitoring of BMP implementation and effectiveness on selected timber sales and road restoration projects and activities. Harvest practices included implementation of stream buffers, and spacing and erosion conditions on skid trails. Roads that were obliterated in the last 4 years were also sampled to evaluate implementation and effectiveness rates of restoration treatments. Findings will be summarized in the 2001 Forest Plan Monitoring Report.

Watershed Condition

Streams and Riparian Ecosystems

Stream and riparian conditions vary widely across the Upper Tucannon and Pataha watersheds. Streams within designated wilderness areas and in unroaded tributaries are minimally influenced by land uses and generally have intact riparian vegetation communities, and stable channels with well-vegetated banks. Outside of wilderness areas, in valleys with roads and other developments, loss of riparian vegetation, compaction of stream banks, and structural channel controls adversely affect stream and riparian function.

Hydrologic Disturbances Processes

Major sources of disturbance include periodic floods and drought. Floods are caused by two principal mechanisms: winter “rain on snow” with frozen ground conditions, which have produced the highest peak flows on record, and the annual occurrence of spring snowmelt floods. Major flooding across the Pacific Northwest in February 1996 has been widely described (see for example Laenen, 1997). Other years with major peak flow events are: 1916, 1930, 1963, and 1964 (peak of record on the Tucannon gage). The February 1996 floods caused major damage to roads and other infrastructure across the Northwest; a federal disaster was declared in Walla Walla, Columbia, and Asotin counties. Post-flood surveys on the Forest identified emergency repair needs for roads, trails, and campgrounds. Assessments were also conducted of flood-caused mass wasting (landslides and debris flows), road-stream crossing failures, impacts to aquatic instream habitat structures, and changes in channel morphology after flooding. Several reports and publications resulted from these assessments (see Fitzgerald and Clifton, 1997, and Clifton et al, 1999). Results from the mass wasting inventory and channel morphology surveys follow.

Mass Wasting

Compared to other regions in the Northwest, the geology and soil types in the northern Blue Mountains are generally stable. The Forest Soil Resource Inventory (SRI) completed in 1978 identified rock and soil types susceptible to mass movement and areas considered to be geophysically active (Ehmer 1978). Review of the SRI and aerial photos for the watershed indicate a low rate of natural landslides and debris flows. Geologic evidence does suggest the occurrence of frequent mass wasting in the past along the Tucannon River, probably produced under different climatic conditions. Alluvial fan lobes vegetated by coniferous trees are present at the outlets of low order tributaries to the mainstem. These lobes typically consist of large sub-angular basalt cobbles and lack fine material. The lack of fine material is likely due to winnowing of sand and silt sized sediment. The overall number of landslides and debris flows on the Forest suggests that while the annual rate of mass wasting is low, during rare storms and flooding, landslides and debris flows do occur.

Forest staff inventoried mass wasting features on the National Forest following the floods of 1996 and 1997. Twenty-one features were identified in the upper Tucannon watershed (criteria for inventory included size: only features displacing more than 100 cubic yards were included) (Table 3-6).

Table 3-6. Mass wasting features inventoried following 1996 floods in the Tucannon Watershed.

HUC/ Slide #	Feature Type	Crown Elev. (ft)	Toe Elev. (ft)	Slope (ft/ft)	Aspect	Stream Class	Manage-ment	1978 SRI Map Unit
03F-1	1	3800	3590	0.14	SE	2	2	312
03E-1	2	3120	3040	0.53	E	1	1	313
03E-2	2	3100	3020	0.4	E	1	1	313
03H-1	2	3020	2990	0.6	S	1	1	313
03C-1	2	3640	3540	0.75	NE	2	1	915
03C-2	2	3680	3600	0.75	NE	2	1	915
03B-1	1	3000	2790	0.1	SE	1	3	912
03B-2	1	3000	2770	0.23	SE	1	3	129
03B-3	1	3000	2800	0.14	E	1	3	129
03B-4	1	3000	2720	0.14	SE	1	3	915
03B-5	1	2720	2640	0.032	SE	1	3	312
03A-1	1	2800	2570	0.14	NE	1	3	312
03A-2	1	3000	2520	0.14	E	1	3	12
03A-3	1	2800	2520	0.15	E	1	3	312
03A-4	1	2820	2520	0.1	SE	1	3	312
03A-5	1	3000	2430	0.22	SE	1	3	312
03A-6	1	3200	2390	0.17	SE	1	3	312
03A-7	1	2920	2330	0.15	E	1	3	312
03A-8	1	3200	2240	0.27	E	1	3	312
03A-9	1	2760	2240	0.4	NE	1	3	312
03A-10	1	3200	2200	0.17	NE	1	3	312

LEGEND:

Type:	Management 1=Road	Class 1 = entered perennial channel
Flow = 1	Management 2=Timber	Class 2 = entered intermittent channel
Slide = 2	Management 3=unknown	

Fifteen of the 21 features inventoried were identified as debris flows, 18 transported material to a perennial channel, 5 features were the result of road failure, and 1 feature was associated with timber harvest.

The majority of mass wasting features entered an active channel. Based on field reconnaissance and detailed mapping, this appears typical of larger mass wasting features on the Forest. Small upland landslides consisted of soil and rock, converged in low order drainages and possibly initiated tributary debris flows. Debris flows then rapidly eroded and transported material in some cases thousands of feet in lower gradient (5 to 30 percent) tributary channels. Debris flows terminated where tributaries intersected the low gradient main channels (Tucannon River).

The majority of inventoried features had an unknown or natural (climatic) cause. Features associated with management activities had obvious causal mechanisms; for example, road-cut and fill failures. Several roads in the upper Tucannon failed during flooding and delivered sediment to an active stream channel.

Average crown elevation was 3085 feet and average toe elevation was 2736 feet (Table 3-7). The elevation zone where mass movements initiated was within the transient snow zone. Physical processes initiating mass failures include increased pore pressure and reduced soil shear strength due to rapid snowmelt (Costa, 1984).

The slope gradient over which mass wasting features transported material, varied by feature type. Landslide slope gradient ranged from 0.40 to 0.75 (feet/feet), compared to debris flow slope gradient, which ranged from 0.032 to 0.53. These features were often connected supporting a hypothesis of upland landslides initiating and contributing to tributary debris flows.

Table 3-7. Summary of mass wasting feature attributes in the upper Tucannon River.

Stream System	# features	#flows	#slides	Avg. Crown Elev.	Avg. Toe Elev.	Avg. slope
Tucannon	21	16	5	3085	2736	0.27

District staff visited selected sites during summer 2001 and made the following observations: debris flow deposition zones were revegetating, channelized scour zones were carrying seasonal flow and continuing to erode along oversteepened scarps and headwall areas. Channel headcutting associated with disturbance had, in most cases, ended at existing hard points in the channels.

Changes in Channel Morphology after 1996-1997 Floods

Four channel reference reaches were established on the Tucannon River between the Forest boundary and the confluence of the Tucannon and Panjab Creek in the summer of 1996. Three of these sites were resurveyed between 1997 and 1999. Adjustments in channel morphology and stream substrate indicate streams responded to increased sediment loads, channel erosion, loss of streamside vegetation, and inputs of large woody debris by local aggradation and incision (Table 3-8). Factors influencing channel adjustment include: hillslope or tributary sediment sources, channel migration during high flows, and debris jams.

Table 3-8. Channel changes Upper Tucannon River 1996-1998: change in cross section area and estimated sediment storage.

Stream/Site name	Drainage Area (mi^2)	Rosgen type	% change XS Area	Volume (yds/100 ft)	Change in Storage	Source/ control
Tucannon at Forest bdy.	93	B3c	5	+113	aggraded	tributary
Tucannon at Cow Camp	79	B3c	5	-75	degraded	channel shift
Tucannon at Panjab	66	B4	3	-147	aggraded	channel shift

Changes in channel substrate were also observed in 3 years of post-flood monitoring. The median particle diameter (d_{50}) decreased in 1997 followed by an increase in 1998 and the percent fines (< 6 mm) increased in 1997, decreasing in 1998 (Table 3-9). Stream substrate measures are another indicator of channel adjustments to high flows and upland mass wasting. Shifts in substrate sizes may be a signal of finer sediment mobilized by hillslope mass wasting being routed through the stream system.

Table 3-9. Post-flood changes in stream substrate, Tucannon River at the Forest boundary.

Year of Survey	Median particle (d_{50})	% finer than 6 mm	# finer than 6 mm	# greater than 6 mm	Chi Square statistic*
1996	85	4	4	110	-
1997	32	40	47	70	51.584*
1998	93	1	1	105	1.753

**Significant difference at $P \leq 0.05$*

Drought

Frequency and effects of periodic drought tend to be less investigated and understood compared to floods. Nevertheless, the phenomenon of drought is significant as a watershed process and disturbance mechanism. Droughts tend to be cyclic, and are directly related to ecological conditions and disturbance. Cycles of drought, insect and disease outbreaks, and wildfire are interrelated processes in the Blue Mountains. The following definitions of droughts were obtained from the National Oceanic and Atmospheric Administration website, (http://www.drought.noaa.gov/):

A drought is a period of abnormally dry weather which persists long enough to produce a serious hydrologic imbalance (for example crop damage, water supply shortage, etc.) The severity of the drought depends upon the degree of moisture deficiency, the duration and the size of the affected area.

There are four different ways that drought can be defined:

> *<u>Meteorological</u> - a measure of departure of precipitation from normal. Due to climatic differences what is considered a drought in one location may not be a drought in another location.*
> *<u>Agricultural</u> - refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.*

<u>Hydrological</u> - occurs when surface and subsurface water supplies are below normal.
<u>Socioeconomic</u>- refers to the situation that occurs when physical water shortage begins to affect people."

Years of below-average streamflow in the Tucannon and Pataha watersheds include: 1915, 1930, 1931, 1977, 1987, 1988, and 1990.

Watershed Condition Ratings

The Tucannon River rated watershed condition class 2 and high priority for restoration in the 2001 Umatilla National Forest Watershed Prioritization report. Watershed condition ratings were assigned to watersheds across the Forest using a combination of land use/condition indicators and resource attributes. Condition class 2 is defined as follows: "watersheds exhibit moderate integrity relative to their natural potential condition. Portions of the drainage network may exhibit an unstable drainage network. Conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses" (USDA, 2001).

Reference Conditions

Reference conditions help explain how watershed conditions have changed over time as a result of human activities and natural disturbance. Reference conditions provide a benchmark to compare current condition, management objectives, and departure from potential. Reference conditions are generally analyzed using historic records but may also be inferred by comparing the condition of bio-physically similar watersheds under different management histories, using a "space for time" comparison approach.

Historical evidence of environmental conditions in the Upper Tucannon and Pataha watersheds are summarized in a report developed for the Interior Columbia Basin Ecosystem Management Project by Beckham (1995). The earliest Euro-American written mention of the Tucannon River was by the 1805-1805 Lewis and Clark expedition. On May 3rd, 1806, Meriwether Lewis, accompanied by three members of the Walla Walla Tribe, wrote observations of the Tucannon watershed including this statement: "this creek is about 12 yds. wide pebbly bottom, low banks and discharges a considerable body of water". Given the time of year, the stream was probably under the influence of melting winter snows. And, "the bottoms of this creek are narrow and with some timber principally Cottonwood and willow…the hills are high and abrupt", evidence of vegetation and landform. The Lewis and Clark expedition followed an established Nez Perce trail, which led from the Walla Walla to the Tucannon, and continued east along Pataha Creek.

Fur trappers and missionaries passed through the valley of the Tucannon in the 1830's. Louis Raboin, a French Canadian fur trapper, established the first settlement in 1855. Settlement and development of the valleys did not begin until the 1870's, after the regional wars between the U.S. Army and America Indian tribes. Even by the time Columbia County was formed in 1875, there were fewer than 200 settlements and a population of less than 500 (Gilbert, 1882 as quoted by Beckham). By the 1880's, livestock grazing, wheat production, development of power and transportation networks, and logging were changing the landscape of the Tucannon and Pataha watersheds.

Beckham (1995) analyzed the notes of land surveyors who conducted their work between 1864 and 1915 providing a glimpse of stream, vegetation, and wildlife conditions in this pre-industrial period. The records made frequent note of abundant cold, clear water and streams that "abound with fish". The heavily vegetated stream corridor provided buffer and shade to the streams (Beckham 1995).

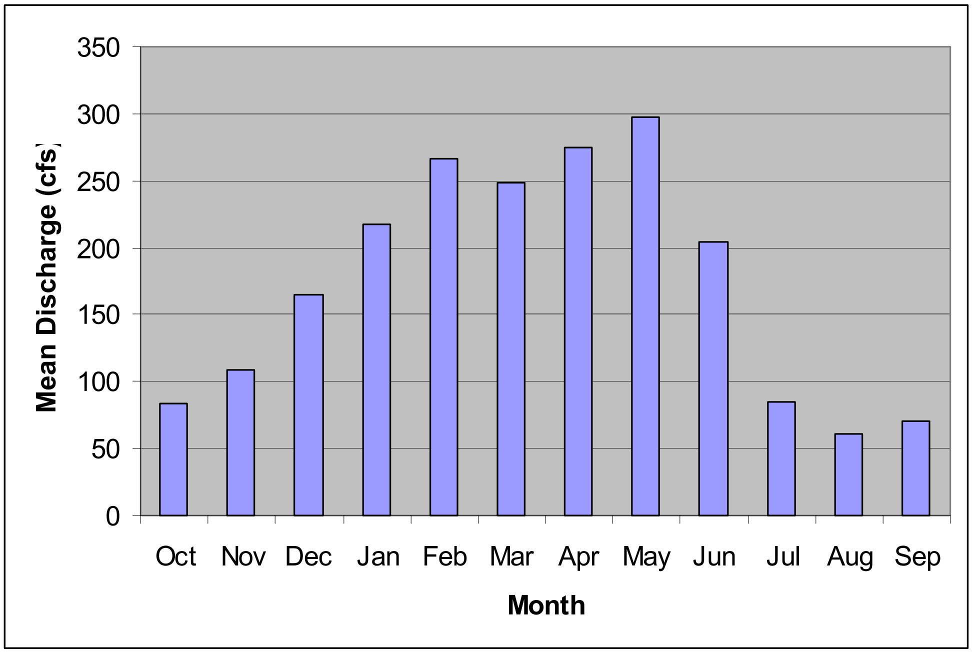
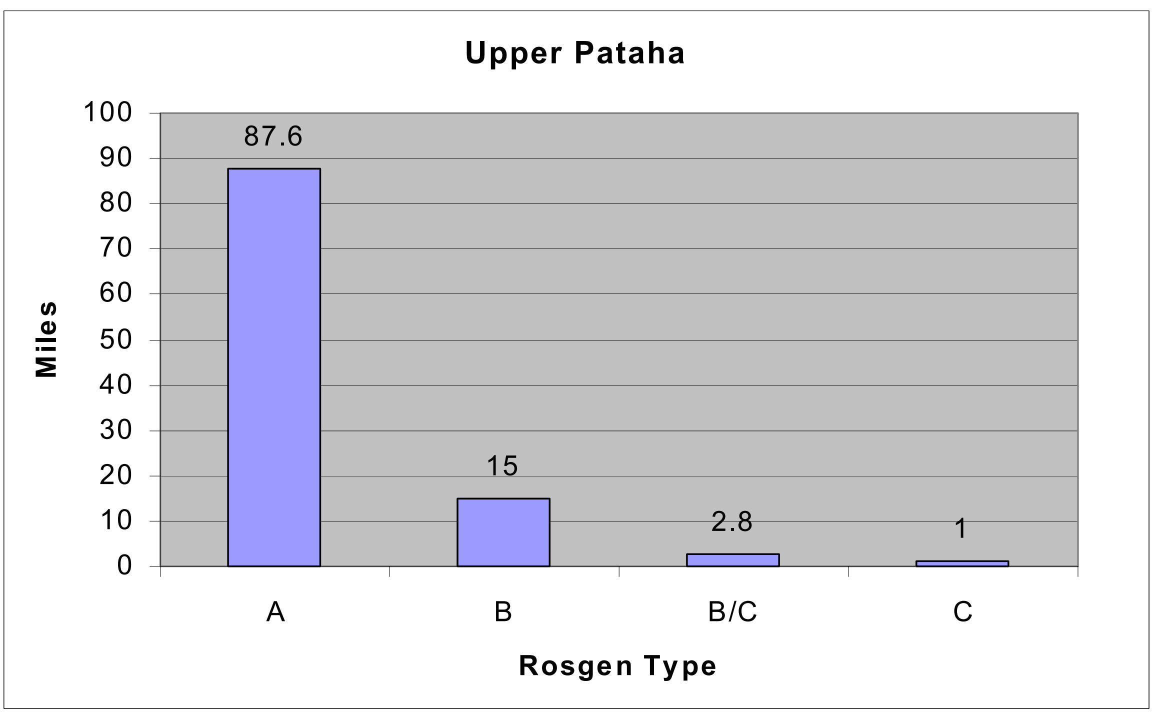


Figure 3-1. Monthly mean discharge for the Tucannon River near Starbuck for the period 1915-2000, (U.S. Geological Survey gage #13344500).



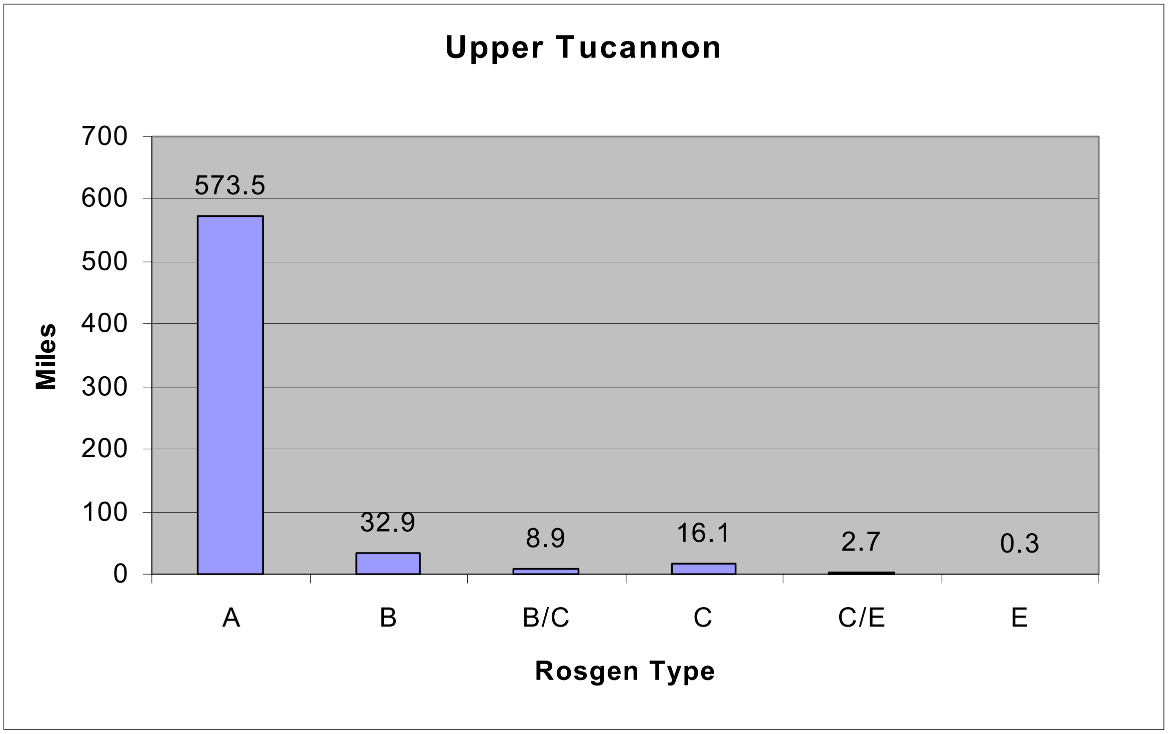


Figure 3-2. Rosgen stream types in the upper Tucannon and Pataha watersheds).

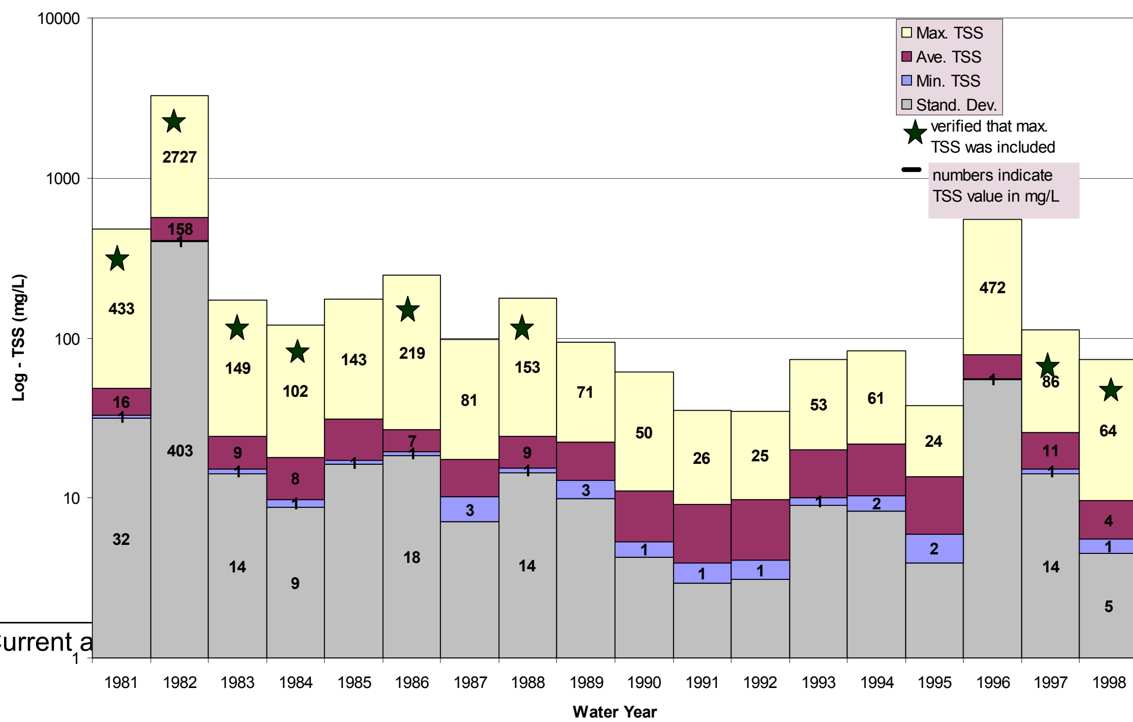


Figure 3-3. Maximum, mean, minimum and standard deviations of total suspended sediment by water year in the Tucannon River at the Forest boundary (1981-1998).

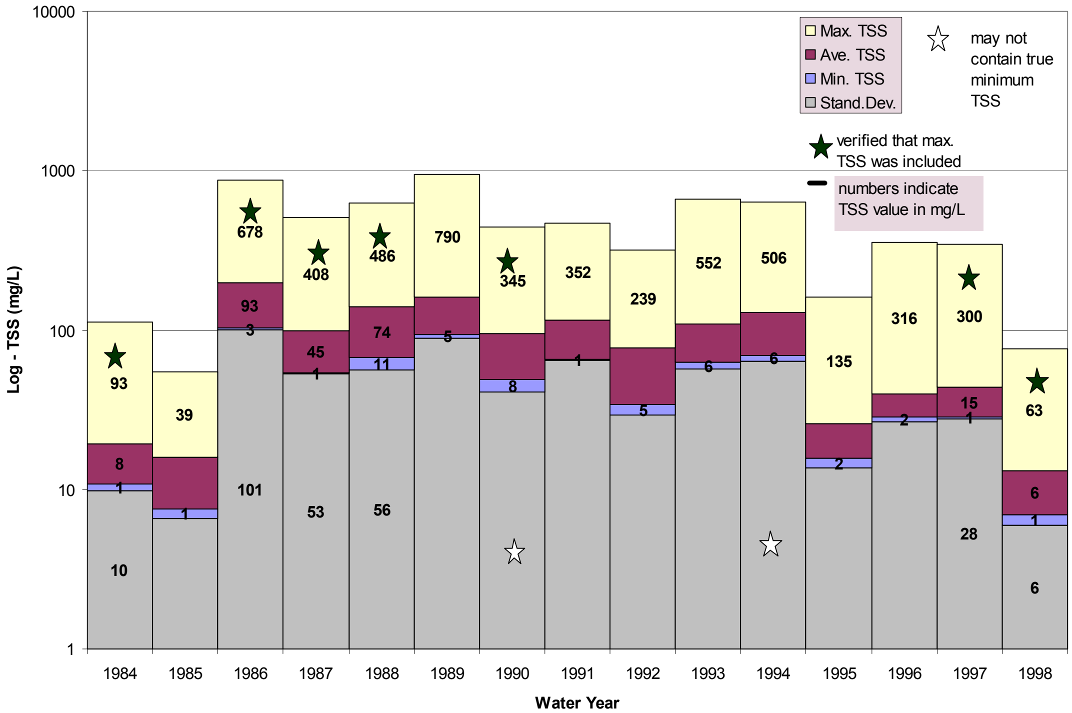


Figure 3-4. Maximum, average, minimum and standard deviation of total suspended sediment by water year in the Tucannon River at Panjab (1984-1998).

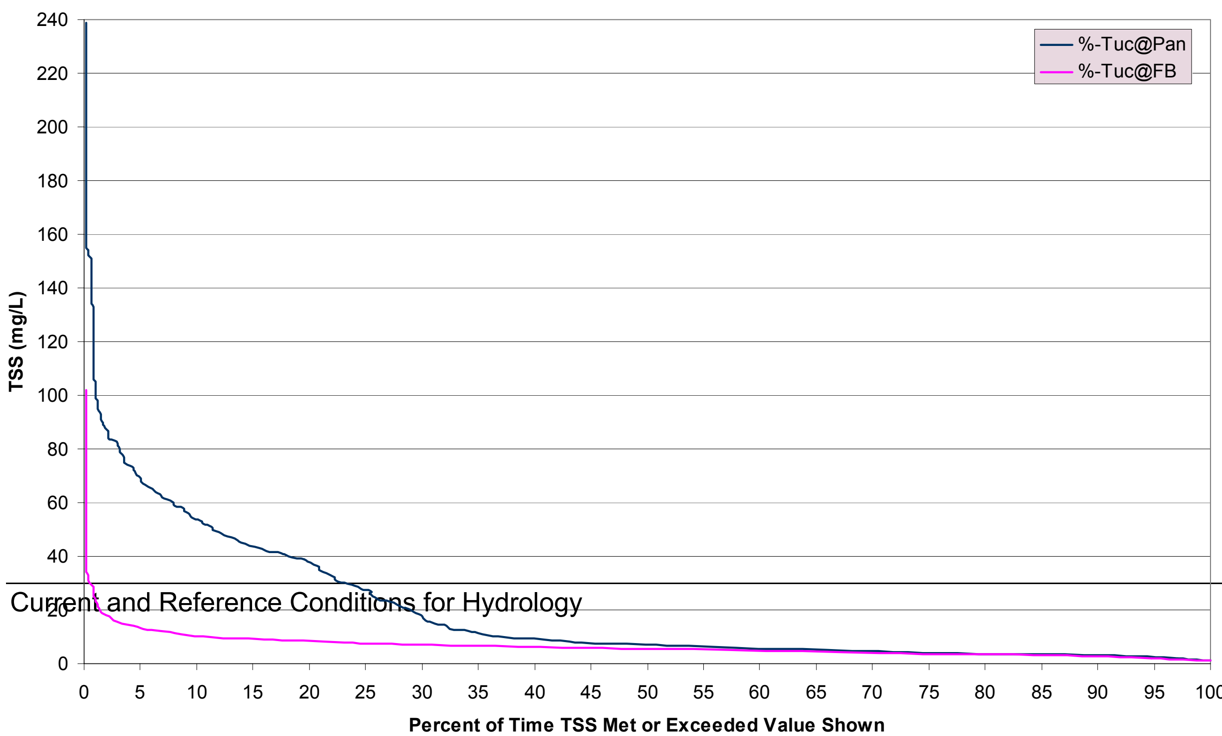


Figure 3-5. Percent of days the Tucannon River met or exceeded the total suspended sediment values shown from January 25 to September 6 (data from 1984, 1992, and 1998).

CURRENT AND REFERENCE CONDITIONS FOR AQUATICS

Editors note: The source of information in this chapter is the Draft Tucannon Subbasin Summary, August 3, 2001, Prepared for the Northwest Power Planning Council. The Draft document is available on the Columbia Basin Fish and Wildlife Authority Internet site at [*http://www.cbfwa.org/files/province/plateau/subsum.htm*](http://www.cbfwa.org/files/province/plateau/subsum.htm)

Chapter Overview

The fisheries discussion considers the entire Tucannon River watershed and the Columbia River Basin with an emphasis on habitats in the analysis area on the National Forest. The contemporary character of the fish habitat in the Tucannon drainage has been shaped through natural disturbance and human use of the land and water. Road building and maintenance, urban and agricultural development, rural development, grazing, tilling, deforestation, water regulation, and flood control structures have combined to alter vegetation, soil properties, topography, runoff, water temperatures, instream flows, and sedimentation. Changes to the watershed processes have yielded a mosaic of aquatic habitat ranging from high quality in the headwaters to severely degraded lower in the drainage. The most severely degraded fish and wildlife habitat areas tend to be below the Forest boundary in the lower portions of the Tucannon and Pataha watersheds where most development and human alteration of the landscape has occurred.

Current Fish Habitat Conditions

Fish habitat below the Forest boundary has been degraded as a result of farming, grazing, logging, road development, concentrated recreation, and catastrophic floods, which have occurred with greater frequency in recent years. Agricultural and livestock management practices coupled with the local soil types and climate have contributed to increased sedimentation and a general reduction of riparian vegetation and instream cover. Loss of riparian vegetation, and water withdrawal has likely contributed to the elevated stream temperatures observed in the lower half of the subbasin. Diked stream reaches have likely impacted fish production as well by reducing pool habitat and riparian area.

Fish production is low in the first 20 miles of the Tucannon River, which is too warm in the summer to provide suitable rearing areas for juvenile chinook. The Tucannon River below Pataha Creek confluence (RM 10) has the poorest physical habitat for salmonids (WDF 1990). The principal constraints are 1) elevated summer stream temperatures at or above upper lethal limits for salmonids, 2) heavy sedimentation deposits that infiltrate gravels, 3) flash flooding events, 4) irrigations diversions, 5) lack of riparian vegetation, 6) unstable stream banks, and 7) problems associated with livestock management. Steelhead rearing habitat also decreases below Marengo (RM 24). Elevated stream temperatures can be largely attributed to loss of riparian vegetation from historic and recent flood damage and riparian grazing. Stream volume reductions associated with irrigation also have an impact on water temperature, and that quantity and quality of instream habitat. The upper Tucannon River on state and federal land has good to excellent spawning and rearing habitat for spring chinook, steelhead, bull trout and whitefish.

The Tucannon River is an adjusting and evolving stream. Many of these changes are related to land uses in the subasin. During the past several decades, the Tucannon River has undergone fundamental changes in flow regime, bed conditions, water quality, and habitat values. The form of the Tucannon River below Willow Creek (RM 13) is still undergoing long-term adjustment. Most channel changes in the lower river pre-date extreme floods that occurred in the 1960's and 1970's. Changes in Pataha Creek seem to have occurred in the first 30 to 50 years following establishment of the region's agricultural economy, and changes observed above Willow Creek took place during the 1964 to 1978 interval (Hecht *et al*. 1982). Hecht *et al*. (1982) identified an evaluated change in the riparian area and streambed channel conditions of the Tucannon River between 1937 and 1978. These changes suggest a 33 to 55 percent decrease in riparian woodland during this time period, much of which was attributed to major floods after 1964. Flood periods were determined to have had their greatest impacts in the middle and upper reaches of the river, while alterations below Marengo pre-date these events. The authors attributed some of the woodland loss to encroachment of other land use practices, principally irrigated fields, and pasturelands. As wooded riparian zones were replaced with open areas, shade was diminished and the riverbanks likely became less stable. The authors could not determine whether the biggest influence in the loss of riparian woodland was flooding or land use practices (Hecht *et al*. 1982).

Stream Geomorphology

Changes in stream physical features have contributed to the Tucannon River's degraded fish habitat condition (Tucannon MWP 1997). Some of those changes include:

- The river has become wide and shallow, causing increased exposure of water surface to solar radiation and high summer air temperatures.
- Large woody material is lacking in the channel for pool formation and fish cover and on the streambanks for future recruitment.
- The stream has been shortened from a meandering river, narrow and deep channel to a straighter, sometimes braided and/or wider and shallower channel, with an overall increased water velocity. These changes have resulted in the loss of quality fish habitat.
- Streambank stability has been diminished due to the loss of root systems of woody material growing on the streambank and an increase in streambank erosion.

Table 4-1 displays a comparison of pool habitat with geomorphic potential. Most reaches on the Tucannon River have a fraction of the natural pools they had in pre-settlement times. The number of pools that could exist in this stream type is one pool for every 5 to 7 bankfull discharge widths. This relationship between the number of pools and bankfull discharge width is described in Leopold (1994) applies to 99 percent of the 12 reaches inventoried on the Tucannon River. A river this size in a stable geomorphic condition could support and maintain this number of pools.

Following the severe flood stage events of the 1960's and 1970's, there was an increase in the size and frequency of peak flow events (Hecht *et al.* 1992). The summary (Hecht *et al*. 1992) states, "We concluded that the channel form is adjusting to increased runoff, much-diminished bank stability and the related major increase in coarse sediment loads. Unlike most streams adjusting to greater or more frequent peak flows, hydraulic roughness of the Tucannon River has apparently decreased as riparian woodlands were lost and as the bed filled with gravel from the banks."

Table 4-1. A summary of stream inventory data collected on the Tucannon River. Federal land is found on reaches 9-12. (Modified from Tucannon MWP 1997)

Reach	Reach Description	Length	Large Pool/ mile	Large Pools	Large Pools with LWD	Small Pools	Small Pools with LWD	Poten-tial Pools	Dominate Stream Types
1	Snake R. Con-fluence to Kellogg Hollow Road Bridge	2.5 (4.6)*	20	50	14	28	9	42	C4 F4
2	to Smith Hollow Road Bridge	3.2 (3.25)**	10	32	6	21	2	72	B4c F4
3	to Pataha Confluence	3.7 (3.71)**	16	59	22	36	10	72	B4c, D4, C4
4	to section 2 Bridge	5.7 (5.9)**	13	74	32	75	27	117	B4c, F4 D4 some C4
5	to King Grade Bridge	4.0 (4.0)**	10	42	16	37	11	85	B4c, F4, D4
6	to Marengo Bridge	3.4 (3.75)**	9.4	32	12	27	11	82	B4c, D4, F4
7	to section 25 Bridge	3.1 (3.2)**	7.1	22	1	12	1	72	B4c, C4 D4 and F4
8	to Hartsock Grade Bridge	1.8 (2.5)**	3.3	6	2	9	0	56	B4c and B3c C4 D4 and F4
9	to Tumalum Creek Confluence	1.7 (2.27)**	7.1	12	3	9	0	54	B4c&B3c C4 split D4
10	to Cummings Creek Confluence	(2.1)**	12.4	26	2	16	1	52	B4c and B3c C4 & F4
11	to USFS boundary sections 35 & 2	3.0 (3.0)**	7.7	23	6	20	3	83	B3c, B3, C3 C4, F3 some B2
12	to bridge at Tucannon Campground	4.3 (4.4)**	11	47	12	61	6	121	B3c, F3 C3, D4 some B2

* Distance from Snake River Confluence to Smith Hollow Road Bridge is 4.6. Stream inventory starts at old railroad bridge instead of confluence.
** NRCS reach distance - the values in parenthesis

Both the 1982 and 1995 stream inventories support the conclusion that the Tucannon River is in an unstable condition. Past flood control projects have resulted in diked channels in many areas, which do not allow the river to dissipate its flood energy across a floodplain, as it would have in the past. Road construction and maintenance, channel realignment after flooding, agricultural production, forest management, and urban development has caused changes in the natural flow characteristics of the river.

On February 7 and 9, 1996, a rain-on-snow event with strong warm winds following 2 weeks of cold weather caused the Tucannon River to reach a flood crest stage of 5,580 cfs (provisional). This flood flow was followed by two other flood flows on April 25, 1996 (1,230 cfs) and on January 1, 1997 (3,500 cfs). The highest previously recorded flow was recorded on December 22, 1964, and measured 7,980 cfs, which was eight times the bankfull dimension. The February 1996 flow was equivalent to five and a half times the established bankfull flow (Leopold 1994). After the flood, stream corridor conditions were compared with conditions recorded prior to the flood.

As bankfull and higher flood events occurred after the channelization efforts of the 1960's and 1970's, bedload gradually accumulated in the system, which raised the channel bed. Consequently, when large flow events occurred three times in an 11-month period, the river changed locations in several places and developed braided channels in other areas. This caused extensive damage to improved property and structures, particularly around bridges and in areas where the river had a high width-to-depth ratio.

Major changes in the Tucannon River since the flood include increased width-to-depth ratios, decreased streambank stability, increased bedload mobility and deposition, and increased frequency of large pools with large woody debris. Braided channel reaches and degraded channels, with center bars are more common since the floods. Streambank stability has been decreased significantly by increased bedload movement, which has deposited gravel bars in the channel. These bars, especially center bars, reduce streambank stability by increasing the amount of water being directed at the streambanks.

The stream banks are especially susceptible to streambank erosion because many of the trees and shrubs have been undercut and have fallen into the channel. The amount of unvegetated stream banks has increased by 15 to 25 percent in some areas. Reproduction of seedling cottonwoods, alder and willow species has been successful in some areas where bare stream banks are open to colonization. Due to the loss of trees along the stream corridor, canopy cover has been reduced by 5 to 15 percent in different stream reaches. This will negatively affect the stream temperature for several years until larger trees are established along the streambank. In some areas above Marengo, large woody debris has been reestablished in the stream corridor. This material has contributed to an increase in pool formation since the floods. Table 4-2 displays a summary of some important geomorphic and riparian changes that occurred during flood stages of 1996 and 1997.

Changes in Fish Habitat and Impacts to Fish

In addition to the re-inventory of the river conducted by the Technical Advisory Committee (TAC), the WDFW conducted habitat surveys during June 1996 to compare pre- and post- flood habitat conditions for selected sections of the river. In order to be consistent with surveys conducted by WDFW in past years, a “pool” was defined as an area where the velocity of the river thalweg becomes noticeably slower and the water is at least 0.5 feet deep with a surface area less than or equal to one square foot. Though these criteria result in much smaller pools than required by adult chinook, the ratio of total pool surface area to that of riffle and run (or glide) within each section should be comparable for pre- and post-flood conditions since riffles and runs were defined similarly by the TAC. For chinook habitat, only “large pools” at least 3 feet deep and 25 square yards were considered by the NRCS and USFS (MacIntosh 1993).

Table 4-2. Stream shape and riparian condition is summarized from the 1996 and 1997 floods (Tucannon MWP 1997).

Tucannon River Feature	February Flood 1996	New Years Flood 1997	Effect
Flow (provisional) Bankfull discharge at Starbuck is 975 cfs.	5580 cfs	3500 cfs	Structures and agricultural fields sustained significant damages.
Streambank Erosion and Stability	Substantial damages. Many banks are eroded and exposed. Occasional dike failures caused additional damages.	Additional streambank erosion since February flood.	Negative, loss of property and/or structures.
Lateral Migration	Increased	Increased	Negative or positive, depending on land uses and meander length.
Bedload Aggradation	Increased Bedload. Aggradation increased substantially after early 60s and 70s dike projects. The potential negative impacts on bridges increased yearly.	Accelerated, due to constructed alluvium berms washing out and less bank stability following 1996 February flood. Aggradation above some bridges will cause severe flow restrictions at flood stage.	Negative, damages to bridges and structures. More bedload introduced than system is capable of moving. Dikes built with High W:D accelerate problem.
Width-to-Depth Ratio (A measure of channel width vs. depth at bankfull stage.)	Increased in areas where channels were diked or braided.	Increased in many areas, especially where river channels were diked, braided or multi-center bars existed.	Negative, affects temperature and river has less capability to move bedload
Sinuosity	Increased	Increased	Positive, for geomorphic stability but potentially negative to improved property.
River Braiding	Increased, especially in areas where river was previously braided	Increased	Negative, adversely affects temperature, salmon habitat and streambank stability.
Pools	Increased due to LWD and lateral movement.	Increase due to LWD and continued lateral movement.	Positive, river system is severely lacking pool habitat
Canopy Cover	Significantly reduced.	Reduced.	Reduced shade and increased water temperature.

There was too much flow to count large pools in the lower sections of the river when the TAC surveyed it in November 1996. The upper sections were surveyed in colder weather and large pools were more easily recognized. According to raw data collected by WDFW (Bumgarner, WDFW, per. com., 1997), in reaches 7 - 10 the surface area for:

- Pools remained the same, but there were more large pools with large woody debris.
- Riffles decreased by 21 percent.
- Runs increased by 63 percent.
- Side channels increased by 80 percent.

According to a report by WDFW (Viola 1997), the number of pools in reaches 11 and 12 decreased by 62 percent and the surface pool area by 66 percent. Viola stated, however, that the remaining pools are larger and have much more large woody debris than pre-flood. He also noted that the mean depth of pools increased by 93 percent. He reported that this part of the stream had lost 25 percent of its shade and 47 percent of the overhanging vegetative cover. The TAC re-inventory noted that the number of large pools in reach 8 improved from 6 in 1994 to 9 in 1996. In reach 9, the number of pools decreased from 12 to 5 and had the least amount of large woody debris per pool. The number of pools decreased from 26 to 12 in reache 10; reach 11 contained the same number of pools (25).

Short-term impacts to steelhead and chinook likely occurred as a result of the floods (Tables 4-2 and 4-3). The April flood may have had the most impact to steelhead and the least impact to chinook. This flood occurred during the peak of steelhead spawning and the streambed was still very unstable from the February flood. The chinook were likely affected most by the January and February floods because most of the eggs and pre-emergent fry were washed out of the gravel or were probably buried by bedload deposition and sediment.

The long-term fisheries impacts from flooding may be fewer adult chinook salmon return from either of the two spawning seasons affected by floods. Poor returns of adult steelhead may also result. On state and federal lands (reaches 9 - 12), there may be better spawning and rearing areas available for future runs, but temperature problems will likely increase due to increased width-to-depth ratio and reduced shade. On private lands (reaches 1 - 8), large woody debris has increased, which will provide pool building materials and instream cover for many years provided that it is not removed. Early intervention by the Columbia Conservation District (CCD) to encourage landowners to maintain and secure large woody debris will be beneficial and will increase the number of large pools. The river has gained sinuosity and some portion of its former floodplain. This will increase geomorphic stability and large, high quality pools as long as new meander patterns are maintained and the river is not restored to its former entrenched and channelized condition.

Table 4-3. Short-term effect on chinook and steelhead from the 1996-1997 floods in the Tucannon subbasin,Washington (Tucannon MWP 1997).

Species life stage	February - 96	April - 96	January – 97
Spring chinook Adults	no impact, none present	no impact, none present	no impact, none present
Spring chinook Juveniles	serious loss of pre- and emergent fry, heavy loss of fingerlings, light to moderate loss of smolts	moderate loss of fry, light loss of fingerlings and smolts	same as Feb –96
Fall chinook Adults	no impact, none present	no impact, none present	no impact, none present
Fall chinook Juveniles	serious loss of pre- and emergent fry; no impact to fingerlings/smolts	light to moderate loss of fry fingerlings/smolts	serious loss of pre- and emergent fry; no impact to fingerlings/smolts
Steelhead Adults	light loss	light to moderate loss	light loss
Steelhead Juveniles	light to moderate loss of eggs; moderate loss of fingerlings; light to moderate loss of smolts	heavy loss of eggs and pre-emergent fry; light loss of smolts	light to moderate loss of eggs; moderate loss of fingerlings; light to moderate loss of smolts

Some of the instream habitat structures such as boulder clusters, rock weirs, and log weirs were either washed downstream or buried. Most of these habitat improvements were completed by WDFW during the mid-1980’s when low flows were most common but they could not sustain a big flood. CCD facilitated habitat and streambank stability structures installed summer 1996, after the 1996 floods, sustained minor damage, mainly cosmetic not functional, in the 1997 flood. Similar habitat enhancement structures installed between 1997 and 1999 are functioning as designed requiring minor maintenance only to enhance fish habitat value and potential use.

There has been a significant alteration of the Tucannon River and its floodplain over the past 65 years. In a report of habitat conditions in 1935, MacIntosh (1989) reports that the Tucannon floodplain above Marengo was densely wooded, principally with conifers. Numerous groves of cottonwood and alder were present in the lower stretches of this area. Further, he reports that there was some scattered alfalfa fields above Marengo but those were not abundant. Below Marengo, a fringe of cottonwood, alder, willow, and brush bound the river.

Currently, from the mouth to Cummings Creek (RM 34.5) floodplain connectivity and function is restricted by some means of diking or levees along an estimated 34 percent of the rivers’ length (S. Martin, WDFW, per. com., 2001). This area is primarily in private land ownership with approximately 1 percent in public ownership. In this 34.5 mile reach, the river has been significantly straightened, losing about 30 percent of it’s pre-1960's flood length which has resulted in higher water velocities and less pool habitat. To maximize land use, agriculture, development and transportation, the floodplain has been isolated from the river by the construction of these dikes and levees. Protecting these capital investments has resulted in a poor and narrow riparian zone and lack of shade. Water temperatures are in excess of 75°F in lower areas of this reach and get as high as 80°F or more at the mouth. Kelley *et al.* (1982) believes that elevated water temperature is an unnatural condition and that it began with the reduction of shade from riparian vegetation during the flood of 1964-1965. They also believe subsequent floods and channelization have made the problem worse. After correlating measures of the quantity and quality of salmonid rearing habitat in different reaches of the stream, Kelley *et al.* (1982) estimated that a program of restoring shade to the Tucannon River from River Mile 32 to Pataha Creek (RM 11.2) would nearly double the number of young salmon and steelhead that could be reared. A program of creating pools in the upper area would increase the juvenile salmonid populations by 50 fish per pool created.

Above RM 34.5 on public land owned by WDFW and USFS and a small piece of privately owned land floodplain connectivity and function is restricted by some means of dike or levees along approximately 13 percent of the river (T. Bruegman, CCD and S. Martin, WDFW, per. com., 2001). The floodplain has been isolated from the river by these dikes and levees to protect capitol investments including Camp Wooten Environmental Learning Center (Washington State Parks), man-made impoundments for a recreational put-take fisheries, fish hatchery and salmonid acclamation facility, transportation system and recreational use facilities and campgrounds. The riparian zone and floodplain in this upper reach is currently impacted by camping activities. Although the river may access the floodplain throughout the majority of this 40-mile reach, the riparian condition is less than ideal. Aerial photographs show substantial open areas and only 2 to 3 layers of vegetation. Streambank stability, and associated instream habitat is in poor condition in this reach. Martin (1992) concluded that in 1991, bull trout harvest and habitat impacts by human activities significantly impact this species. Specifically, of four Blue Mountain streams studied, the Tucannon River had the greatest land use and stream disturbance. Impacts include a maintained road, horseback trails, camping sites, and cattle grazing. Stream disturbances included cattle grazing, removal of riparian vegetation by campers, and human disturbance.

Forest Service has not grazed cattle in the Tucannon River watershed since 1996. Also during this period of time, both the WDFW and USFS made concerted efforts to move campsites away from the streambank in concert with PACFISH standards.

Instream Fish Habitat

Instream habitat use by bull trout and steelhead trout is well documented in the Tucannon River (Martin 1992; Bumgarner 1999; Viola 1991). In 1991, Martin (1992) found that juvenile bull trout growth, abundance, and condition were lower in the Tucannon River than in Mill Creek, which is an adjacent protected watershed. Habitat conditions were also found to be less desirable in the Tucannon River. Scour, pool, and cascade habitat were less available in the Tucannon River than in Mill Creek. Further, sub-adult bull trout were more often found in sites containing undercut banks and sites with woody debris. These habitat types were more frequently encountered in Mill Creek than in the Tucannon River. Martin (1992) reports a strong relationship between sub-adult bull trout and sites containing boulders, overhead cover less than 1 meter above the water, woody debris in the water, undercut banks, and surface turbulence.

Kelley *et al.* (1982) reported that in 1981 only 4 percent of the Tucannon River's length was comprised of pool habitat. Seidel *et al.* (1985) found that 11 percent was pool habitat, while Martin (1992) found pool habitat to comprise 10 percent of the total area above the Tucannon Hatchery. Kelley *et al.* (1982) reported that the common cause for a pool was the redirection of current against erosion resistant substrate or logjams. They report that in the reach between River Mile 32 and Marengo (RM 24), the banks were nearly entirely rip-rapped, preventing pool formation. Of 18 reaches studied between Sheep Creek and Powers Bridge, 12 had significant portions of the banks altered and rip-rapped.

In general, all elements of fish habitat below the analysis area are in poor condition in the Tucannon River from Bridge 14 (RM 32) downstream. Levees have resulted in few off-channel rearing habitats, restriction of the river to access the floodplain, an increase in the magnitude and periodicity of floods, poor riparian zones, the inability of large woody debris to enter the channel, and a decrease in the number of pools. Land use impacts have resulted in increased sediment which impacts egg survival, water infiltration and subsequent runoff, and a reduction of properly functioning riparian areas. Above bridge 14 to Panjab Creek, pool habitat, large woody debris, riparian vegetation and off channel habitat are considered poor while above Panjab Creek, juvenile salmonid rearing habitat conditions were considered by Kelley *et al.* (1982) to be fair to good.

Stream Survey Data on the National Forest

An ongoing stream survey effort for streams on the National Forest has been active since 1992 using the methods in the Stream Inventory Handbook, USDA Forest Service, Region 6. Thirteen streams with approximately 70 miles of habitat in the Tucannon analysis area have been surveyed with resurveys on the Tucannon River, Little Tucannon River, and Cummings Creek following the 1996 flood flows. In 1995 stream reaches of 1 to 1.5 miles were selected on the Tucannon River above Sheep Creek, Little Tucannon River, and Panjab Creek for a more intensive documentation of fish habitat with annual survey as representative reaches. Representative reaches on Hixon Creek and Meadow Creek were added in recent years.

Data from the stream surveys document good to excellent fish habitat conditions on the National Forest. Tucannon River headwaters and tributaries Bear Creek, Sheep Creek, Cold Creek, Panjab Creek, Meadow Creek, and Turkey Creek can be described as excellent fish habitat streams within wilderness or in relatively unmanaged portions of the Forest with near natural conditions and cold water supporting native fish species including bull trout. Fish habitat conditions in Pataha Creek on the National Forest are described as good to fair with evidence of past logging and cattle grazing. Two culverts at road crossings are found in the first stream reach with step weirs to improve fish passage. Brook trout are found throughout Pataha Creek on the National Forest. Bull trout are not present. The Tucannon River from the Forest Boundary to Panjab Creek confluence with the tributaries Cummings Creek, Hixon Creek, Little Tucannon River and Tumalum Creek are rated fair to good fish fish habitat. Summer water temperatures increase as we look downstream. Bull trout are found in the mainstem Tucannon River but may not be found in tributaries on the National Forest below Little Tucannon River. The Tucannon River was bull dozed below its confluence with the Little Tucannon River following the 1964 flood. This stream reach has been diked and shortened contributing to decreased fish habitat quality and lack of floodplain connectivity. Fish habitat restoration opportunities in the Tucannon analysis area are found in the lower reaches of the Tucannon and its tributaries and Pataha Creek.

Riparian/Floodplain

Riparian/floodplain habitat is limited and highly vulnerable to degradation from various human activities and development. Riparian/floodplain habitat within the subbasin contains cottonwoods, willows, and various shrub species. Since the arrival of settlers in the early 1800's, from 50 to 90 percent of riparian habitat in Washington has been lost or modified. Riparian zones along the Tucannon River have been lost and fragmented by agricultural development. Habitat improvement projects are ongoing within the floodplain. Due to fire suppression and the lack of timber harvesting along the WDFW riparian area, native tree species such as cottonwood and brush such as willows have been replaced by conifer species. Riparian habitat supports beaver, muskrat, otter, amphibians, reptiles, passerines, waterfowl, whitetail and mule deer, and many other species.

Fish Status

The Tucannon River supports a diverse collection of anadromous and resident fish species throughout the subbasin (Table 4-4). These are described individually below

Spring Chinook

Prior to the late 1800's, there was an annual spawning return (escapement) of Snake River spring/summer chinook salmon that may have exceeded 1.5 million fish (Bevan *et al.* 1993). By 1975, escapement was down to only 122,500 in the Columbia River (WDF *et al*. 1990), or 8 percent of the historic run. The 1994 return of 1,822 fish, 0.12 percent of the historic run, was the lowest ever recorded, to that time. The estimated escapement into the Tucannon River was 140 fish that year. In 1995, the return to the Tucannon River was only 54. These counts set new record low numbers. Since then, returns have varied from 144 to about 250 each year (Bumgarner *et al*. 2000). Snake River spring/summer and fall chinook were listed by the National Marine Fisheries Service (NMFS) as "threatened" species on April 22, 1992. A petition to further list them as endangered is pending based on the outcome of proposed changes to the Endangered Species Act (ESA) (Griffin 1995), even though the 2001 spring chinook return to the Snake River is expected to be the highest in many years (greater than 100,000 fish into the Snake River).

The U.S. Bureau of Fisheries, now NMFS, recorded the first scientific documentation of chinook in the Tucannon River, and conducted fish habitat surveys in February and June of 1935 (Parkhurst 1950). In 1938, the Columbia River Investigation Team attempted to trap and count all adult chinook that entered the river. Unfortunately, the trap washed out after only 24 fish were trapped. The sport fishery claimed another 26 fish. Later that year, surveyors failed to find any sign of spawning.

Parkhurst (1950) cites local residents as saying that the last large run of spring chinook occurred in 1915, at which time, "It was reliably estimated that an average of 500 salmon per day entered the river during the spawning migration, which lasts through May and June." These figures indicated annual returns, prior to 1916; of up to 30,000 spring/summer chinook may have occurred in the Tucannon River.

By 1935, the chinook run in the Tucannon River was already so depleted that surveyors commented, "The Tucannon is apparently of little value as a salmon producer at present. However, it has excellent potential value, and could support a good run if provisions were made for passage of fish over existing obstructions, and all diversions were adequately screened to prevent the destruction of downstream migrants."

Table 4-4. Fish species present in the Tucannon subbasin, Washington (Mark Schuck, WDFW per. com., 2001)

Species	Origin	Status
Bull trout (*Salvelinus confluentus*)	N	C/I
Steelhead trout (*Oncorhynchus mykiss*)	N	C/D
Spring Chinook salmon (*Oncorhynchus tshawytscha)*	N	C/D
Fall Chinook salmon (*Oncorhynchus tshawytscha)*	N	O/S
Mountain whitefish (*Prosopium williamsoni)*	N	O/U
Brook trout (*Salvelinus fontinalis)*	E	O/U
Pink salmon (*Oncorhynchus gorbuscha*)	E*	O/U
Northern pikeminnow (*Ptychocheilus oregonensis)*	N	C/S
Longnose dace (*Rhinichthys cataractae*)	N	C/U
Speckled dace (*Rhinichthys osculus)*	N	C/U
Redside shiner (*Richardsonius balteatus*)	N	C/U
Chiselmouth (*Acrocheilus alutaceus*)	N	O/U
Peamouth (*Mylocheilus caurinus*)	N	O/U
Largescale sucker (*Catostomas macrocheilus*)	N	O/U
Longnose sucker (*Catostomas catostomas*)	N	C/U
Bridgelip sucker (*Catostomas columbianus*)	N	C/U
Pacific lamprey (*Entosphenus tridentatus*)	N	O/S-D
River lamprey (*Lampetra ayresi*)	N	O/S-D
Torrent sculpin (*Cottus rhotheus*)	N	O/D
Margined sculpin (*Cottus marginatus*)	N	C/S
Piute sculpin (*Cottus beldingi*)	N	C/S
Brown bullhead (*Ictalurus nebulosus*)	E	O/U
Smallmouth bass (*Micropterus dolomieui*)	E	O/S
Bluegill (*Lepomis macrochirus*)	E	O/U
Crappie (*Pomoxis spp.*)	E	O/S
Channel catfish (*Ictaluris punctatus*)	E	O/S
Grass pickerel (*Esox americanus vermiculatus*)	E	O/U
Pumpkinseed (*Lepomis gibbosus*)	E	O/U
Carp (Cyprinus carpio)	E	O/S
E=Exotic, N=Native, A=Abundant, C=Common, O=Occasional, U=Unknown, S=Stable, I=Increasing, D=Decreasing		

* This species has been documented only one year.

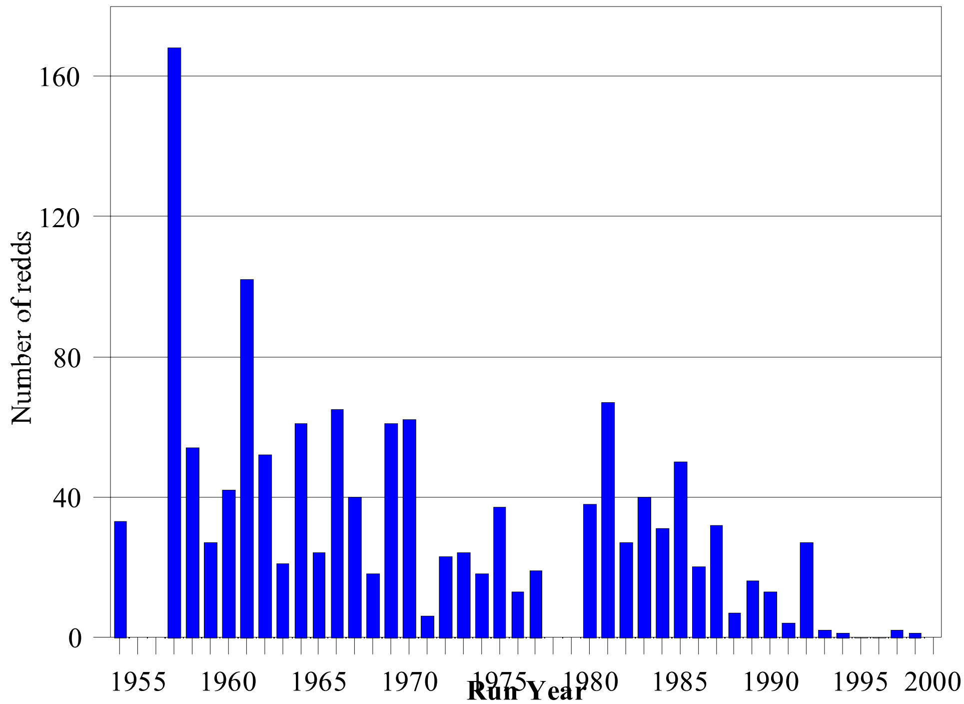


Figure 4-1. Spring chinook redds in historic index (RM 42-45) (Bumgarner* et al. *2000).

The Washington Department of Fisheries (WDF) estimated that from 100 to 3,000 chinook still entered the river each year prior to 1954 (Edson 1960). The WDF first began yearly surveys in 1955 to count redds between the Camp Wooten Bridge and the Cow Camp Bridge. These redd counts were used to show the relative escapement trend over the years. This trend in the historic index reach has been downward since surveys began (Figure 4-1), but since 1985 the abundance of redds in the index areas have been influenced by downstream broodstock collection for the hatchery program. In 1984, the entire river was surveyed in order to better relate the redd counts from the 3-mile index reach to the rest of the river. Since then, this counting method has been refined and the index areas have been expanded.

In 1985, the WDF installed a temporary trap near the Tucannon Hatchery to capture upstream-migrant adults and a juvenile trap at RM 13 to capture downstream-migrant juvenile fish (see Map 4-2 for hatchery locations). The adult trap was made permanent in 1990. These traps have been used for annual adult counts and tagging studies involving native and hatchery fish, resulting in a more detailed summary of chinook utilization for the entire river.

The earlier redd counts reflect only the number of adults that made it to the upper river to spawn. Historically, the entire mainstem, including all of the shallow spawning areas, was open for sport fishing from late May to mid-July, with a six-fish limit, only two over 20" long. According to information gathered by Johnson (1995), much of this "sport catch" was taken illegally by snagging, gaffing or spearing. The DeRuwe dam was a favorite gaffing site until it was destroyed in the 1964 flood (DeRuwe 1995). Many fish were also taken by using wire-mesh "nets" strung across the river. Johnson (1995) documents a long history of intense salmon poaching in the Tucannon River which had a negative impact on the population and a direct effect on the redd counts. During more recent spawning surveys, WDFW personnel have noted that poaching is still evident (Bumgarner *et al.* 1994). In 1958, WDF changed its sport fishing regulations so that chinook fishing was not allowed upstream of the Tucannon Campground Bridge. Prior to 1964, when WDF first required a sport salmon punchcard, the size of the sport catch in the Tucannon River was unknown. Between 1964 and 1974, annual estimates ranged from over 900 fish in 1966 down to 77 in 1972. Because of the decline in both the sport catch and the number of redds, WDF closed the entire river for chinook sport fishing in 1974. In 1977, WDF closed the entire Snake River for both commercial and sport fishing for adult spring chinook, though sport fishers were still allowed to take jacks, less than 24", until 1985, when all chinook fishing was closed.

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Nez Perce Tribe closed their historic Tucannon River ceremonial and subsistence fishery in 1984. This fishery allowed salmon to be gaffed in their spawning areas. The tribes did not keep a record of their catch, but biologists for the CTUIR estimated the catch at less than 50 fish per year (WDF *et al.* 1990).

The historic numbers of Tucannon River spring/summer chinook had already declined before Bonneville Dam was constructed. Since there is very good documentation of fish losses at these dams, it can be assumed there was a further decline with the completion of McNary Dam in 1953, The Dalles in 1957, and the John Day in 1968. The run was again reduced as a result of the construction and operation of Ice Harbor Dam in 1961 and Lower Monumental Dam in 1969 (see Map 4-3).

The *Lower Snake River Fish and Wildlife Compensation Plan* (LSRCP) was completed in 1976. Mitigation for lost anadromous fish resources was based on escapement estimates derived from counts of adult fish at each dam. In 1996, agencies determined that the Tucannon River accounted for only 3.4 percent, 2,400 adults, of the spring/summer chinook that returned to the Snake River. Two percent of the estimated historic run of 1.5 million fish is 30,000, which supports the pre-1915 run size described by Parkhurst (1950). The Tucannon spring chinook hatchery program began in 1985 in an effort to supplement the native population. However, poor ocean conditions and other out-of-basin factors have caused the population to continue to decline.

Tucannon River spring chinook runs were relatively stable from 1985 to 1993 with a mean run of 550 fish. However, between 1994 and 1999, the average run declined to 196 fish, with record lows in 1994 and 1995. In addition to the poor adult returns, floods during the winters of 1996 and 1997, coupled with relatively low redd counts because of the depressed runs, left the river well below historical carrying capacity. The number of natural smolts from brood years 1994-1996 averaged less than 3,000 fish annually (Schuck 1999). Conversely, an average of 42,000 natural smolts migrated from the 1985-1993 brood years. Adults returning from the three depressed brood years are estimated at only 50-60 total fish.

Fall Chinook

In 1935, local residents told surveyors that until 1922-23, there was a run of chinook that entered the river in the fall, but this run had been "greatly depleted." According to Kelley (1982), WDF thought this run had disappeared prior to 1960, but Lyle Gilbreath, who grew up on the Tucannon River, remembers seeing chinook spawning in late fall below Starbuck Dam during the 1970's. The WDF *et al.* (1990) documents counts made by NMFS that ranged from 20 to 200 redds between 1976 and 1980 near the mouth of the river (Table 4-3). The WDFW has used standardized redd surveys since the fall of 1985 to compare annual spawning densities in the stream reach between the mouth and Starbuck Dam (Table 4-5). In 1990 they extended these surveys to include areas upstream of the Starbuck Dam.

During the 1990-1993 surveys, 88 carcasses were found, of which only 21 were tagged hatchery fish (Bugert *et al.* 1991, Mendel *et al.* 1992 and 1994). Although many of these adult fish are natural, stray hatchery fall chinook from Lyons Ferry Hatchery and the Umatilla River have been documented in the river for several years (Mendel *et al*. 1996, Wargo *et al.* 1999) even though no hatchery fall chinook have been released into this river. Sediment deposition in the lower Tucannon River is expected to have caused poor survival for progeny from fish that had previously spawned in the lower river. Fall chinook have been seen spawning upstream of Starbuck Dam since 1992, when WDFW and BPA constructed a fish ladder (Mendel *et al.* 1994).

Table 4-5. Fall chinook spawning surveys below Starbuck Dam.

Year	Redds	Redds/Mile		Year	Redds	Redds/Mile
1985	0	0		1993	21+7**	3.5
1986	0	0		1994	25	4.2
1987	16	2.7		1995	28+1**	4.7
1988	26	4.4		1996	31+12**	6.9
1989	48	8.0		1997	24+3**	3.3
1990	61	10.2		1998	38+2**	8.5
1991	50	8.4		1999	18+3**	4.0
1992	21+2**	3.5		2000	15+4	3.3

*only for redds below the dam ** redds found above the dam

Coho Salmon

Parkhurst (1950) noted that, according to local residents, the last run of silver (coho) salmon entered the river in October 1929, although "a small number of these fish probably still appear." The Tucannon River coho may have become extinct by 1955 (Kelley *et al.* 1982), though coho were still found within the Snake River system until at least 1986 (Wortman 1993). Edson (1960) reported that sporadic returns of up to 100 adults were still occurring after the Snake River coho sport fishery had been closed during the 1950's. He thought the river could still support a sizeable run of coho. Stray hatchery origin fish, suspected to have originated from smolt releases into the Clearwater River in Idaho, or elsewhere, have recently been observed spawning in the river below RM 5.0 (Wargo *et al.* 1999). Juvenile coho smolts were identified at a WDFW outmigrant trap located on the lower Tucannon River, which may have been produced from redds identified the previous year.

Pink Salmon

Pink salmon have been documented in the Columbia River since at least 1941, but only a few times in the Snake River, most recently in 1975 and 1991. During surveys for fall chinook in the fall of 1975, one male and four female carcasses were found in the Tucannon River, downstream of Starbuck Dam. They appeared to have spawned in the area where fall chinook had spawned

(Basham and Gilbreath 1978). There are no records of hatchery releases of pink salmon into the Tucannon or Snake rivers.

Steelhead/Rainbow trout

According to Parkhurst (1950) at the time of the 1935 survey, a considerable run of steelhead was believed to still enter the river, but not as abundantly as in the past. Unfortunately, they made no estimate of run size at the time, but other researchers estimate the steelhead run could have been between 3,400 and 4,000 adults (Eldred 1960; USACE 1975). Kelly *et al.* (1982) estimated the Tucannon drainage would be capable of producing 280,000 steelhead smolts under improved conditions (see Map 4-5, Map Appendix). Production at this level in the past may have returned as many as 14,000 adults. Parkhurst reported finding only resident rainbows (likely, young steelhead) in the upper portions of tributary streams during the 1935 survey.

Prior to 1970, returns of native steelhead to the Tucannon River were estimated to average 3,400 or 3 percent of the total Snake River return (WDF *et al.* 1990). Using harvest report card data since 1947, Washington Department of Game (WDG) estimated "in-river" sport catches ranged from a high of 689 in 1957 down to 24 in 1973. The sport fishery was closed in 1974, but has been open since 1985 with a requirement that all “wild” (native) fish be released. Other restrictions may be needed as the estimated number of returning wild fish has steadily declined since 1988 (Table 4-6).

Table 4-6. Steelhead escapement, Marengo to Sheep Creek.

Year	Wild	Hatchery	Total		Year	Wild	Hatchery	Total
1987	521	750	1,271		1994	151	96	247
1988	525	787	1,312		1995	147	230	377
1989	319	388	707[1]		1996	71	322	393[2]
1990	416	343	759[1]		1997	no data		
1991	210	256	466[1]		1998	no data		
1992	166	513	679		1999	85	340	425
1993	94	475	679		2000			

[1] Estimated from juvenile index counts of “fry” that resulted from uncounted spawners

[2] Panjab Creek not included

Escapement estimates are based on redd counts, sport catch, juvenile population and adult counts at the hatchery trap. Steelhead redd counts are not always reliable population indicators, however, because these fish spawn during the spring runoff when the flows are high and turbid, making both the fish and redds difficult to see. The index does not include fish that spawn in tributaries or downstream and upstream of the spawning-index reach, which starts at Marengo and ends at the mouth of Sheep Creek. Although the escapement of wild fish into the system to spawn has fluctuated greatly in recent years (WDF and WDW 1993), the stock is considered depressed based on chronically low spawner escapement. Juvenile fish densities remained reasonably stable for the period 1985-1994 (Schuck *et al.* 1998). The origin of the stock is likely a mixture of native and non-native stocks due to hybridization with hatchery stocks. Improved sampling methods were initiated in 1992 for spawning surveys with good results and they will be continued in the future.

In addition to steelhead redds, trout sized redds have been identified during spring steelhead surveys and late summer spring chinook surveys. These redds often cannot be associated with bull trout, and WDFW biologists believe that they are made by resident trout. This increase in the observation of trout spawning may be the result of more restrictive fishing regulations and stream reach closures allowing resident fish to mature to spawning age.

Sporadic outplants of hatchery steelhead from several other rivers were made between 1936 and 1980. Since 1983, hatchery production for the Tucannon River has been produced under the LSRCP program at the Lyons Ferry Hatchery.

A consumptive hatchery steelhead fishery occurs on the Tucannon River between September 1 and April 15. Since 1985, approximately 250-840 fish annually have been harvested (WDFW harvest report cards).

A summer trout fishery (June-October) concentrated angling effort on WDFW's Wooten Wildlife Area until the 1990s. Then, fish stocking was moved down stream to minimize potential impacts to listed spring chinook and the fishery became more dispersed. Between 1983 and 1991, 20,000 to 42,000 catchable size rainbow trout (≥ 8") were stocked each year. Considerable hooking and releasing of wild rainbow and juvenile steelhead occurred in the fishery, although in 1985 direct harvest of wild fish in the fishery was estimated to be only 0.6 percent (279 fish) of total harvest (Schuck and Mendel 1987). Actual mortality due to hooking is unknown. Sixty-six percent of Tucannon River anglers use some form of bait (A. Viola, WDFW, per. com., 1993), and Mongillo (1984) estimated that 50 percent of fish hooked with bait and released could eventually die. Stocking of rainbow trout, was decreased until 2000 when it was terminated, along with bait restricted fishing and increased minimum size limits in the upper river, were put into effect to protect naturally producing populations of trout and spring chinook salmon. All tributaries to the Tucannon River, except Pataha Creek, are closed to fishing. All stocking of resident rainbow trout was terminated in 2000.

Lamprey

Pacific lampreys (*Entosphenus tridentatus*) have life histories and survival problems similar to salmon. They were once an abundant commercial fish in the Columbia River system. Kelley (1982) reported seeing only juvenile Pacific lamprey, caught in quiet backwater areas throughout their sampling area (RM 6 to RM 42). As few as 40 adults were counted passing Ice Harbor Dam in 1993. Bumgarner (per. com., 1999) reported that juvenile lampreys had been captured in the smolt trap located at RM 1.9 every spring since 1986. A few adults have been seen each year in the smolt trap by WDFW staff since 1995. The National Marine Fisheries Service lists the Pacific lamprey as a species of concern, and the Confederated Tribes of the Umatilla Indian Reservation has begun investigations on the status of lamprey in the Snake River and Walla Walla systems. River lamprey (*Lampetra ayresi*) and brook lamprey may also exist in the Tucannon River, but their presence is uncertain.

Bull trout

Bull trout spawn and rear in the upper portions of the river and adults and subadults migrate to the lower Tucannon River and Snake River in the winter months (see Map 4-6, Map Appendix). They return to the upper river and its tributaries each spring to spawn and are likely a distinct stock (WDFW 1998). Bull trout spawning ground surveys were initiated in 1991 and have continued intermittently). Bull trout were listed as threatened under the ESA in June 1998. No hatchery program is currently planned for bull trout in the Tucannon subbasin. However, the release of brook trout (*Salvelinus fontinalis)* into the subbasin several decades ago resulted in the establishment of a self-sustaining population in upper Pataha Creek. These fish represent a potential threat to the population stability of bull trout and they may be a competitive population for food and space with native steelhead/rainbow.

Table 4-7. Tucannon River bull trout spawning survey redd counts, 1991 – 2000 (G. Mendel, WDFW per. com., Jan. 2001).

Year	Number of redds	Miles surveyed	Redds/mile
1991	57	12.9	4.4
1992	66	10.8	6.1
1993	NA	NA	NA
1994	131	8.5	15.4
1995	114	11.5	9.9
1996	184	16	11.5
1997	78	18.5	4.2
1998	108	17.25	6.3
1999	222	30.65	7.2
2000	151	17.65	8.6

The WDFW initiated several actions to protect and restore the Tucannon River bull trout population. Historically, the entire mainstem Tucannon was open to harvest of bull trout during the general trout season (June 1 to October 31). Beginning in 1996, the upper river above Panjab Creek was closed to all fishing, and in 1999 the river was closed to bull trout harvest. The bull trout population appears to be responding positively to these actions as the number of redds has increased in the spawning grounds.

Several tributaries in the headwaters of the Tucannon River are important bull trout habitats. Cummings Creek is the farthest downstream tributary containing bull trout. Adfluvial, fluvial, and resident forms are believed present. Stream surveys in 1991 documented the presents of bull trout approximately 6 miles above the mouth of Cummings Creek.

Bull trout were documented spawning in the lower reaches of Panjab Creek in 1995. Resident and fluvial life history forms are believed to be present.

Juvenile bull trout were observed in Sheep Creek in 1992 below the culvert on Road 4712. The culvert was replaced by a trail bridge in 2001 providing improve fish passage to 0.5 miles of available habitat with access ending at Sheep Creek falls.

Bull trout presence in the lower half mile of Bear Creek was documented in the fall of 1994 and 1995. Resident, fluvial, and adfluvial life history forms are believed present. Bear Creek is one of the uppermost tributaries of the Tucannon River.

Resident bull trout are suspected in the headwaters of Pataha Creek and the Little Tucannon River but their presence is considered undetermined at this time.

Mountain whitefish

Mountain whitefish are native to the Tucannon subbasin and known to exist throughout the mainstem river. They are common throughout the Columbia River system and are most often found in streams with large pools. They are bottom-oriented fish feeding on a wide variety of aquatic insects. Mountain whitefish spawn from October to early December by casting eggs over substrate of loose gravel. They do not build redds. The eggs hatch in the early spring and the newly hatched fish spend their first few weeks in the shallows of the streams. Although there is a season for whitefish that runs concurrently with the steelhead season, their status is unknown.

Non-native Species

Several introduced species of fish inhabit the Tucannon subbasin. Brook trout (*Salvelinus fontinalis)* were introduced into the Pataha Creek drainage in the 1970's (WDFW planting records). A small self-sustaining population of brook trout remains in the upper reaches of Pataha Creek (G. Mendel, WDFW, per. com., 1999). Brown trout *(Salmo trutta)* were reared at the Tucannon Hatchery for release into the Touchet River and local lakes from 1970 to 1999. Brown trout were once mistakenly stocked into the Tucannon River in the 1980's. There have been a few confirmed catches of brown trout from the Tucannon River. Presumably, they were fish that had escaped from the hatchery or from the one known stocking event. The population is believed to be very small or non-existent now, with no successful natural reproduction having been documented for several years. Warm water species inhabit the lower Tucannon River up to highway 12, with the greatest number of fish concentrated in the first few miles above the Snake River impoundment. Smallmouth bass *(Micropterus dolomieui)* and channel catfish *(Ictalurus punctatus)*are abundant in the Snake River and, therefore, represent a significant predatory threat to outmigrating juvenile salmonids from the Tucannon. Grass pickerel (*Esox americanus vermiculatus*) apparently have accessed the Tucannon from the Palouse River where their presence has been documented (Wydoski and Whitney 1979).

Dace

Four species of minnow are known in the Tucannon watershed and are most common below the Forest boundary. The Tucannon River supports populations of speckled dace *(Rhinichthys osculus)* and redside shiner *(Richardsonius balteatus)* common especially in the lower reaches of the watershed. Longnose dace *(Rhinichthys cataractae)* and northern squawfish *(Ptychocheilus oregonensis)* are also found in the Tucannon watershed. The Tucannon stream survey (1992) documented redside shiner from the Forest boundary upstream to the confluence of Panjab Creek.

Sculpin

The margined sculpin (*Cottus marginatus*) is locally common and its range overlaps with the piute sculpin (*Cottus beldingi)*.

The margined sculpin is a small fish seldom over 3 inches long with a large head. The body tapers to a narrow caudal peduncle. They are mottled in color resembling the stream bottom. Freshwater sculpins are not game fish and little is known about their natural history. Sculpin are recognized as bottom dwelling fish that are known to feed on aquatic invertebrates, young fish, and fish eggs.

The reproductive behavior of the margined sculpin has been studied and was reported in the Washington State Status Report for the margined Sculpin, September 1998. Gravid margin sculpin were collected in May and June and spawned in aquariums. Eggs were deposited under rocks and were strongly guarded. The eggs were sometimes fanned with the caudal fin.

Lonzarich (1993) reported possible habitat preferences for margined sculpin based on where they were most commonly collected. They were more common in pools and glides and less common but not absent in riffles. Margined sculpin were often found over small gravel and silt substrate and appeared to avoid large gravel, cobble, and boulder substrate. Adults tended to be found in deeper and faster water then juveniles. Habitat selection did not vary greatly over seasons. They were most commonly found in water temperatures between 41°F and 61°F.

The margined sculpin is listed as a Species of Concern by the U.S. Fish and Wildlife Service. It is listed as a State Candidate species in Washington and as a sensitive species by the Oregon Department of Fish and Wildlife. The margined sculpin in a U.S.D.A. Forest Service Regional Forester's Sensitive Species. Even though locally common, the margined sculpin's future is considered vulnerable and is of concern due to its very small range.

Artificial Production

The Tucannon Hatchery was constructed in 1949 by the Washington Department of Game (WDG, which is now WDFW) to produce rainbow trout to support a popular sport fishery (Map 4-2, Map Appendix). In 1984, under terms of the LSRCP, this hatchery was purchased and refurbished by the U.S. Army corps of Engineers (USCOE) to act as a satellite station to the Lyons Ferry Hatchery, which was built on the Snake River and became operational in 1983. Both of these hatcheries are used in combination to mitigate for fish and fishing losses caused by the four lower Snake River dams. A goal of wild fish restoration was added to this hatchery mitigation program because of federal ESA listings and declining populations of wild salmonids in the Snake River basin.

Supplementation of natural populations is an experimental approach being used to rebuild fish runs in the Columbia Basin. Several potential negative effects of supplementation have been identified, including decreased reproductive potential, decreased survival at various life stages, increased harvest or injury associated with fisheries targeting hatchery fish, loss of genetic variation, and others. Nevertheless, the co-managers have agreed in fisheries management forums to utilize supplementation strategies in some locations because of the potential it offers in returning a larger number of spawners than result from natural production alone. Bugert (1989) initiated a long-term sampling protocol for Tucannon spring chinook. The sampling documented some of the potential effects and determined the degree to which the effects affected spring chinook in the river. Washington Department of Wildlife (WDW) (1993) identified problems with the hatchery steelhead stock used in the LSRCP for Tucannon River releases and recommended development of a new stock for the program. Phelps (WDFW, per. com., 1994) concluded that wild steelhead remained genetically distinct from Lyons Ferry Hatchery stock steelhead. Phelps also concluded that the natural declining population was likely being suppressed through interbreeding with hatchery stock steelhead. The WDFW believes that the data supported this conclusion and it appeared to show that little or no introgression of the hatchery stock had occurred into the natural population, as would be expected if there were successful interbreeding. The WDFW believes that the continued use of hatchery fish could damage the population. However, the tribal co-managers have offered other interpretations of the data, most recently in the spring of 2000 on the issue of allowing hatchery steelhead to pass upstream of the weir. Although there is no evidence of similar problems for spring chinook, smolt to adult returns (SAR) for hatchery reared fish are significantly less than for their wild counterparts (Bumgarner *et al.* 1998). This survival difference suggests a negative effect associated with the hatchery. Despite these concerns, the WDFW has initiated intensive fish culture by mean of a captive broodstock project, in which smolts are produced and released from fish kept in captivity for their entire lifecycle. This is an effort to quickly rebuild population numbers and stave off loss of the genetic resource present in wild spring chinook. The captive broodstock effort is in addition to a conventional hatchery spring chinook supplementation program that releases yearling smolts into the river from adults returning to the river annually.

Chinook Salmon

In 1962, two spring-fed rearing ponds were excavated at Russell Springs, 2 miles downstream of Cummings Creek, and planted with non-native spring chinook fry. The first release of 16,000 Klickitat River stock occurred in August 1962. In June 1964, 10,500 Willamette River stock were outplanted. The large flood of 1964-65 destroyed these ponds and the program was discontinued (Phinney and Kral 1965). These were the only introduced non-native chinook that have been documented in the Tucannon River.

The LSRCP goals for the hatchery program are to increase the annual escapement of Tucannon spring chinook salmon to 1,152 hatchery spring chinook adults, and 18,300 hatchery fall chinook to the Snake River basin, while preserving the genetic integrity of these native stocks of salmon (WDFW 2000c). WDFW will not be producing an HGMP for most hatchery actions funded by the LSRCP for approximately 2-3 years, because they are currently covered in the NMFS Biological Opinion for the LRSCP.

The LSRCP hatchery program began by collecting native spring chinook adults, trapped near the Tucannon Hatchery in 1985, on their way to upriver spawning areas. Each year since then the returning hatchery and wild adults have been trapped near the Tucannon Hatchery for hatchery broodstock collection (egg take) or they have been enumerated and released upstream to spawn naturally. In recent years both hatchery and wild (unmarked) spring chinook have been collected for hatchery broodstock. The fish are taken to the Lyons Ferry Hatchery to remain in cold well water until they are ready to spawn in the fall. They are spawned and reared at Lyons Ferry Hatchery until they are marked and transferred to the Tucannon Hatchery in October. All hatchery smolts are tagged with coded-wires and fin-clips so they can be recognized as hatchery progeny when they return as adults. They remain at the Tucannon Hatchery until they are transferred in late winter to the Curl Lake acclimation pond about 5 miles upstream of the hatchery. They remain at the pond until March or April when they are volitionally released into the Tucannon River at about 15 fish per pound. The targeted release number is 132,000 smolts per year (WDFW 2000c) but releases have often been well below that level (Table 4-8). Yearling smolt releases have increased to an average of 127,000 each year, resulting in annual hatchery returns of 300-400 adults each year until 1993 (Figure 4-2) (Bumgarner *et al.* 1997). Recently, a captive brood program (where juvenile spring chinook are raised at the hatchery through their entire life cycle until spawning) was added to the Tucannon spring chinook supplementation program. This is an effort to increase the number of spring chinook released into the Tucannon to try and increase the critically low numbers of adult spring chinook returning to the Tucannon River (WDFW 2000d-Master Plan to NPPC).

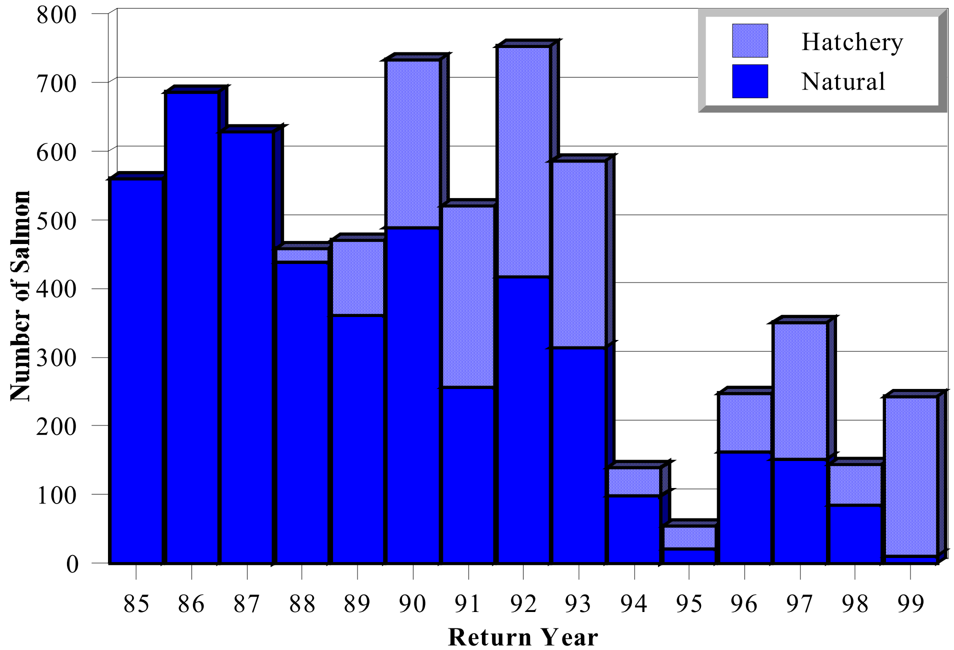


Figure 4-2. Tucannon River Spring Chinook escapement (Bumgarner* et al. *1997).

The Lyons Ferry hatchery fall chinook stock was developed from native Snake River fall chinook. From 1976-1984 unmarked fall chinook were trapped at Snake River dams to develop an eggbank program. These fish were transported and held, gametes were taken, and progeny were reared and marked at various hatcheries in the Columbia Basin. Smolts were released back into the mainstem Snake River or the Kalama River (Bugert and Hopley 1989) in an effort to save this stock from extinction while Lyons Ferry Hatchery was being planned and constructed. Returns from this broodstock became the founding population for the Lyons Ferry Hatchery fall chinook program. Since 1984, broodstock has been collected at the hatchery or at Snake River dams (Mendel 1998). Currently, hatchery fall chinook salmon are released into the Snake River at Lyons Ferry Hatchery and at several sites upstream of Lower Granite Dam (Table 4-8). There have been no known releases of hatchery fall chinook into the Tucannon River, but carcasses of stray hatchery fall chinook from the Lyons Ferry and the Umatilla hatcheries have been found in the Tucannon River on several occasions since 1990 (Mendel *et al.* 1992; Wargo *et al.* 1999).

Table 4-8. LSRCP releases of hatchery reared spring chinook and steelhead into the Tucannon River from Lyons Ferry or Tucannon hatcheries (WDFW data from M. Schuck, per. com., 2001).

	Summer Steelhead		Spring Chinook	
Year	# fish	Lbs fish	# fish	Lbs. Fish
1983	148,275	21,600		
1984	195,315	32,352		
1985	151,609	26,598		
1986	141,068	25,281		
1987	141,959	24,905	12,922	2,172
1988	161,293	28,297	152,725	15,173
1989	160,131	36,393	152,165	16,907
1990	119,264	23,060	145,146	13,195
1991	200,761	50,682	99,057	11,007
1992	130,040	31,037	85,737	7,798
1993	113,539	23,597	131,380	6,422
1994	145,538	33,365	83,409	5,957
1995	146,070	27,561	138,648	9,569
1996	139,242	28,417	130,069	8,120
1997	139,971	22,703	62,144	3,541
1998	160,068	33,259	75,419	4,820
1999	179,089	40,482	24,168	1,550
2000	145,768	34,054	127,939	10,276

Steelhead

Between 120,000 and 160,000 steelhead smolts were released annually from the Curl Lake acclimation pond from 1985 to 1997 primarily for adult steelhead harvest augmentation in the Snake and Tucannon rivers. The adult hatchery return goal for the Tucannon River is approximately 875 fish for harvest. Lyons Ferry and several hatchery stocks have been released into the Tucannon River in the past. Problems with the returning hatchery fish have been identified. Straying to distant reaches of the Snake River has considerably decreased adult returns to the Tucannon River. Some of the problem is suspected to be stock related. For this reason, trapping and spawning of wild origin Tucannon River fish began in 1991 to develop a new broodstock. Poor survival success of the resulting smolts caused WDFW to discontinue stock development after 3 years. The program was restarted in 1999-2000 by trapping wild origin adult fish in the lower Tucannon River for development of a local broodstock. Wild origin steelhead are considered distinct based on their spawning distribution and genetic information; (R. Waples, NMFS. Per. com., 1993; T. Shaklee, WDFW, per. com., 1999). These fish will be used in the Lower Snake River Compensation Plan program as the preferred stock for release into the Tucannon River and this stock should address ESA stock concerns over the use of Lyons Ferry and other out-of-basin hatchery stocks.

A study in 1991 showed that up to 17 percent of the hatchery stock smolt releases did not migrate from the river, and some were shown to become predatory on juvenile salmonids (Schuck *et al.* 1994). By using a different outplanting procedure at Curl Lake the percentage of residuals was reduced to 3.1 percent in 1993. Further changes were implemented in 1998 when all hatchery stock smolt releases occurred at or below RM 24.8 to minimize their potential interaction with wild adult steelhead and spring chinook. Hatchery stock return rates from Tucannon River smolt releases continue to be less than for any of the other Washington Lower Snake River Compensation Plan sites (Martin *et al.* 2000).

Coho

In 1963, the WDF released 15,170 coho salmon fry into a 1-acre excavated pond at Russell Springs. After reaching smolt-size, they were released to the river in June 1964. Although the pre-smolts were sampled and found to be in good condition and had good survival, no follow-up sampling was completed, so the adult return rate is unknown (BPA 1984). The 1964-65 floods washed out these ponds and ended the coho program. A few hatchery coho from outside the basin have entered the Tucannon River to spawn each of the past 3-4 years.

Rainbow Trout

Hatchery rainbow trout (primarily Spokane stock) have been released into the Tucannon River as part of the LSRCP program for over 15 years (Table 4-9). These fish were intended to mitigate for lost fisheries in the mainstem Snake River caused by construction and operation of the four lower Snake River dams. Initially, the fish were released primarily within state owned lands with public access near the Tucannon Hatchery. However, during the last several years the fish were released in the lower portion of the Tucannon River to minimize adverse effects on listed steelhead and spring chinook. In 2000, these releases into the Tucannon River were terminated. The fish stocking has been shifted to area lakes and ponds to continue to provide fishery mitigation and to minimize potential adverse effects on listed salmonids in the Tucannon River.

Table 4-9. Rainbow trout stocked into the Tucannon River, Washington, 1983 - 1999 (WDFW data from M. Schuck, per. com., 2001).

Year	# fish		Year	# fish
1983	42,201		1992	10,212
1984	30,450		1993	8,400
1985	34,411		1994	6,652
1986	25,134		1995	4,056
1987	22,978		1996	4,050
1988	22,269		1997	4,000
1989	23,346		1998	3,016
1990	18,549		1999	2,976
1991	21,113		2000	0

Existing and Past Fish Planning Efforts

Various state and federal agencies, tribes and local watershed groups have developed planning documents, policies and management guidelines for fish and wildlife habitat protection and enhancement for the Tucannon subbasin. Currently, the most effective plans and efforts are those that have been collaboratively developed and implemented, adequately funded, and produce short and long-term on-the-ground results.

The Tucannon and Pataha model watershed plans were developed as part of the Nap's "Strategy for Salmon" and emphasizes section 7 of that strategy and specifically addresses the involvement of locally-based model watershed plans for developing and implementing fish and wildlife habitat protection and restoration measures.

The Tucannon subbasin restoration efforts have been expanded with planning, management, and funding being supported by programs outside of NPPC/BPA. While effectiveness in implementing these plans, policies and regulations varies, efforts to increase inter-agency coordination and cooperation are being made in the subbasin.

Tucannon River Model Watershed Project

The Northwest Power Planning Council and the Bonneville Power Administration designated the Tucannon River Watershed as a "model watershed" in 1993. During years 1993 through 1995 a locally based effort, lead by the Columbia Conservation District, brought together technical agencies, the tribes, and local citizenry to develop the Tucannon River Model Watershed Plan. The plan effort encompassed existing studies and assessments, conducted reach-by-reach current condition surveys, and population assessments to develop a management based implementation plan to protect, enhance, and restore salmonid habitat. 1996 to present has highlighted implementation of habitat restoration projects. Projects are designed and implemented to address identified limiting factors. Monitoring and Evaluation of these efforts indicate positive short term impacts to habitat, however, long-term impacts of riparian function restoration will need time to develop and thus to be evaluated.

Pataha Creek Model Watershed Project

All projects and administration of programs inside the Pataha Creek watershed have been funded by BPA. The remainder of Garfield County and lands lying inside the boundaries of the Pataha Conservation District receive funding from the Washington State Conservation Commission, state funding from HB2496, and the Salmon Recovery Funding Board.

Up until 1996, demonstration sites using riparian fencing, off-site watering facilities, tree and shrub plantings, and upland conservation practices were used to inform and educate landowners. These demonstration sites were the primary focus of the implementation phase of the *Pataha Creek Model Watershed Plan*. Efforts began in 1997 to stabilize the banks, reduce sedimentation, and create fish habitat in Pataha Creek. Root wads and woody debris were incorporated into the rock barbs and vanes to create fish habitat that was either destroyed or was not present before the project was built. All the sites were planted with trees and shrubs to add further protection to the site and add the shade and vegetation needed for reducing sediment and lowering water temperature.

A showcase project for the Pataha Creek Model Watershed Project includes implementation of an off-site watering facility as part of a cost share program. It is anticipated that water quality will be improved by removing livestock from the stream. Other project activities include improvements to a corral system and a highway drainage system, tree planting, and implementation of habitat enhancements such as rock vanes and rock vortex weirs.

Several projects have been implemented to reduce erosion from croplands. Three-year continuous no-till projects are on schedule and monitoring is ongoing. Other practices such as terrace, waterway, sediment basin construction, and strip cropping systems are also taking place.

Nez Perce Tribe Conservation Enforcement Program

The Nez Perce Tribe (NPT) Conservation Enforcement Program enforces NPT hunting and fishing regulations within the Tucannon subbasin. Conservation enforcement officers conduct checks in the Tucannon subbasin seasonally as regulations, including season opening and closings, are issued by the NPT. According to Captain Adam Villavicencio (D. Johnson, Nez Perce Tribe, per. com., 2000), approximately 70 – 80 hours are expended on patrols for fishing violations during the spring chinook fishing season, and greater than 200 hours are expended on patrols during hunting season. Fishing for spring chinook has been closed during the last several years. Enforcement activities focus on preventing unlawful harvest including hunting or fishing without a tribal enrollment, hunting or fishing with non-tribal member partners and wastage. The NPT Conservation Enforcement program is partially funded by Bonneville Power Administration.

WDFW Bull Trout Species Interaction Study

BPA funded studies in the early 1990s that determined bull trout population densities in the Tucannon watershed and several other watersheds in southeast Washington, and the overlap of bull trout and steelhead or spring chinook salmon by habitat type. These studies examined the potential impacts of interspecific competition and anadromous fish. (Martin et al. 1992).

WDFW/LSRCP

The Washington Department of Fish and Wildlife is funded by the Lower Snake River Compensation Plan for operation of the Lyons Ferry Hatchery Complex and production of steelhead, spring chinook and rainbow trout for the Tucannon subbasin. The Lower Snake River Compensation Plan also funds the hatchery evaluation program that monitors the wild anadromous fish populations in the Tucannon River and the effectiveness of the hatchery program. These Washington Department of Fish and Wildlife programs have operated since about 1982. Evaluation activities include spawning surveys, adult trapping, juvenile population estimates and smolt trapping. Washington Department of Fish and Wildlife produces several reports annually for different aspects of the programs.

Washington State Salmon Recovery Funding Board

Columbia Conservation District installed instream, riparian, and upland habitat enhancement projects in 1999 and 2000 (CCD).

The USDA Columbia Conservation District, Washington Conservation Commission, and the USDA Farm Security Agency work cooperatively to implement the Conservation Reserve Enhancement Program for riparian buffer enhancement along salmonid fish bearing streams.

USDA Farm Security Agency & Natural Resource Conservation Service, Conservation Reserve Programs are multi-year and continuous programs to remove critical areas from active production and to create, restore and enhance wildlife and fish habitat.

U. S. Army Corp of Engineers Instream Fishery Enhancement

The Army Corp of Engineers and Washington Department of Fish and Wildlife Instream habitat Improvement Project, (Vail 1979) was funded by the USACE and established as partial mitigation for fish losses caused by construction and operation of dams on the Snake River and was part of the Lower Snake River Compensation Plan. Instream habitat was improved in southeast Washington streams to enhance natural production of salmonids and improve fishing success by anglers. This program operated from about 1979 through 1986. Numerous instream structures were constructed and evaluated for the amount of habitat they provided and the response by salmonids.

Army Corp of Engineers and Washington Department of Fish and Wildlife Fishery Enhancement Project (Mendel 1981) was funded in two phases by the U.S. Army Corp of Engineers to examine the fishery enhancement potential of streams in southeast Washington. The project was terminated after only one year. Streams were examined and a brief assessment of their habitat conditions and limiting factors was compiled in a phase one report. In phase two, several higher quality areas were sampled to determine fish abundance and habitat conditions and the information was compiled into a report.

WDOE Instream Flow Restoration

The WDOE and the Washington Water Trust are working together to obtain water rights through lease and/or purchase for instream trust water rights. Negotiations are currently ongoing with two landowners on the Tucannon River, which, if successful, will result in a conversion of 2 to 5 cfs from out-of-stream consumptive use to instream flow trust water rights.

Metering of surface water diversions is required by statute (RCW 90.03.360). The WDOE is currently developing implementation plans that call for measurement devices on 80 percent of the water diversions within Water Resource Inventory Area 35.

Recreation Management

The Washington Department of Fish and Wildlife relocated camping sites away from the river, and placed control fences to discourage use on the streambank at sites where relocation is not an option.

The USFS restricted camping within 75 feet of the stream rehabilitated degraded streambanks. These campgrounds and campsites will be rehabilitated and restored to native condition. Both agencies have initiated public information efforts to protect natural resources.

Factors Limiting Fish Populations

The primary limiting factors that have contributed to the current depressed status of fish, wildlife and their associated habitats in the Tucannon subbasin are broadly classified into habitat degradation and non-native species competition. Habitat degradation can be described as the loss of quality, quantity, diversity and connectivity of habitat components and function. Many environmental and managed factors contribute to and influence these limiting factors and their resulting impacts on fish, wildlife and habitat resources in the Tucannon subbasin.

Key limiting factors affecting fish include water quality, geomorphic instability, riparian function, sediment, instream habitat, hatchery effects, out-of-basin effects, minimum viable populations, passage, data gaps, illegal harvest, exotic species, ecological productivity, and flow.

Water Quality

Water temperature is the main water quality limiting factor off the Forest and below the analysis area for the Tucannon subbasin. Historic and current temperature data indicate that the lower reaches of the Tucannon River and Pataha Creek have temperatures up to 75.2°F (24.0°C) during the summer months. The Tucannon River is on the current 1998 303(d) list of impaired water bodies for temperature for the segment that extends from the mouth at the Snake River to Tumalum Creek at river mile (RM) 32.7. WDOE is proposing to establish a temperature TMDL for this segment for the 2001 watershed cycle.

High fecal coliform concentration is the primary concern for Pataha Creek. Pataha Creek is on the 1998 and 1996 303(d) list of impaired waters for fecal coliform bacteria. WDOE is proposing a bacteria TMDL on the segment of Pataha Creek from the mouth at the Tucannon River (RM 11.2) to the headwaters for the 2001 watershed cycle.

Geomorphic Instability

Levees constructed for flood control have diminished the river's ability to create adequate complex pool habitat, off-channel-rearing areas, and to adequately access the floodplain. The amount of unvegetated stream banks has increased exposing raw banks to erosion resulting in sediment and gravel filling of the streambed and increasing sediment impacts to fish during the egg and pre-emergent fry stages.

Riparian Function

The River's ability to dissipate flood energy across a floodplain has diminished due to diked channels; land use practices, and decreased riparian woodlands. Percent of canopy cover tends to increase with increased elevation. Recreational impacts also increase with increased elevation and the put and take fisheries developed and maintained on public lands. These impacts have decreased vegetative cover resulting in diminished riparian filtration and stabilization functions, increased surface exposure to radiant heat, and increased bank instability.

Sediment

Land use practices have increased sediment delivery rates to the drainages and reduced floodplain and riparian function to filter and stabilize streambanks. The degraded condition of the riparian area and rangeland along with infestations of non-native grasses and weeds have inhibited the ecosystems ability to recover from natural or climatic events and continue to reduce the riparian biofunction ability.

Pataha Creek delivers large amounts of sediment to the lower Tucannon River. Fragile soil types and land use practices have also contributed to gravel that has become cemented with fine sediment impacting fall chinook using the lower Tucannon River below the analysis area.

Instream Habitat

Significant human actions throughout the basin have destabilized the Tucannon River. Road construction, river straightening and diking and effects from upland management such as forest and farm management practices have lead to a loss of instream habitat for fish. Catastrophic floods in 1964 and 1996 and human actions afterward also have eliminated high quality habitat for fish.

Hatchery Effects

Hatchery augmentation/supplementation within the Tucannon has been substantial since the 1950s. Out-of-basin stocks of trout, salmon and steelhead and hatchery production practices have been identified as contributing to the jeopardy opinion rendered by NMFS for hatchery actions in the Snake River basin. While managers have begun to address this issue in the Tucannon, significant hatchery fish releases occur annually.

Out-of-Basin Effects

Managers within the Tucannon have identified that fishery resources within the Tucannon are affected by outside actions such as migration corridor survival, fisheries, ocean productivity and pollution. Further, managers agree that actions within the Tucannon to recover listed salmonid populations cannot succeed without coordinated Columbia River basinwide efforts.

Minimum Viable Population Size

Habitat degradation, hydropower development, overfishing, other fishery management problems, and ocean and in-basin productivity problems have all contributed to the decline of salmonid populations in the Tucannon. Spawning populations of spring chinook salmon and summer steelhead have both recently been estimated to be below 100 individuals for some recent years. Such low escapements could seriously affect the ability of the populations to persist.

Exotic Species

The introduction and proliferation of non-native (exotic) species of fish, wildlife, plants and insects (e.g. – knapweed, yellow-star thistle, smallmouth bass, brook trout), pose a significant threat to the ecological health of the basin.

Fish Passage

Restrictive/impassable culverts and improperly or unscreened irrigation diversions affect fish populations within the basin. New NMFS screening criteria and lack of compliance by some irrigators potentially take juvenile salmonid during their rearing/migration periods. Some potential upstream migration barriers have been identified in Pataha Creek drainage.

Gaps in Data

Lack of extensive fish population and habitat characterization and assessments limit the ability of managers to establish reliable spawning escapements, assess carrying capacities of habitats, and direct in-basin actions in the most cost effective and efficient manner.

Legal Harvest

Populations of fish and wildlife that may be at or below MVP, and are subject to illegal harvest, may be unable to recover from this activity because of a significant loss of spawners/breeders. Single stochastic events of this kind may result in the loss of long-term genetic health. WDFW enforcement personnel have documented frequent illegal harvest of bull trout adults and subadults.

Ecological Productivity

Recent research in the Northwest has established a strong link between marine nutrient loading (from salmonid carcasses) and the ecological health of fish, wildlife and forest resources, and primary productivity of the subbasin. The documented or suspected declines of salmon populations within the basin and the resultant decreases of salmon carcass deposition suggest nutrient privation may be limiting basin productivity.

Flows

In 1993, WDFW recommended instream flows for the Tucannon River based upon IFIM methodology. The 7-day low flows of the Tucannon River have exceeded the IFIM recommended flows in almost every year since 1959. Linear regression analysis at the USGS Tucannon Gage No. 13344500 show the number of days where the IFIM recommended flow is not met has increased from approximately 30 days in 1960 to 60 days in 1990. Exceedance curves for the Tucannon River based on historical flow data show the flow recommended by the IFIM analysis is not met more than 50 percent of the time during late July, through all of August, and into early September (Covert, *et al*. 1995).

CURRENT & REFERENCE CONDITIONS FOR UPLAND FOREST VEGETATION

Chapter Overview

This report provides the results of an upland-forest vegetation analysis for the Tucannon watershed. The following upland-forest ecosystem elements were analyzed: potential vegetation, cover types, size classes, structural classes, density classes, canopy layers, and disturbance processes. A variety of information sources were used for the analysis; the most important ones are described in Table 5-1.

Table 5-1. Data sources used for analysis of upland-forest vegetation.

Data Source	Description of Data Source
ADB (Activities Database).	ADB is a normalized, relational database system assembled and maintained by the Pomeroy Ranger District. Detailed information is stored about current and historical timber harvest, reforestation, thinning, and other management activities.
Aerial Detection Surveys.	The Pacific Northwest Region of the Forest Service has been monitoring the impacts of important forest insects since 1947, when the first aerial sketch map was completed to provide information about a spruce budworm outbreak (Dolph 1980). Sketch maps have been completed annually since then; maps from 1980-2001 were used to characterize insect-caused damage for the Tucannon analysis area.
EVG (Existing Vegetation).	EVG stores information about existing vegetation at the stand level. The original data was based on interpretation of aerial photography acquired in 1987 and 1988. For the Tucannon watershed, 38% of the polygons were characterized using photo-interpretation data from EVG.
GLO (Government Land Office) Survey Notes.	The GLO was formed in 1812 to survey the public domain. Their survey notes described vegetation and other biophysical features. Survey notes from the late 1850s to the early 1900s were used to assemble a database, and it was then used as one data source for characterizing historical vegetation conditions.
Historical Forest-Type Maps.	Historical forest-type maps were an important data source for characterization of reference conditions. Maps for Columbia and Garfield counties were published by the Pacific Northwest Forest Experiment Station in 1935 at a scale of 1 inch equals 1 mile (Kemp and others 1935a, 1935b).
MSS (Managed Stand Survey).	MSS is a plot-based system that sampled young, managed stands with an average diameter of 3 inches or more – primarily plantations that had been thinned at least once. Each installation was a 5-point plot cluster covering about 1 acre. Eleven MSS plots were installed in the Tucannon analysis area in 1990.
Potential Vegetation Map (PVeg).	From May to November of 1998, Karl Urban, Forest Botanist, prepared a potential vegetation map. The map contains over 20,000 polygons, each of which has an ecoclass code (plant association or plant community type). Management implications were also recorded for some polygons (potential for quaking aspen, etc.).
FSVeg (Stand Exams).	Stand exams are designed to collect information at the stand level. Site, stand, and tree data are collected on temporary plots. For the Tucannon analysis area, 61% of the polygons were characterized using stand examinations (including walk-through surveys and Pomeroy RD data updates based on local knowledge).

Sources/Notes: See "Description of Composite Vegetation Database" (Powell 2001c) for more information about the vegetation data used for this upland-forest analysis.

Potential Vegetation

In the Tucannon analysis area, 35 upland-forest potential vegetation units have been identified (Johnson and Clausnitzer 1992, Johnson and Simon 1987; see Table 5-2). Sites that can support similar plant associations are grouped together as a plant association group (PAG). In a similar way, closely related plant association groups can be aggregated into potential vegetation groups (PVG). Upland-forest potential vegetation types occurring in the Tucannon watershed have been assigned to ten PAGs and to three PVGs (Table 5-2). Table 5-1 above summarizes selected characteristics of the PVGs. Map 5-1 (see Map Appendix) shows the location and distribution of upland-forest PVGs.

Some late-seral (successional) vegetation types persist on the landscape and have been referred to as plant community types in vegetation classifications. Forested plant community types have one or more dominant tree species in the overstory, and well-developed undergrowth. The undergrowth may reflect the climax composition, but the overstory dominants are often long-lived seral trees that established after a previous disturbance event. In the Tucannon analysis area, seven forested plant community types have been identified (Johnson and Clausnitzer 1992, Johnson and Simon 1987; see Table 5-2).

Table 5-2. Potential vegetation hierarchy for upland forests of the Tucannon watershed.

PVG	PAG	ABBREVIATION	COMMON NAME OF VEGETATION TYPE	AREA
Cold Upland Forest	Cold Moist	ABLA2/MEFE	Subalpine fir/Fool's huckleberry	865
	Cold Dry	ABGR/VASC	Grand fir/Grouse huckleberry	218
		ABLA2/VASC	Subalpine fir/Grouse huckleberry	1,119
		PICO(ABLA2)/VASC	Lodgepole pine (subalpine fir)/Grouse huckleberry pct	32
	Cool Dry	ABLA2/CARU	Subalpine fir/Pinegrass pct	5
Moist Upland Forest	Cool Wet	ABGR/TABR/CLUN	Grand fir/Pacific yew/Queen's cup beadlily	1,775
		ABGR/TABR/LIBO2	Grand fir/Pacific yew/Twinflower	1,360
	Cool Very Moist	ABGR/POMU-ASCA3	Grand fir/Swordfern-ginger	235
		ABGR/TRCA3	Grand fir/False bugbane	1,343
		PICO(ABGR)/ALSI	Lodgepole pine (grand fir)/Sitka alder pct	292
	Cool Moist	ABGR/CLUN	Grand fir/Queen's cup beadlily	1,660
		ABGR/LIBO2	Grand fir/Twinflower	6,901
		ABGR/VAME	Grand fir/Big huckleberry	8,016
		ABLA2/LIBO2	Subalpine fir/Twinflower	46
		ABLA2/TRCA3	Subalpine fir/False bugbane	536
		ABLA2/VAME	Subalpine fir/Big huckleberry	4,904
		PICO(ABGR)/VAME	Lodgepole pine (grand fir)/Big huckleberry pct	32
		PICO(ABGR)/VAME-LIBO2	Lodgepole pine (grand fir)/Big huckleberry-twinflower pct	49
		PICO(ABLA2)/VAME	Lodgepole pine (subalpine fir)/Big huckleberry pct	2,491

PVG	PAG	ABBREVIATION	COMMON NAME OF VEGETATION TYPE	AREA
	Warm Very Moist	ABGR/ACGL	Grand fir/Rocky Mountain maple	1,805
	Warm Moist	PSME/HODI	Douglas-fir/Oceanspray	1,684
Dry Upland Forest	Warm Dry	ABGR/CAGE	Grand fir/Elk sedge	343
		ABGR/CARU	Grand fir/Pinegrass	143
		ABGR/SPBE	Grand fir/Birchleaf spiraea	178
		PIPO/CARU	Ponderosa pine/Pinegrass	107
		PIPO/SYAL	Ponderosa pine/Common snowberry	105
		PSME/CAGE	Douglas-fir/Elk sedge	362
		PSME/CARU	Douglas-fir/Pinegrass	234
		PSME/CELE/CAGE	Douglas-fir/Mountain mahogany/Elk sedge pct	1,604
		PSME/PHMA	Douglas-fir/Ninebark	9,929
		PSME/SYAL	Douglas-fir/Common snowberry	2,051
		PSME/VAME	Douglas-fir/Big huckleberry	591
	Hot Dry	PIPO/AGSP	Ponderosa pine/Bluebunch wheatgrass	808
		PIPO/CELE/FEID-AGSP	Ponderosa pine/Mtn. mahogany/Idaho fescue-blue. wheat.	288
		PIPO/FEID	Ponderosa pine/Idaho fescue	139

Sources/Notes: Adapted from Powell (1998). 'Pct' after a common name refers to a plant community type (a seral plant community); all other vegetation types are plant associations described in Johnson and Clausnitzer (1992) or Johnson and Simon (1987). Area figures (acres) include National Forest System lands only.

Table 5-3. Selected characteristics of potential vegetation groups (PVG) for upland forests.

PVG	Area (Acres)	Distur-bances	Fire Regime	Patch Size	Elevation (Feet)	Slope (Percent)	Dominant Aspects
Dry Upland Forest	29,141	Fire Insects Harvest	Under-story	1-2,000	4347 (2534-6139)	43 (3-75)	Southeast Southwest North
Moist Upland Forest	37,916	Diseases Harvest Fire Insects	Mixed Severity	1-10,000	4954 (3085-6279)	32 (3-69)	North Northwest Northeast East
Cold Upland Forest	2,543	Wind Insects Fire Diseases	Stand Replace ment	1-1,000	5713 (4140-6199)	25 (7-49)	North Northwest West

Sources/Notes: Areas, elevations, slope percents, and aspects were summarized from the Tucannon vegetation database ('ExistVeg'). Patch size (acres) was taken from Johnson (1993). Disturbances, which show the primary agents affecting upland-forest ecosystems, were based on the author's judgment. For elevations and slope gradients, values are portrayed in the following format: average (minimum-maximum). Fire regime ratings have the following interpretation (Smith 2000):
Understory: fires generally not lethal to dominant vegetation – approx. 80% or more survives fire.
Mixed Severity: fires cause selective mortality or varies between understory and stand replacement.
Stand Replacement: fires kill or top-kill the dominant vegetation – approx. 80% or more is killed.

Forest Disturbance Processes.

Defoliating Insects.

The Tucannon ecosystem analysis area has experienced two budworm outbreaks during the last 50 years. Early in the first outbreak (1944-1958), most of the budworm-host type in the analysis area was defoliated to some degree by 1950 (Dolph 1980). In response to the defoliation and its resultant tree damage (top-killing and mortality), much of the Tucannon watershed was sprayed in either 1951 or 1952 to reduce budworm populations to non-damaging levels. DDT was applied during these projects (USDA Forest Service 1970). After the earlier outbreak collapsed in 1958, western spruce budworm remained at endemic levels until 1980, when another outbreak began in mixed-conifer stands near Cove, Oregon. The 1980-1992 outbreak moved from south to north in the Blue Mountains. The Tucannon watershed did not experience widespread defoliation during this outbreak, although limited areas were defoliated in 1988 and 1992 (see Table 5-4).

Table 5-4. Acreage of insect-caused forest damage in the Tucannon watershed, 1980-2001.

Year	Mixed-Conifer Beetles	Pine Beetles	Defoliators	Other	Total	Percent of Watershed
1980	1,345	93	—	—	1,438	1.9
1981	916	31	—	—	947	1.2
1982	452	260	—	—	712	0.9
1983	176	233	—	—	410	0.5
1984	—	72	—	—	72	0.1
1985	243	—	—	—	243	0.3
1986	206	122	—	—	328	0.4
1987	1,385	491	—	—	1,876	2.4
1988	7,720	30	734	—	8,483	11.0
1989	26,718	—	—	—	26,718	34.6
1990	28,008	55	—	—	28,063	36.4
1991	16,842	34	—	—	16,877	21.9
1992	1,017	58	2,676	—	3,750	4.9
1993	332	69	—	—	401	0.5
1994	431	27	—	—	458	0.6
1995	498	250	—	—	748	1.0
1996	127	4	—	—	131	0.2
1997	347	4	—	51	402	0.5
1998	166	206	—	292	664	0.9
1999	945	44	—	44	1,032	1.3
2000	450	15	7,606	—	8,071	10.5
2001	166	40	5,273	3,703	9,182	11.9

Sources/Notes: Areas (acres) were derived from insect detection surveys (sketch maps) completed by the Pacific Northwest Region of the Forest Service (see Table 5-2). Note that area figures in this table include National Forest System (NFS) lands only. The 'mixed-conifer beetles' category includes Douglas-fir beetle, fir engraver, spruce beetle, and western balsam bark beetle. 'Pine beetles' includes mountain pine beetle in either lodgepole pine or ponderosa pine, *Ips* beetle in pine, and western pine beetle. 'Defoliators' includes western spruce budworm and Douglas-fir tussock moth. 'Other' includes larch casebearer, balsam woolly adelgid, and needle cast in larch. Some areas on the sketch maps show more than one agent; in those instances, only the first (primary) agent was used for this summary. Totals were not computed for the damage category columns because when insect activity is on-going in an area, the same acres may be affected in multiple years (e.g., acreage values are not mutually exclusive from year to year). The ‘percent of watershed’ values were calculated by dividing the ‘total’ values by the NFS acres in the analysis area (77,137 acres for the Tucannon watershed).

A major Tussock moth outbreak occurred in the early 1970s when tussock moth defoliated vast areas in northeastern Oregon and southeastern Washington, and in northeastern Washington. By 1972, over 197,000 acres were defoliated in eastern Oregon and eastern Washington. Perhaps some of the worst damage occurred on the north end of the Umatilla National Forest, including major portions of the Tucannon watershed (Graham and others 1975). Several areas of tussock moth damage in the Tucannon watershed were proposed for spray treatment in 1974 (Graham and others 1975) but were never sprayed. In the Tucannon watershed, at least 16.8 million board feet were harvested in 3 tussock-moth salvage sales: Stockade Salvage, Stevens Salvage, and Wind & Martin (USDA Forest Service 1974). A subsequent outbreak began in the spring of 2000 and 39,392 acres on the Pine, Pomeroy, and Walla Walla Ranger Districts were sprayed with TM-BioControl during June and July of 2000. The objective of the spray project was to minimize tussock-moth damage in specific areas of high concern (old-growth stands, bull-trout habitat, etc.) (USDA Forest Service 2000). According to GIS maps produced during the suppression project, none of the Tucannon watershed was sprayed with TM-BioControl in 2000. Tussock-moth defoliation could continue for several more years.

Fire.

Fire was an important ecosystem process on dry-forest sites in the Tucannon analysis area, and on some of the moist-forest ones as well. Within these environments, plants have been exposed to the long-term influence of fire. Some species such as ponderosa pine, western larch, snowbrush ceanothus, serviceberry, and bluebunch wheatgrass are considered to be “fire adapted”. That is, over many centuries, they evolved strategies to help them maintain populations on sites where fires occurred frequently. Other vegetation such as grand fir is not well adapted to recurrent fire. Historically, frequent fires tended to reduce the abundance of young grand firs because their thin bark and low-hanging branches made them vulnerable to fire damage (Table 5-5).

Many wildfires were ignited by lightning storms during summer (Plummer 1912) but a large number were started by American Indians (Barrett 1980, Boyd 1999, Robbins 1997). Fire was used by Indians to clear brush for improved hunting access, for entertainment, and for a variety of cultural purposes. Oregon tribes used smoke to harvest pandora moths – after fire was run through an infested pine stand, the caterpillars would drop from the trees to the ground and were then gathered for food (Pyne 1982).1

Fire effects were often described in early journals. A recent book synthesizes journals and other writings from 19th century travelers on the Blue Mountains portion of the Oregon Trail (Evans 1991). When 66 journal accounts from that book were analyzed, 89 percent of them referred to open ponderosa pine stands and 54 percent noted burned underbrush or grassy glades, much

1 American Indians used most of the life stages of pandora moth for food – the Klamath and Modoc tribes dug up and used the pupae in a concoction called ‘bull quanch,’ whereas the Piutes gathered and dried the mature caterpillars and combined them with vegetable-type materials in a dish called ‘peage’ (Patterson 1929).

smoke in late summer and fall, or a lack of underbrush and dense thickets (Wickman and others 1994).

According to these journal and diary accounts for the Blue Mountains, the forest at low and mid elevations was comprised mostly of ponderosa pine, the pine forests were open and park-like with grass as the predominant undergrowth vegetation, and fire was a regular autumnal occurrence (Irving 1837, Wickman and others 1994).

Table 5-5. Fire resistance characteristics for major conifers of the Tucannon watershed.

Tree Species	Bark Thickness	Rooting Habit	Bark Resin (Old Bark)	Branching Habit	Stand Density	Foliage Flammability	Fire Resistance
Western Larch	Very thick	Deep	Very little	High and very open	Open	Low	Very high
Ponderosa Pine	Very thick	Deep	Abundant	Moderately high & open	Open	Medium	High
Douglas-fir	Very thick	Deep	Moderate	Moderately low & dense	Moderate to dense	High	High
Grand Fir	Thick	Shallow	Very little	Low and dense	Dense	High	Medium
Western White Pine	Medium	Medium	Abundant	High and dense	Dense	Medium	Medium
Lodgepole Pine	Very thin	Medium	Abundant	Moderately high & open	Dense	Medium	Low
Engelmann Spruce	Thin	Shallow	Moderate	Low and dense	Dense	Medium	Low
Subalpine Fir	Very thin	Shallow	Moderate	Very low and dense	Moderate to dense	High	Very low

Sources/Notes: Adapted from Powell (2000). Species rankings reflect the predominant situation for each trait. A trait is not absolute – it can vary during the lifespan of an individual tree, and from one individual to another in a population. For example, grand fir's bark is thin when young, but thick when mature.

Large fires were common during Euro-American settlement of the Interior Northwest. Emigrants set many fires, either accidentally or intentionally. Miners often set fires to clear away brush and forest debris, thereby exposing rock outcrops for inspection by prospectors (Veblen and Lorenz 1991). Likewise, some early fires were started by livestock ranchers to remove brush and promote grass growth (Harley 1918). Whether of human or natural origin, large fires definitely occurred in the Tucannon analysis area during the presettlement era:

Even though emigrants caused some fires, they also contributed to conditions that limited fire intensity and spread. For instance, immense bands of sheep grazed in the Blue Mountains during the late nineteenth century and early twentieth century (Coville 1898, Galbraith and Anderson 1970, Tucker 1940), consuming herbaceous vegetation that otherwise would have been available as fine fuel for a fire (Case and Kauffman 1997, Irwin and others 1994). Figure 5-1 summarizes historical grazing trends for three classes of livestock (cattle and calves, sheep and lambs, horses and ponies); it includes data for the two counties in Washington (Columbia and Garfield) containing the Tucannon watershed.

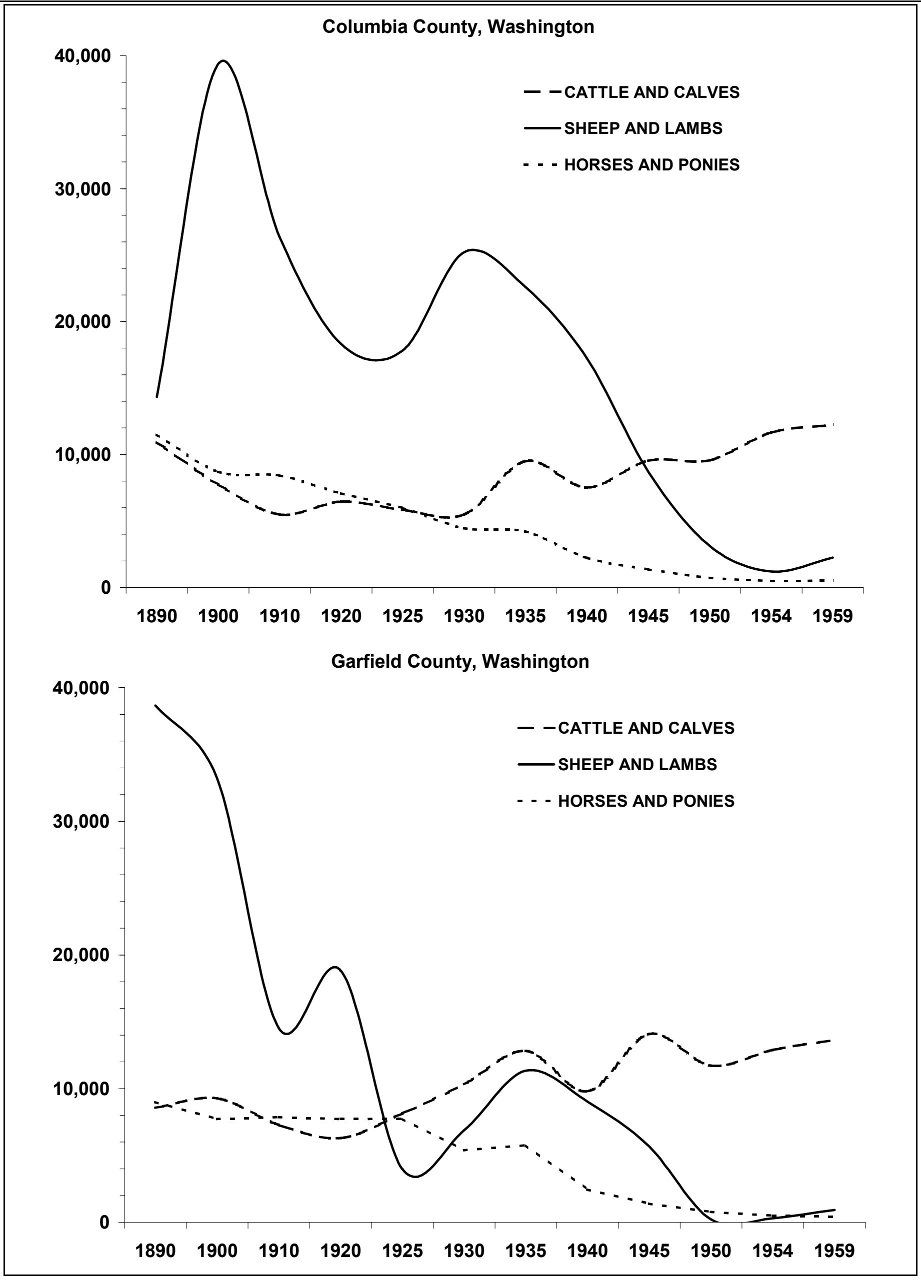


Figure 5-1. Number of grazing animals for Columbia and Garfield Counties, Washington (from Bureau of Census 1895, 1902, 1913, 1922, 1927, 1932, 1942, 1946, 1952, 1956, 1961).

After livestock removed most of the herbaceous vegetation from beneath forest stands, it was very difficult for fires to spread through them. That was particularly true for open stands of ponderosa pine because herbaceous vegetation was an important fuel component. When heavy livestock grazing coincided with effective suppression of low-intensity surface fires, the result was an increase in forest regeneration (Rummell 1951), as described in this account:

> And in open, overmature stands this [yellow pine] reproduction is even now so dense and large in many places as to practically prevent grazing. This advance reproduction has mostly come in during the last 25 or 30 years, and is due to the protection from fire which the forest has received partly by the Forest Service and partly by the unconscious efforts of the settlers and stockmen. **Yellow Pine Management Study in Oregon in 1916 (Weitknecht 1917).**

On dry-forest sites that historically supported open (park-like) ponderosa pine, suppression of the native disturbance regime – frequent surface fires (underburning) – had the unintended consequence of allowing grand firs and Douglas-firs to replace the pines. By the late 1970s, it was believed that at least 25 percent of the historical ponderosa pine type had been replaced with mixed-conifer forest (Barrett 1979); the reduction was apparently much greater than that for the southern Blue Mountains (Malheur National Forest), where ponderosa pine declined by more than half between 1936 and 1980 (Powell 1994).

The Tucannon watershed was one of four areas included in a study of historical fire regimes for the Blue Mountains of northeastern Oregon and southeastern Washington. Forty individual fire events were interpreted for the watershed, with the first one occurring in 1583 and the last one in 1898. Thirty-eight of the forty fire events affected dry-forest sites, with the smallest fire extent on dry sites being 47 acres and the largest at 3,417 acres. Average fire extent for 38 dry-forest fires in the Tucannon watershed was 1,036 acres (Heyerdahl and Agee 1996).

Timber Harvest.

Some level of timber harvest has occurred ever since Euro-American emigrants settled the Blue Mountains. The first commercial logging in the northwestern pine region of eastern Oregon and Washington began around 1890 (Weidman 1936), although limited harvesting occurred during the preceding 25 years to meet the needs of miners and early settlers. Some of the first roads reaching into the Blue Mountains were wagon roads for hauling wood and rails out to farms and ranches.

A local demand for construction timbers – trusses for mine tunnels and wooden viaducts to carry water – resulted in the first timber harvests in the Blue Mountains. Within a year after gold was discovered in the John Day River valley (in June of 1862 near Canyon City, Oregon), an enterprising person opened a sawmill to cut lumber for miners who were building flumes and sluices (Robbins 1997).

During the Euro-American settlement era, timber met a variety of the homesteaders' needs including logs for homes, posts and poles for corrals, and rails for fencing. The resinous, durable woods of ponderosa pine and western larch were ideal for providing many of those necessities (Robbins 1997, Tucker 1940). In the early days, lodgepole pine was harvested as a fuel source; the Meacham area, located southwest of the Tucannon watershed, averaged more than 9,000 cords of wood a year (mostly fuelwood) between 1884 and 1924 (Tucker no date).

After World War II, ponderosa pine and other species were intensively harvested to feed a rapidly growing market for clear lumber for home construction, railroad ties, and to fabricate shipping boxes for apples and other agricultural products (Bolsinger and Berger 1975, Gedney 1963, Robbins 1997).

Timber harvest has had a widespread but somewhat limited impact on vegetation conditions in the Tucannon watershed. For national forest lands located in eastern Oregon and eastern Washington, timber harvest levels declined by 72 percent between 1990 and 1995 (O'Laughlin and others 1998). That trend is clearly reflected in the timber harvest history for the Umatilla National Forest (Figure 5-2); recent timber harvest levels for the Umatilla National Forest (including national forest lands in the watershed) are the lowest since the mid- to late-1950s.

Figure 5-2. Timber harvest history for the Umatilla National Forest, 1922-2001.

In the Tucannon watershed, commercial timber harvest on federal lands began in the mid 1950s when a sale was sold in the Cummings Creek area. This early sale was a 'partial cut' where only the most valuable trees were removed. By the mid 1960s, small clearcut sales were made in the Abels Ridge and Turkey Creek areas. These early clearcut sales now have vigorous second-growth stands of mixed conifers that have been thinned several times since the 1970s. Many other timber sales followed in the late 1960s and early 1970s, including several in the Meadow Creek and Ruchert Springs areas. Stockade and other timber salvage sales were completed in the late 1970s following a Douglas-fir tussock moth outbreak (Johnson 1995).

Table 5-6 summarizes tree density for eleven managed stand survey plots located in the Tucannon watershed. It shows that reforestation following timber harvest has been successful, at least when tree density is used as a criterion of success. On average, the sampled plantations support 1,491 trees per acre. Plantations with high tree densities will eventually need to be thinned to maintain tree vigor and to avoid future forest health problems.

Table 5-6. Tree density for managed stand survey plots located in the Tucannon watershed.

Plot	Plant Association	PAG	PP	LP	WL	DF	WP	ES	GF	SF	Total
			← NUMBER OF TREES PER ACRE BY TREE SPECIES →								
2251	GF/CARU	WD	63	0	35	121	0	0	315	0	534
2252	PP/FEID	HD	147	0	0	7	0	0	0	0	154
2253	PP/FEID	HD	12	0	0	4	0	0	0	0	16
2260	GF/CARU	WD	335	0	4	12	0	20	100	0	471
2263	GF/LIBO2	CM	0	0	4	44	0	4	433	0	485
2265	SF/VAME	CM	0	168	0	4	0	1,083	1,020	1,424	3,699
2268	GF/LIBO2	CM	336	717	0	64	0	60	915	0	2,092
2269	GF/VAME	CM	399	204	20	364	8	500	1,720	20	3,235
2270	SF/VAME	CM	0	4	8	0	0	103	0	345	460
2272	GF/VAME	CM	19	68	11	444	0	224	1,875	0	2,641
2273	GF/VAME	CM	0	148	4	100	0	1,124	1,127	112	2,615
		Mean	187	218	12	116	8	390	938	475	1,491

Sources/Notes: Based on 11 managed stand survey plots installed in the Tucannon watershed in 1990 (see Table 5-2 for more information about MSS plots). Plant associations are described in Table 5-4 (note that GF refers to ABGR, PP refers to PIPO, and SF refers to ABLA2). PAG refers to plant association group (CM is Cool Moist, HD is Hot Dry, and WD is Warm Dry). Species are arranged by seral status (from early-seral at left to late-seral at right) and their codes are as follows: PP, ponderosa pine; LP, lodgepole pine; WL, western larch; DF, Douglas-fir; WP, Western white pine; ES, Engelmann spruce; GF, grand fir; SF, subalpine fir. Note: when calculating mean values, plots where a species did not occur (the zero values in a column) were not used.

Current Conditions

Forest Cover Types.

Table 5-7 summarizes the area of existing forest cover types for the Tucannon area. It shows that the predominant forest cover type is Douglas-fir (29% of the watershed has Douglas-fir as the plurality or majority species), followed by grand fir (23%), ponderosa pine (20%), and western larch (7%). Forests with a plurality or majority of subalpine fir, Engelmann spruce, or lodgepole pine are uncommon because each of them occupies less than 5 percent of the watershed. Map 5-2 (Map Appendix) shows forest cover types for the Tucannon watershed.

Table 5-7 shows that the watershed has an unbalanced representation of pure and mixed forest (in actuality, even the pure stands contain tree species other than the primary one). Pure stands (cover types where one species is the majority) comprise 24 percent of the Tucannon forested area; mixed stands (types where no single species is the majority) comprise 76 percent of the watershed's forested acreage.

About 10 percent of the analysis area supports nonforest vegetation, most of which is grassland. Dry meadows and bunchgrass communities (dominated by fescues and bluebunch wheatgrass) are common grassland types. Shrublands comprise a relatively small proportion of the nonforest vegetation, although a diverse mix of shrub types is present. Often, the nonforest vegetation occurs as a juxtaposition of forest and grassland referred to as grass-tree mosaic (GTM). In general, GTM consists of forested stringers alternating with nonforest communities (grasslands and shrublands).

Forest Density Classes.

Sixty-one percent of the Tucannon watershed has been examined using field surveys (stand examinations and walk-through surveys). Stand exams provide quantified data suitable for characterizing forest (tree) density (trees per acre or basal area per acre) but they do not provide estimates of canopy cover or crown closure. The other 38 percent of the analysis area was characterized using photo-interpretation surveys that provide canopy cover information but no estimates of basal area or trees per acre.

Table 5-7. Existing forest cover types of the Tucannon watershed.

Code	Cover Type Description	Acres	Percent
ABGR	Forest with grand fir as the majority species	3,945	5.1
mix-ABGR	Mixed forest with grand fir as the plurality species	14,271	18.3
ABLA2	Forest with subalpine fir as the majority species	281	0.4
mix-ABLA2	Mixed forest with subalpine fir as the plurality species	1,841	2.4
LAOC	Forest with western larch as the majority species	857	1.1
mix-LAOC	Mixed forest with western larch as the plurality species	4,665	6.0
PICO	Forest with lodgepole pine as the majority species	63	0.1
mix-PICO	Mixed forest with lodgepole pine as the plurality species	1,927	2.5
PIEN	Forest with Engelmann spruce as the majority species	298	0.4
mix-PIEN	Mixed forest with Engelmann spruce as the plurality species	3,047	3.9
PIPO	Forest with ponderosa pine as the majority species	4,208	5.4
mix-PIPO	Mixed forest with ponderosa pine as the plurality species	11,437	14.6
PSME	Forest with interior Douglas-fir as the majority species	6,738	8.6
mix-PSME	Mixed forest with interior Douglas-fir as the plurality species	15,827	20.1
mix-JUOC	Mixed forest with western juniper as the plurality species	37	0.1
Forb	Nonforest cover types dominated by forb communities	141	0.2
Grass	Nonforest cover types dominated by grass communities	7,221	9.3
Shrub	Nonforest cover types dominated by shrub communities	340	0.4
Private	Private lands in the analysis area (no cover type determined)	956	1.2

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Forest cover types where one tree species is the majority (comprising 50% or more of the stocking) are named for that species (Eyre 1980). For polygons where no single species predominates, the cover type is named for the plurality species followed by 'mix' to designate a mixed-species composition. Note that 159 acres of nonforest cover type (forb, grass, shrub) occurs on forest sites (it is 'nonstocked' forest land).

To provide a forest density measure that is compatible with both data sources, measured basal area values from stand exams were converted to their equivalent canopy cover values using the Forest Vegetation Simulator computerized model.

Table 5-8 summarizes the area of existing forest density classes for the Tucannon watershed. It shows that the predominant situation is low-density forest (10-40% canopy cover; 31% of the Tucannon watershed), followed by high-density forest (greater than 70% cover; 30% of the watershed) and then moderate-density forest (41-70% cover; 29% of the watershed). Map 5-3 (Map Appendix) shows forest density classes in the Tucannon watershed. *Note that 11 percent of the watershed was unclassified with respect to this analysis indicator*.

Table 5-8. Existing forest density classes of the Tucannon watershed.

Code	Forest Density Class Description	Acres	Percent
Low	Live canopy cover of trees is between 10 and 40 percent	23,918	30.6
Moderate	Live canopy cover of trees is between 41 and 70 percent	22,282	28.5
High	Live canopy cover of trees is greater than 70 percent	23,400	30.0
[None]	Nonforest cover types; private lands	8,499	10.9

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c).

Forest Size Classes.

Historically, forest size classes were defined using economically important criteria that emphasized wood product or timber commodity considerations (small sawtimber, large sawtimber, etc.). Size class definitions recently evolved to incorporate a biological approach based on tree size or physiological maturity. This Tucannon analysis used size class definitions that reflect tree size (note that size class was based on tree diameter rather than tree height).

Table 5-9 summarizes the area of existing forest size classes for the Tucannon watershed. It shows that the predominant size class is small trees ranging from 9 to 21 inches in diameter (34% of the forested portion of the watershed when combining size classes 6.5, 7, and 7.5), followed by medium trees ranging from 21 to 32 inches in diameter (23%), small and medium trees mixed together (16%), and poles and small trees mixed together (13%). Forest polygons dominated by seedlings and saplings mixed together occupy about 5 percent of the watershed. Other forest size classes are relatively uncommon because each of them occupies less than five percent of the forested portion of the Tucannon watershed. Map 5-4 (Map Appendix) shows forest size classes for the Tucannon watershed. *Note that 11 percent of the watershed was unclassified with respect to this analysis indicator*.

Table 5-9. Existing forest size classes of the Tucannon watershed.

Code	Forest Size Class Description	Acres	Percent
1	Seedlings; trees less than 1 inch in diameter	84	0.1
2	Seedlings and saplings mixed together	3,695	4.7
3	Saplings; trees from 1 to 4.9 inches in diameter	1,889	2.4
4	Saplings and poles mixed together	1,502	1.9
5	Poles; trees from 5 to 8.9 inches in diameter	2,419	3.1
6	Poles and small trees mixed together	9,242	11.8
6.5	Small trees from 9 to 14.9 inches in diameter	11,030	14.1
7	Small trees from 9 to 20.9 inches in diameter	1,526	2.0
7.5	Small trees from 15 to 20.9 inches in diameter	11,102	14.2
8	Small trees and medium trees mixed together	10,835	13.9
9	Medium trees from 21 to 31.9 inches in diameter	16,113	20.1
10	Medium and large trees mixed together	136	0.2
[None]	Nonforest cover types; private lands; unclassified	8,526	10.9

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Forest size classes are based on the predominant situation and are seldom pure – the pole size class (5) has a predominance of pole-sized trees (50% or more) but may also contain minor amounts of other size classes. For multi-layered stands, this information pertains to the size class associated with the predominant layer.

Forest Structural Classes.

Table 5-10 summarizes the area of forest structural classes for the Tucannon watershed. It shows that the predominant structural class is 'stem exclusion open canopy' (21% of the analysis area), followed by 'young forest multi strata' (16%), 'old forest single stratum' (14%), 'old forest multi strata' (13%), 'stem exclusion closed canopy' (12%) and 'stand initiation/bareground' (12%). 'Understory reinitiation' is relatively uncommon in the watershed – it occupies only 2 percent of the analysis area. Map 5-5 (Map Appendix) shows forest structural classes for the Tucannon watershed. *Note that 11% of the watershed was unclassified with respect to this analysis indicator*.

Table 5-10. Existing forest structural classes of the Tucannon watershed.

Code	Forest Structural Class Description	Acres	Percent
OFMS	Old Forest Multi Strata structural class	10,289	13.2
OFSS	Old Forest Single Stratum structural class	10,901	14.0
SECC	Stem Exclusion Closed Canopy structural class	9,037	11.6
SEOC	Stem Exclusion Open Canopy structural class	16,086	20.6
SI/BG	Stand Initiation/Bareground structural class	9,484	12.1
UR	Understory Reinitiation structural class	1,506	1.9
YFMS	Young Forest Multi Strata structural class	12,297	15.8
[None]	Nonforest cover types; private lands	8,499	10.9

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Forest structural classes are described in O'Hara and others (1996) and in Powell (2000; see table 2, page 16).

Forest Canopy Layers.

Table 5-11 summarizes the area of existing forest canopy layers for the Tucannon watershed. It shows that the predominant situation is a two-layer stand structure (53% of the analysis area), followed by a highly complex layer structure (3 or more layers; 22% of the Tucannon watershed) and then single-layer forest (14% of the watershed). Map 5-6 (Map Appendix) shows forest canopy layers for the Tucannon watershed. *Note that 11 percent of the watershed was unclassified with respect to this analysis indicator*.

Table 5-11. Existing forest canopy layers of the Tucannon watershed.

Code	Forest Canopy Layer Description	Acres	Percent
1	Live canopy (crown) cover of trees occurs in l layer (stratum)	10,868	13.9
2	Live canopy cover of trees occurs in 2 layers or strata	41,440	53.1
3	Live canopy cover of trees occurs in 3 or more layers or strata	17,267	22.1
[None]	Nonforest types; private lands; one unclassified forest polygon	8,525	10.9

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c).

Reference Conditions

Forest Cover Types.

Historically, forest cover types were named for an economically important species such as ponderosa pine that might be present at a fairly low level of abundance, thus ignoring a more abundant but less valuable species. Therefore, the historical forest type maps used to characterize reference conditions may contain inherent biases related to the commercial value of certain species.

Table 5-12 summarizes the area of historical forest cover types for the Tucannon watershed. It shows that the predominant forest cover type in 1935 was ponderosa pine (35% of upland forests in the watershed had ponderosa pine as the plurality or majority species), followed by lodgepole pine (31%), subalpine fir (21%), and nonforest vegetation (11%). Forests with a plurality or majority of grand fir, Douglas-fir, or western larch were apparently uncommon if the historical forest type mapping is accurate. Map 5-7 (Map Appendix) shows the geographical distribution of forest cover types in 1935.

Table 5-12. Historical forest cover types of the Tucannon watershed (1935).

Code	Forest Cover Type Description	Acres	Percent
ABGR	Forests with grand fir as the majority tree species	38	< .1
ABLA2	Forests with subalpine fir as the majority tree species	309	0.4
Burned	Burns (fires) at time of survey; no cover type provided	391	0.5
Nonforest	Nonforest cover types (no lifeform specified)	8,529	10.9
PICO	Forests with lodgepole pine as the majority tree species	762	1.0
PIPO	Forests with ponderosa pine as the majority tree species	23,217	29.7
mix-ABLA2	Mixed forest with subalpine fir as the plurality species	16,361	21.0
mix-LAOC	Mixed forest with western larch as the plurality species	103	0.1
mix-PICO	Mixed forest with lodgepole pine as the plurality species	23,229	29.8
mix-PIPO	Mixed forest with ponderosa pine as the plurality species	4,196	5.4
Private	Private lands in the analysis area (no cover type available)	956	1.2

Sources/Notes: Summarized from the '1935veg' database (see Powell 2001d for a description of the 1935 county-level forest type maps).

Forest Density Classes.

Table 5-13 summarizes the area of historical forest density classes for the Tucannon watershed. It shows that the predominant situation in 1935 was low-density forest (10-40% canopy cover; 53% of the classified portion of the watershed), followed by high-density forest (> 70% cover; 25%) and then moderate-density forest (41-70% cover; 22%). *Note that 66 percent of the watershed was unclassified with respect to this analysis indicator*.

Table 5-13. Historical forest density classes of the Tucannon watershed (1935).

Code	Forest Canopy Layer Description	Acres	Percent
Low	Live canopy (crown) cover of trees occurs in l layer (stratum)	14,302	18.3
Moderate	Live canopy cover of trees occurs in 2 layers or strata	5,895	7.6
High	Live canopy cover of trees occurs in 3 or more layers or strata	6,747	8.6
Unclassified	Nonforest; private; and unclassified forest lands	51,147	65.5

Sources/Notes: Summarized from the '1935veg' database (see Powell 2001d).

Forest Size Classes.

Table 5-14 summarizes the area of historical forest size classes for the Tucannon watershed. It shows that the predominant forest size class in 1935 was a mixture of saplings and poles (31% of the watershed), followed by medium trees ranging from 21 to 32 inches in diameter (29%), and then a mixture of small and medium trees (25%). Map 5-8 (Map Appendix) shows the geographical distribution of forest size classes in 1935. *Note that 13 percent of the watershed was unclassified with respect to this analysis indicator*.

Table 5-14. Historical forest size classes of the Tucannon watershed (1935).

Code	Forest Size Class Description	Acres	Percent
2	Seedlings and saplings mixed together	145	0.2
4	Saplings and poles mixed together	24,214	31.0
6	Poles and small trees mixed together	1,420	1.8
7.5	Small trees from 15 to 20.9 inches in diameter	71	0.1
8	Small trees and medium trees mixed together	19,463	24.9
9	Medium trees from 21 to 31.9 inches in diameter	22,592	28.9
Unclassified	Nonforest; private; and unclassified forest lands	10,185	13.0

Sources/Notes: Summarized from the '1935veg' database (see Powell 2001d). Forest size classes are based on the predominant situation and are seldom pure – the medium size class (9) has a predominance of medium-sized trees (50% or more) but may also contain minor amounts of other size classes.

Forest Structural Classes.

Table 5-15 summarizes the area of historical forest structural classes for the Tucannon watershed. It shows that the predominant structural class in 1935 was 'old forest single stratum' (29% of the watershed), followed by 'old forest multi strata' (25%), 'stand initiation' (23%), and 'stem exclusion closed canopy' (11%). The other three structural classes were uncommon – each of them occupied less than one percent of the analysis area. Map 5-9 (Map Appendix) shows the geographical distribution of forest structural classes in 1935. *Note that 12 percent of the watershed was unclassified with respect to this analysis indicator*.

In 1935, this mix of structural classes was primarily a result of bark beetle and defoliator outbreaks, parasite and pathogen infestations, wildfire, windstorm, and other native disturbance processes. The historical forest type mapping included 640 acres of recent timber harvest for the Tucannon watershed; this acreage represents only 0.8 percent of the watershed's area.

Table 5-15. Historical forest structural classes of the Tucannon watershed (1935).

Code	Forest Structural Class Description	Acres	Percent
OFMS	Old Forest Multi Strata structural class	19,669	25.2
OFSS	Old Forest Single Stratum structural class	22,592	28.9
SECC	Stem Exclusion Closed Canopy structural class	8,166	10.5
SEOC	Stem Exclusion Open Canopy structural class	133	0.2
SI	Stand Initiation structural class	17,870	22.9
UR	Understory Reinitiation structural class	103	0.1
YFMS	Young Forest Multi Strata structural class	71	0.1
[None]	Nonforest cover types; private lands	9,485	12.2

Sources/Notes: Summarized from the '1935veg' database (see Powell 2001d). Forest structural classes are described in O'Hara and others (1996) and in Powell (2000; see table 2, page 16).

Forest Canopy Layers.

Reference conditions could not be interpreted for this analysis indicator because canopy layer information was not provided by the 1935 forest type mapping.

Comparison of Current and Reference Conditions

Forest Cover Types.

Forest composition of the Tucannon watershed has been surprisingly inconsistent over the last 65 years (Tables 5-7 and 5-12). Currently, the most prevalent cover type is Douglas-fir forest, and yet Douglas-fir was not mapped at all in 1935! A similar situation exists for other cover types, as shown below when the top four types for each comparison period are ranked:

Rank	Current Conditions	Reference Conditions
1	Douglas-fir	Ponderosa Pine
2	Grand Fir	Lodgepole Pine
3	Ponderosa Pine	Subalpine Fir
4	Western Larch	Nonforest

Some of these differences are undoubtedly 'real' and reflect species composition changes occurring over the last 65 years, but others may be due to inaccuracies associated with the 1935 forest type maps.

Recent bioregional assessments concluded that dry-forest areas have vegetation conditions that are out-of-balance when compared with the historical (presettlement) situation (Caraher and others 1992, Hessburg and others 1999, Lehmkuhl and others 1994, Quigley and Arbelbide 1997). Further analysis of forest cover types corroborates that finding and suggests that too many dry-forest sites in the analysis area currently support grand fir or Douglas-fir types (Table 5-16).

Table 5-16. Historical range of variability analysis for vegetation composition (dry upland forest PVG only).

Cover Type	Historical Range (%)	Current Percentage	Interpretation
Ponderosa Pine	72-90	38.0	Well below HRV
Interior Douglas-fir	8-14	52.7	Well above HRV
Grand Fir	1-5	7.2	Slightly above HRV
Grass/Forb	0-2	0.1	At low end of HRV
Shrub	0-3	0.1	At low end of HRV
Other		1.9	

Sources/Notes: Current percentages were derived from the 'ExistVeg' database (see Powell 2001c). Historical ranges are approximate and were inferred from Morgan and Parsons (2000). Note that this information pertains to the 'dry upland forest' PVG only; historical ranges and the current percentage values would vary for other PVGs.

Forest Density Classes.

A comparison of current and reference conditions (Tables 5-8 and 5-13) indicates that the percentage of moderate- and high-density forest increased substantially over the last 65 years. However, this comparison is misleading because a very high proportion of the Tucannon watershed was not rated for this analysis indicator in 1935 (66%). For that reason, it is difficult to form any definite conclusions about forest-density trends for the Tucannon watershed.

Recently developed stocking guidelines (Cochran and others 1994, Powell 1999) were used to analyze existing forest density levels to infer whether they are ecologically sustainable. By using the stocking guidelines in conjunction with potential vegetation (potential vegetation groups), it was possible to determine the acres that would be considered overstocked.

Overstocked forests have density levels in the 'self-thinning zone' where trees aggressively compete with each other for moisture, sunlight, and nutrients. Forests in the self-thinning zone experience mortality as crowded trees die from competition or from insects or diseases that attack trees under stress (Powell 1999).

A forest density analysis was completed because it can help identify opportunities to use thinning and other density management treatments to address forest health issues. The density analysis was based on a process described in Powell (2001b). Results of the forest density analysis are summarized in Table 5-17. It shows that about 55 percent of upland forests in the Tucannon watershed are overstocked, ranging from a low of 52 percent for dry-forest sites to a high of 78 percent for cold-forest sites.

Table 5-17. Forest density analysis for the Tucannon watershed.

Potential Vegetation Group	Not Overstocked (Acres)	Overstocked (Acres)	Overstocked (Percent)
Dry Upland Forest	13,981	15,160	52.0
Moist Upland Forest	16,569	21,347	56.3
Cold Upland Forest	563	1,980	77.9
Total (Upland Forest)	31,113	38,487	55.3

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Criteria used for determination of stocking status ('overstocked' or 'not overstocked') are described in Powell (2001b).

Crown fire susceptibility

A crown fire susceptibility analysis was completed for the Tucannon watershed. Each forest polygon was rated in terms of its potential to express crown fire behavior during a fire event. Crown fire potential was assessed using stand density thresholds related to the crown bulk density of canopy foliage (Agee 1996). The crown fire assessment procedure is described in Powell (2001a).

Results of the crown fire analysis are summarized in Table 5-18. It shows that about 24 percent of upland forests in the Tucannon watershed have the potential to express crown fire behavior during a fire event, ranging from a low of 8 percent for dry-forest sites to a high of 52 percent for cold-forest sites. Map 5-10 (Map Appendix) shows the geographical distribution of areas with crown fire potential for the Tucannon watershed.

Areas with crown fire potential present an opportunity to use thinning and other density management treatments to address wildfire risk issues, particularly in instances where crown fire potential coincides with the urban-wildland interface.

Table 5-18. Crown fire analysis for the Tucannon watershed.

Potential Vegetation Group	No Crown Fire Potential (Acres)	Crown Fire Potential (Acres)	Crown Fire Potential (Percent)
Dry Upland Forest	26,951	2,190	7.5
Moist Upland Forest	24,455	13,461	35.5
Cold Upland Forest	1,233	1,310	51.5
Total (Upland Forest)	52,639	16,961	24.4

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Criteria used for determination of crown fire potential ('no crown fire potential' or 'crown fire potential') are described in Powell (2001a) and based on work by Agee (1996).

Forest Size Classes.

Forest size classes have been relatively stable over the last 65 years (Tables 5-9 and 5-14). The main difference is related to the primary (rank #1) size class, as shown in the summary below:

Rank	Current Conditions	Reference Conditions
1	9-21″ DBH Trees	Saplings & Poles
2	21-32″ DBH Trees	21-32″ DBH Trees
3	Small & Medium	Small & Medium
4	Poles & Small	Poles & Small

One of the implications of this trend is that there is less area dominated by very small trees now than there was historically. In 1935, forests dominated by seedlings, saplings, or poles comprised over 31 percent of the Tucannon watershed; currently, only 9 percent of the watershed supports those size classes (when considering size classes 1, 2, 3, and 4 combined).

A reduced representation of the smallest size classes is probably due to a variety of factors, including differences in resolution between the historical and current data sources (the historical map was compiled using ground reconnaissance; the current map is a product of stand exams and photo-interpretation data); plant succession (immature forest in 1935 is now mature forest 65 years later); and disturbance processes (the 1935 map may have depicted young, regenerating forests resulting from wildfires or other disturbance processes).

Forest Structural Classes.

A comparison of historical and current structural classes (Tables 5-10 and 5-15) shows that mid-seral structural classes are now predominant in the Tucannon watershed, whereas old forest structure was most common in 1935 (refer to Table 5-10 or 5-15 for a description of the codes):

Rank	Current Conditions	Reference Conditions
1	SEOC	OFSS
2	YFMS	OFMS
3	OFSS	SI
4	OFMS	SECC

The implications of this trend is that old forest structure was more common historically than it is now; that mid-seral structure (stem exclusion and young-forest multi strata) is more prevalent now than it was historically; and that early-seral structure (stand initiation) was more abundant historically than it is now.

To understand the implications of current conditions, it is often helpful to put them in an historical context. A technique was recently developed to help put current conditions in their historical context – the historical range of variability (HRV).

Managers often consider HRV to be an indicator of ecological sustainability – historical conditions are believed to represent sustainable conditions, at least to whatever extent Nature emphasized sustainability. A key premise of HRV is that native species are adapted to, and have evolved with, the prevailing disturbance regime of an area. For that reason, ecosystem elements occurring within their historical range are believed to represent resilient and healthy situations (Morgan and others 1994, Swanson and others 1994).

Structural classes are inclusive – any particular point on a forest's developmental pathway can be assigned to a structural class. They are also universal – every forest eventually passes through a series of structural classes, although not every stand occupies every class or spends an equal amount of time in any particular class. For those reasons – inclusiveness and universality – structural classes provide a valuable framework for comparing current and reference conditions.

HRV is an analytical technique that can be applied to a wide variety of ecosystem elements; see Table 5-16 for an example of its use to evaluate vegetation composition for the dry-forest potential vegetation group. An HRV analysis was also used to evaluate structural composition for the Tucannon watershed. It was based on two primary factors – forest structural classes and potential vegetation (as represented by PVGs). Results of the HRV analysis are provided in Table 5-19. It summarizes the current percentage of each structural class, by potential vegetation group; the historical ranges for each of the structural classes are also shown.

Perusing the HRV results in Table 5-19 shows that the stem exclusion structural classes tend to be above their historical ranges; understory reinitiation tends to be below the historical range; and that old forest is above or below its historical range, varying by structural class (OFSS versus OFMS) and by PVG.

Table 5-19. Historical range of variability (HRV) analysis for forest structural classes.

PVG		FOREST STRUCTURAL CLASSES							NFS
		SI	SEOC	SECC	UR	YFMS	OFMS	OFSS	Acres
Cold	H%	1-20	0-5	5-20	5-25	10-40	10-40	0-5	2,543
	C%	17	**46**	3	**0**	29	**5**	0	
Moist	H%	1-10	0-5	5-25	5-25	40-60	10-30	0-5	37,916
	C%	11	**19**	10	**1**	**23**	14	**21**	
Dry	H%	5-15	5-20	1-10	1-10	5-25	5-20	15-55	29,141
	C%	17	**26**	**17**	4	10	16	**10**	

Sources/Notes: Summarized from the 'ExistVeg database (see Powell 2001c). Upland forest potential vegetation groups (PVG) are described in Powell (1998) and in Table 5-4. Historical percentages (H%) were derived from Hall (1993), Johnson (1993), and USDA Forest Service (1995), and are summarized in Blackwood (1998). Current percentages (C%) were based on NFS lands. Structural class codes are described in Powell (2001c) and in Tables 5-14 and 5-19. Gray cells show instances where the current percentage (C%) is above the historical percentage (H%) for a structural class. Black cells show instances where the current percentage is below the historical percentage. *Since an HRV analysis is somewhat imprecise, deviations (whether above or below the H% range) were only noted when the current percentage differed from the historical range by more than 2 percent*. Note: Blackwood (1998) does not provide historical ranges by PVG, so historical ranges for the following PAGs were selected to represent the PVGs used above: cold dry PAG for Cold PVG; cool moist PAG for Moist PVG; and warm dry PAG for Dry PVG.

Forest Canopy Layers.

Trends could not be interpreted for this analysis indicator because canopy layer information was available for current conditions but not for reference conditions.

Further analysis of existing canopy layers shows that 82 percent of dry-forest sites in the Tucannon watershed currently have a multi-layered structure. This situation is inconsistent with the historical situation because it is believed that dry forests had a very high percentage of single-layer structure in the presettlement era, with perhaps as much as 55 to 70 percent of ponderosa pine forest occurring in the 'old forest single stratum' structural class (see OFSS historical range for the 'warm dry' and 'hot dry' plant association groups in Blackwood 1998).

CURRENT AND REFERENCE CONDITIONS FOR WILDFIRE RISK

Overview of Wildfire

Fires in the interior Columbia Basin have been characterized as both benign and catastropical, (Agee 1994). Assigning a value to these natural events implies there is some level of desirability associated with each event. Such socioeconomic value judgments are misleading for they place fire in a positive or negative role. Fire effect on a forested environment is influence by frequency, duration and intensity and can vary 1000-fold (Van Wagner 1965). These factors, in turn, vary with forest type, depending on: 1) fuels and fuel structure; 2) topography; and 3) weather variables. What is essential is an understanding of fire's long-term interaction in an ecosystem process. As these ecosystems appear to be less sustainable today than they were historically (Agee 1994), one could conclude that fire is an essential ecological process. Fire occurring at some level of intensity and periodicity is required for long-term sustainability of these ecosystems.

Fire has been a pervasive disturbance process in the Blue Mountains for as long as vegetation has been present. Historical records and fire-scarred trees suggest that fire burned at frequent intervals in the forest and grasslands of this area. Frequent fire has had a major influence on the vegetation in the Blue Mountains.

The impact of fire on the ecosystems of the Blue Mountains varies with intensity and frequency. Fire as a process 1) prepares seedbeds; 2) cycles nutrients; 3) adjusts successional pathways; 4) modifies habitats; 5) influences vegetative mix, age and structure; 6) effects disease and insect susceptibility; and 7) reduces and creates fire hazards.

Prior to organized suppression in the early twentieth century, frequent fires of varying intensities characterized the Tucannon analysis area. Heyerdahl (1996) found the mean fire return interval for this area to be approximately 24 years. These fires where usually low intensity surface fires, but when topography, fuels and weather were aligned, high intensity fire would develop. This resulted in fire regime with a vegetative montage generally dominated by early seral, fire adapted, and fire resistant species. The relative absence of fire has resulted in a transitional fire regime characterized by a higher percentage of high intensity fire and vegetative changes such as greater abundance of late seral, fire intolerant species such a grand fir.

The fire severity regimes of the Blue Mountains are displayed below (Table 6-1) based on potential vegetation (Agee 1990). Within each regime is severity range either in the same fire or between fires (Agee 1994).

Reference Conditions for Fire

Historic Fire Regimes

Historic fire regimes describe the historic fire conditions under which vegetative communities evolve and are maintained. These represent the structure and composition of vegetation in a fire environment in the absence of human interaction. Five historical natural fire regime groups have been described in the Cohesive Strategy (Forest Service Management response to GAO Report GAO/RCED-99-65). They represent combinations of fire frequency and fire severity:

Table 6-1 Historic natural fire regimes groups

Fire Regime Group	Fire Return Frequency	Fire Intensity/Severity
I	0-35 years	Low
II	0-35 years	High (stand replacement)
III	35-100+ years	Mixed
IV	35-100+ years	High (stand replacement)
V	>200 years	High (stand replacement)

Table 6-2 lists the historic fire regime groups for the Forest Service lands within the Tucannon Watershed. They are based on potential vegetation and plant association groups (PAG's) for the Umatilla National Forest (see Map Appendix, Map 6-1).

Table 6-2 Fire regime acres on Forest Service lands within the Tucannon watershed.

Fire Regime	Acres	Percent
I	36,333	47%
II	12	0.01%
III	38,187	49%
IV	61	0.07%
V	2,536	3.9%

There has also been a slow transition in fuels. Fuels have changed from primarily surface fuels at low loading levels (4-8 tons/ac), to moderate to high surface loadings, (12–24 tons/ac and greater), with a vertical component connecting surface fuels to crown bases. Parts of the analysis area with shallow, rocky soils do not show this transition or show it to a lesser degree.

Natural fire ignitions and fires that were a result of human use of the area were considered the reference conditions from which current conditions could be evaluated. Fire recurrence was relatively frequent and intensities were mixed (Agee 1996). Fire recurrence declined dramatically after the late 1800's.

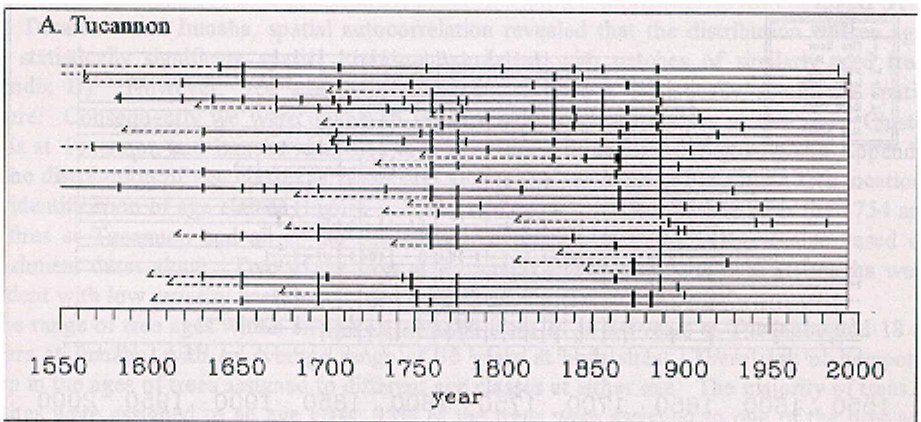


Figure 6-1 Fire chart for dry forest at Tucannon fire history sampling sites. Each horizontal line shows the composite fire record at a single sampling plot through time (Heyerdahl 1996).

This decline correlates directly to an increase in grazing (Irwin et al. 1994). Fire starts have remained relatively stable from the reference period, while fire size has significantly decreased over time due to increasingly successful fire suppression. Biomass and fire intensity has increased due to suppression, climate and less grazing. The current trend for fire frequency is flat at approximately 13.4 fires within the analysis area, annually, (see Map Appendix, Map 6-2). The majority of these are natural ignitions. Current trends should see a slow increased in burned acres with an increasing probability of a large area being burned, at moderate to high intensities, in a short period.

Current Wildfire Risks

Fuels

There are 13 Fire Behavior fuel models, which are grouped into four major categories: grass, shrub, timber and slash. Definitions for each of the 13 fuel models come from Anderson (1982). The criteria are based on the fuels, which will carry a fire. Each model yields flame length and rate-of-spread information for the purpose of fire behavior prediction and fire planning. The models described in this section exist in the project area and are displayed by acreage and percentage of occurrence for the analysis area. The fuel model and representative stand descriptions are intended to help clarify current ground fuel situations with the visual aid of the landscape fuel model maps of the analysis area (Map Appendix, Map 6-3).

The fuel model map displays the dominant model identified in the stands, (1, 2, 5, 8, 9, &10), but it is very important to note that every stand commonly has secondary models with variable occurrence percentages. For example, stands identified as primarily Fuel model 8 or 9 will have a certain percentage of model 10, but “pockets” of model 10 are not being mapped over the entire landscape in this analysis. Also, areas that are identified as model 10 will not yield continual model 10.

Fuel Model 1: Fire carries through fine herbaceous fuels that are cured or nearly cured. Very little shrubs or timber is present. Grassland, savanna and stubble are commonly modeled.

Fuel Model 2: Fuel is primarily fine herbaceous fuels, curing or dead. In addition, litter and stem wood from open shrub or timber overstory contribute. Open shrublands or pine stands are most commonly modeled.

Fuel Model 5: Fuels consist mostly of litter cast by shrubs and the forbs in the understory. Green stands of deciduous shrubs are most commonly modeled.

Fuel Model 8: Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand. Representative conifer types are white pine, lodgepole pine, spruce, fir and larch.

Fuel Model 9: Describes fires that run through surface litter faster than model 8 and have longer flame heights. Both long-needle conifer stands and hardwood stands are typical. Closed stands of long-needled pine like ponderosa pine are usually modeled.

Figure 6-2. Fuel Model 9

Fuel Model 10: Fire burns in the surface and ground fuels with greater fire intensity that the other timber litter models. Dead-down fuels include greater quantities of 3-inch or larger limbwood resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect or disease ridden stands, windthrown stands, overmature situations with dead fall, and aged light thinning or partial-cut slash.

Figure 6-3. Fuel Model 10

Table 6-3. Fuel Model Acres

Fuel Model	Acres	Percent
1	7,262	9%
2	16,382	21%
5	3,217	4%
8	35,525	46%
9	6,581	9%
10	8,161	11%

Fire Condition Class

Condition classes are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities. Condition classes are mapped in Map Appendix, Map 6-4.

Table 6-4. Condition Classes

Condition Class	Attributes	Example Management Options
I	Fire regimes are within or near an historical range. The risk of losing key ecosystem components is low. Fire frequencies have departed from historical frequencies (either increased or decreased) by no more than one return interval. Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
II	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components has increased to moderate. Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This change results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. Vegetation attributes have been moderately altered from their historic ranges.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
III	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed (either increased or decreased) by multiple return intervals. This change results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. Vegetation attributes have been significantly altered from their historic ranges.	Where appropriate, these areas need high levels of restoration treatments, such as hand or mechanical treatments. These treatments may be necessary before fire is used to restore the historical fire regime.

Table 6-5. Condition Class Acres

Condition Class	Acres*	Percent
I	34,611	45%
II	33,052	43%
III	9,465	12%

* Data are a coarse estimate of condition class derived from Forest-wide coverages.
These data are being revised as part of project-level field verification at the Pomeroy Ranger District

CURRENT AND REFERENCE CONDITIONS FOR BOTANICAL RESOURCES

Overview

Species encounter lists compiled as part of the 30 sensitive plant surveys conducted within the Tucannon analysis area between the years 1988-2001 have identified 708 vascular plant taxa (Appendix C). This represents 67 percent of all plant taxa currently found on the Pomeroy Ranger District, 46 percent of all plant taxa currently identified on the Umatilla National Forest. Approximately 66,607 acres, 83 percent, of the Tucannon analysis area has been surveyed to date. Of the 13,169 unsurveyed acres, 11,917 are within the Wenaha-Tucannon Wilderness, the remaining 1,252 acres are State lands along the Tucannon River. At present, about 50 percent of the State lands have been surveyed.

Historic records lack sufficient detail to compare present with historic floristic diversity in the Tucannon analysis area. However, the analysis area likely supports more plant taxa today than it did in pre-settlement times. Introduced or non-native taxa account for this increase. Floristic make-up (Table 7-1.) is 86 percent native and 14 percent non-native to North America. Introduced taxa come from all corners of the globe and appeared with the new-world settlement.

Table 7-1. Numbers of species by life form and origin (native or introduced)

Life-form	Taxa	Native	Introduced
Forbs	515	449	66
Grasses	69	42	27
Grass-likes	34	34	0
Shrubs	71	67	4
Trees	19	18	1
Total	708	610	98

Table 7-2. Numbers of surveyed acres by year within the Tucannon analysis area

1988	1989	1990	1991	1992	1993	1994	1996	1998	1999	2000
5,556	5,318	12,349	10,330	24,142	8,052	3,709	18,477	1	9,784	3,559

Detailed botanical inventory records prior to 1988 do not exist for the analysis area. The botany program has averaged 9,207 acres per year during the 11 field seasons in which surveys have been conducted in the analysis area (Table 7-2.). Modest collection searches of several regional herbaria did not reveal new taxa currently unidentified by the Botanical Resources Program. To date no currently identified plant taxa within the analysis area have been extirpated or suffered irreversible population viability thresh-holds.

Historic Forest Sensitive Plant species (Table 7-3.) once numbered 13 within the analysis area. Currently only clustered lady slipper (*Cypripedium fasciculatum*) remains on the Forest Sensitive Plant list and is currently the only known sensitive plant found within the analysis area. A single population persists near the Tucannon Guard Station that was found by Karl Urban in 1993. The small population remains stable and is monitored every year in May. Exhaustive botanical surveys, sound forest management practices, and careful mitigation have contributed to the delisting of these 12 former sensitive plant species in Washington.

Table 7-3. Presently listed and historically listed Forest sensitive plant species in the Tucannon analysis area.

Scientific name	Common name	Sensitive status	Life form	Native status
Astragalus whitneyi sonneanus	balloon pod milkvetch	HSW	F	N
Chaenactis douglasii douglasii	hoary chaenactis	HSW	F	N
Cypripedium fasciculatum	clustered lady slipper	PSW	F	N
Delphinium depauperatum	slim larkspur	HSW	F	N
Hackelia diffusa	diffuse stickseed	HSW	F	N
Impatiens aurella	jewelweed	HSW	F	I
Lupinus garfieldensis	Asotin lupine	HSW	F	N
Orobanche pinorum	pine broomrape	HSW	F	N
Penstemon pennellianus	Pennell's penstemon	HSW	F	N
Carex backii	Back's sedge	HSW	G-L	N
Ribes oxyacanthoides s. cognatum	Umatilla gooseberry	HSW	S	N
Ribes oxyacanthoides s. irriguum	Idaho gooseberry	HSW	S	N
Ribes wolfii	Wenaha currant	HSW	S	N

PSW=Presently Sensitive in Washington; HSW=Historically Sensitive in Washington
F=Forb; G-L=Grass-like; S=Shrub
N=Native; I=Introduced

Table 7-4 lists and ranks additional Forest and Region 6 Sensitive Plants that have potential for occurring within the analysis area. The majority has a low probability of occurring, in part due to existing population distributions, lack of current documented potential habitat, and the high level of survey coverage. Additional surveys focusing on unsurveyed portions of the analysis area (Wilderness and State), and remaining areas with high potential habitat during appropriate phenological windows will further refine this list. It is highly probable that more populations will be found. Clustered lady slipper prefers the cool-moist to warm-dry ecotypes associated with Grand-fir and Douglas fir plant associations. Two additional species with high potential for occurrence, Nez Perce mariposa lily (*Calochortus macrocarpus* v. *maculosus*), found in rocky, grass steppe canyons and many flowered phlox (*Phlox muliflora*) found at upper elevations on open, rocky places, have been documented on adjacent private and nearby Forest land. The Federally listed species Spalding's catchfly (*Silene spaldingii*), Ute ladies'-treses (*Spiranthes diluvialis*), and the Candidate species slender moonwort (*Botrychium lineare*) are ranked as very low owing to their unique habitat requirements, primarily soils and elevation. Further botanical surveys will again be crucial in providing further documentation in support of the low probability of occurrence assessment. This can only be achieved by the continued commitment and support of the Pomeroy Ranger District staff in helping with logistics, housing, and long range project planning. Table 7-3 illustrates the success of botanical surveys. Many of these former sensitives exhibit narrow endemism, existing only in the Blue Mountains Province, their delisting a direct result of extensive botanical surveys.

Table 7-4. Potential of additional Region 6 and Forest sensitive plant species occurring within the analysis area

Scientific name	Common name	Potential
Allium campanulatum	Sierran onion	Moderate
Allium dictuon	Blue Mountain onion	Low
Astragalus arthurii	Arthur's milkvetch	Low
Astragalus cusickii cusickii	Cusick's milkvetch	Low
Bolandra oregana	Oregon bolandra	Moderate
Botrychium ascendens	upward lobed moonwort	Low
Botrychium campestre	Iowa moonwort	Low
Botrychium crenulatum	crenulate moonwort	Low
Botrychium crenulatum	crenulate grape-fern	Low
Botrychium hesperium	western moonwort	Low
*Botrychium lineare**	slender moonwort	Very Low
Botrychium paradoxum	two-spiked moonwort	Low
Botrychium pedunculosum	stalked moonwort	Low
Calochortus longebarbatus longebarbatus	longbearded sego lily	Low
Calochortus marcocarpus maculosus	Nez Perce Mariposa Lily	High
Calochortus nitidus	broad-fruit mariposa	Low
Carex hystericina	porcupine sedge	Moderate
Carex interior	inland sedge	Low
Cypripedium fasciculatum	clustered lady slipper	High
Leptodactylon pungens hazeliae	prickly phlox	Low
Lupinus sabinianus	Sabin's lupine	Low
Lycopodium complanatum	ground cedar	Low
Mimulus clivicola	bank monkey-flower	Moderate
Montia diffusa	branching montia	Low
Phacelia minutissima	least phacelia	Moderate
Phlox multiflora	many flowered phlox	High
Ranunculus populago	mountain buttercup	Moderate
*Silene spaldingii***	Spalding's silene	Very Low
*Spiranthes diluvialis***	Ute ladies'-tresses	Very Low
Suksdorfia violacea	violet Suksdorfia	Moderate
Trifolium douglasii	Douglas clover	Low
Trifolium plumosum s. plumosum	pussy clover	Low

♦ Scientific Name: Based on the national standardized PLANTS (Plant List of Accepted Nomenclature, Taxonomy, and Symbols) database adopted by the USDA. This database reflects current taxonomic classifications and nomenclature.
*Federal Candidate Species
**Federally Listed as Threatened

Floristic Diversity

A notable feature of the floristic composition and distribution of the Tucannon analysis area is the number of introduced or non-native taxa (Table 7-5.). Currently one in seven identified plants, 98 taxa in all, is non-native to the Tucannon analysis area. This is not wholly unexpected given the early settlement history, abundant water, fertile soils, low elevation, and long growing season available in the Tucannon valley. The aggressive physiology evident in the majority of non-native taxa provides a competitive advantage over native taxa. The non-native component consists of 7 noxious and, or "weedy" taxa, recognized as such in both Oregon and/or

Washington. Fifteen taxa are "legacy" or "old school" conservation/restoration cultivars, intentionally broadcast to provide soil stabilization and forage enhancement. Common practice for over a century, these species have seen extensive distribution throughout the entire Umatilla National Forest, and on adjacent lands. These "legacy" species include Legume's, *Medicago lupulina* (Black Medic), *Trifolium hybridum* (Alsike Clover), *T. pratense* (Red Clover), *T. repens* (White Clover), and grasses, *Agropyron intermedium* (Pubescent Wheatgrass), *Agrostis alba* (Redtop), *Alopecurus pratensis* (Meadow Foxtail), *Arrhenatherum elatius* (Tall Oatgrass), *Bromus inermis* (Smooth Brome), *Dactylus glomerata* (Orchard Grass), *Lolium arundinaceum* (Tall Fescue), *Phalaris arundinacea* (Reed Canary grass), *Phleum pratense* (Common Timothy), *Poa compressa* (Canada Bluegrass), and *Poa pratensis* (Kentucky Bluegrass). Canary reedgrass in particular, used in the past for riparian restoration, has spread throughout much of the Tucannon analysis area. The aggressive nature, in terms of rapid colonization, habitat conversion, and monoculture habit, have the potential to restructure both the hydrology and plant communities associated with the Tucannon rivers natural biophysical make-up. The historically valuable role of introduced species in soil stabilization cannot be controverted nor can the successes of introduced species. The use of native species has all but eliminated the need for introduced taxa in restoration projects.

Of the remaining non-natives the vast majority merely represent a range of individual species spread rate from a distant point source via accidental vectoring, such as cheat grass, yellow star thistle, knapweeds, and sulfur cinquefoil. Some were intentionally introduced such as bachelor's button, closely related to knapweeds and yellow star thistle, now occupying many acres of private land adjacent to the analysis area. Blackberry's, especially Himalayan, are well established in the moist bottomlands adjacent to the Tucannon River and have the potential for tremendous rates of spread. Lilacs of many colors, naturalized tulips, black locust and old fruit trees are common around abandoned homesteads and pose little invasive threat.

The majority of introduced vascular plant taxa listed in Table 7-5 continue with varying rates of expansion into all plant associations, especially those with historic and/or continued disturbance. Dry forest types, rangeland, and riparian areas are the most susceptible. The final distribution and composition of non-native taxa within the native ecosystem can only be speculated at this time. Taxa listed as noxious can be expected to persist, increasing in both composition and distribution throughout the Tucannon analysis area in proportion to present and historical anthropogenic use of the land. Factors promoting these increases are; 1) current existing distribution, and density throughout the local area, both vegetative and seed, 2) competitive and establishment advantages over native taxa, 3) depleted forested and non-forested ecological conditions, often below recovery thresholds, 4) loss of localized native seed sources, 5) pre-existing populations and continued use on adjacent lands, and 6) lack of modern legislation allowing use of appropriate chemical treatment of noxious weed sites on Federal lands.

Table 7-5. Introduced Vascular Plant Taxa within the Tucannon analysis area.

Scientific name	Common name	Life form
Alyssum alyssoides	pale alyssum	F
Amaranthus albus	white tumbleweed	F
Anthemis cotula	Mayweed chamomile	F
Arctium minus	common burdock	F
Arenaria serpyllifolia	thyme-leaf sandwort	F
Buglossoides arvensis	corn gromwell	F
Camelina microcarpa	littlepod falseflax	F

Scientific name	Common name	Life form
Capsella bursa-pastoris	Shepherd's purse	F
Centaurea biebersteinii	spotted knapweed	F
Centaurea cyanus	bachelor's button	F
Centaurea diffusa	diffuse knapweed	F
Centaurea solstitialis	yellow star thistle	F
Cerastium fontanum s. vulgare	mouse-ear chickweed	F
Cichorium intybus	Chicory	F
Cirsium arvense	Canada thistle	F
Cirsium vulgare	bull thistle	F
Cynoglossum officinale	common houndstongue	F
Daucus carota	Queen Anne's lace	F
Dianthus armeria	Deptford pink	F
Dipsacus fullonum	Teasel	F
Erodium cicutarium	stork's bill	F
Geranium molle	Dovefoot geranium	F
Geranium pusillum	small-flowered crane's bill	F
Holosteum umbellatum	jagged chickweed	F
Hypericum perforatum	Klamathweed	F
Impatiens aurella	Jewelweed	F
Lactuca serriola	prickly lettuce	F
Leucanthemum vulgare	oxeye daisy	F
Linaria dalmatica	bastard toadflax	F
Medicago lupulina	black medic	F
Medicago sativa	Alfalfa	F
Medicago sativa s. falcate	yellow lucerne	F
Melilotus officinalis	white sweetclover	F
Myosotis scorpioides	common forget-me-not	F
Onopordum acanthium	cottonthistle	F
Plantago lanceolata	Buckhorn plantain	F
Plantago major	nippleseed plantain	F
Potentilla recta	erect cinquefoil	F
Ranunculus acris	meadow buttercup	F
Rumex acetosa	garden sorrel	F
Rumex acetosella	sheep sorrel	F
Rumex crispus	curly dock	F
Rumex obtusifolius	broad-leaved dock	F
Sanguisorba minor	garden burnet	F
Scleranthus annuus	Knotgrass	F
Senecio jacobaea	tansy ragwort	F
Sisymbrium altissimum	tumblemustard	F
Sisymbrium loeselii	Loesel tumblemustard	F
Spergularia rubra	red sandspurry	F
Stellaria media	Chickweed	F
Tanacetum vulgare	common tansy	F
Taraxacum laevigatum	smooth dandelion	F
Taraxacum officinale	common dandelion	F
Thlaspi arvense	field pennycress	F
Tragopogon dubius	yellow salsify	F
Tragopogon pratensis	meadow salsify	F
Trifolium aureum	yellow clover	F
Trifolium dubium	suckling clover	F
Trifolium hybridum	alsike clover	F
Trifolium pratense	red clover	F
Trifolium repens	white clover	F

Scientific name	Common name	Life form
Valerianella locusta	European corn salad	F
Verbascum blattaria	moth mullein	F
Verbascum thapsus	flannel mullein	F
Veronica anagallis-aquatica	water speedwell	F
Veronica arvensis	Common speedwell	F
Agrostis gigantea	Redtop	G
Agrostis stolonifera	Redtop	G
Alopecurus pratensis	meadow foxtail	G
Arrhenatherum elatius	tall oatgrass	G
Bromus briziformis	rattlesnake brome	G
Bromus commutatus	hairy brome	G
Bromus hordeaceus s. hordeaceus	soft brome	G
Bromus inermis	smooth brome	G
Bromus inermis s. inermis	smooth brome	G
Bromus japonicus	Japanese brome	G
Bromus tectorum	cheatgrass brome	G
Dactylis glomerata	orchard grass	G
Elytrigia intermedia	pubescent wheatgrass	G
Eragrostis cilianensis	Stinkgrass	G
Lolium arundinaceum	tall fescue	G
Lolium perenne	perennial ryegrass	G
Phleum pratense	Common timothy	G
Poa annua	annual bluegrass	G
Poa bulbosa	bulbous bluegrass	G
Poa compressa	Canada bluegrass	G
Poa palustris	fowl bluegrass	G
Poa pratensis	Kentucky bluegrass	G
Poa trivialis	roughstalk bluegrass	G
Pseudoroegneria spicata s. inermis	beardless bluebunch wheatgrass	G
Ventenata dubia	Ventenata	G
Vulpia bromoides	six-week fescue	G
Vulpia microstachys microstachys	small fescue	G
Rosa eglanteria	Sweetbriar	S
Rubus discolor	Himalayan blackberry	S
Rubus laciniatus	evergreen blackberry	S
Syringa vulgaris	Lilac	S
Robinia pseudoacacia	black locust	T

Due in part to the disruption of the Blue Mountains historic fire regime, plant communities have been greatly altered. Fire, historically a major defining force within the ecosystem, is today conspicuously absent. A floristic “migration” is in evidence as the thresh hold of maximum historical range of variability is approached and in instances surpassed. A landscape level ecological restructuring of floristic composition and distribution is subtly occurring. The absence of a naturally occurring fire regime, the introduction of non-native species, increased herbivory and resource based management practices are creating new and largely undefined ecological complexes. The outcome of these floristic shifts is unclear.

As current ecological conditions within the Tucannon watershed further diverge from historic levels, assessing and prioritizing plant species at risk, restoration projects, and botany surveys will become a crucial tool in future land management decisions. Taxa at risk are taxa with narrow, and specific physical and biological requirements. They are considered to have narrow ecological amplitude and frequently occupy only one ecological setting. These taxa are most susceptible to loss of viability, population decline and have higher potential for extirpation.

Preventing the listing of additional species, further ecological fragmentation, and loss of native species integrity are key issues.

Cooperative multi agency, multi-discipline restoration opportunities abound within the Tucannon analysis area especially in riparian areas, treatment of noxious weeds, and use of native species. The Umatilla can provide seed and vegetative materials, plus the invaluable experience to use it correctly, should a large-scale multi-agency restoration effort occur. The Pomeroy District has excelled at using native species in restoration projects throughout the analysis area, excelling in road cut/fill stabilization, and road reclamation projects utilizing native grass seed, grass plugs, and shrubs. The district has a large and diverse native seed inventory from which to draw upon, and the experience to use it wisely. Recent installation of two bridges for hikers and horse traffic and the subsequent associated restoration work at Sheep Creek, trail head for trail 3135, and on Panjab Creek, trailhead for trail 3127, typify the high standards and multidisciplinary approach to native restoration work.

Table 7-6 lists species currently in use (bold text) on the Umatilla National Forest and suggested species that could be developed as part of the Forest's restoration strategy to diversify and increase native species suitable for restoration purposes. Species are listed by ecological settings.

Table 7-6. Checklist of Principal Species for Restoration by Ecological Setting

Ponderosa Pine Ecological Setting (pp)			
Genus	Species	Common Name	Life Form
Achillea	***millifolium***	Yarrow	F
Lupinus	*holosericeus*	Silky Lupine	F
Lupinus	*sulphureus*	Sulphur Lupine	F
Lupinus	*caudatus*	Tailcup Lupine	F
Agropyron	***spicatum***	Bluebunch wheatgrass	G
Bromus	***carinatus***	Mountain Brome	G
Elymus	***glaucus***	Blue Wildrye	G
Festuca	***idahoensis***	Idaho Fescue	G
Festuca	***rubra***	Red fescue	G
Koleria	***macrantha***	Prairie junegrass	G
Poa	***secunda***	Sandberg's bluegrass	G
Sitanion	***hystrix***	Squirrel tail	G
Stipa	*occidentalis*	Western Needlegrass	G
Carex	*geyeri*	Elk sedge	G-L
Amelanchier	***alnifolia***	Service berry	S
Cercoarpus	***ledifolius***	Mtn. mahogony	S
Crataegus	***douglasii***	Black Hawthorn	S
Holodiscus	*discolor*	Ocean-spray	S
Philadelphus	***lewisii***	Mockorange or Syringa	S
Prunus	*emarginata*	Bitter cherry	S
Prunus	*virginiana*	Common Chokecherry	S

Ponderosa Pine Ecological Setting (pp)			
Genus	Species	Common Name	Life Form
Purshia	***tridentata***	Bitter brush	S
Rosa	*nutkana*	Nootka Rose	S
Rosa	*woodsii*	Wood's rose	S
Symphoricarpos	*albus*	Common Snowberry	S
Symphoricarpos	*oreophilus*	Mountain Snowberry	S
Pinus	***ponderosa***	Ponderosa pine	T
Pseudotsuga	***menziesii***	Douglas fir	T

Warm, Dry Ecological Setting (wd)			
Genus	Species	Common Name	Life Form
Achillea	***millifolium***	Yarrrow	F
Lupinus	*sulphureus*	Sulphur Lupine	F
Thermopsis	***montana***	Mtn. Thermopsis	F
Bromus	***carinatus***	Mountain Brome	G
Deschampsia	*elongata*	Slender hairgrass	G
Elymus	***glaucus***	Blue Wildrye	G
Festuca	***idahoensis***	Idaho fescue	G
Fesuca	***rubra***	Red fescue	G
Poa	***secunda***	Sandberg's Bluegrass	G
Koleria	***cristata***	Prairie Junegrass	G
Melica	*bulbosa*	Onion Grass	G
Trisetum	*canescens*	Tall Trisetum	G
Carex	*geyeri*	Elk Sedge	G-L
Amelanchier	***alnifolia***	Western Serviceberry	S
Ceanothus	*sanguineus*	Redstem Ceanothus	S
Crataegus	***douglasii***	Black Hawthorn	S
Holodiscus	*discolor*	Creambush Oceanspray	S
Philadelphus	***lewisii***	Mockorange or Syringa	S
Prunus	*virginiana*	Western Chokecherry	S
Rosa	*nutkana*	Nootka Rose	S
Rosa	*woodsii*	Wood's Rose	S
Sambucus	***cerulea***	Blue Elderberry	S
Symphoricarpos	*albus*	Common Snowberry	S
Symphoricarpos	*oreophilus*	Mountain Snowberry	S
Acer	***glabrum***	Rocky Mountain Maple	T
Larix	***occidentalis***	Western Larch	T
Pinus	***monticola***	Western White Pine	T
Pinus	***ponderosa***	Ponderosa Pine	T
Pseudotsuga	***menziesii***	Douglas Fir	T

Cool, Moist Ecological Setting (cm)

Genus	Species	Common Name	Life Form
Lupinus	***polyphyllus***	Big Leaf Lupine	F
Thermopsis	***montana***	Mtn. Thermopsis	F
Bromus	***vulgaris***	Columbia Brome	G
Bromus	***carinatus***	Mountain Brome	G
Deschampsia	*elongata*	Slender hairgrass	G
Elymus	***glaucus***	Blue Wildrye	G
Festuca	*occidentalis*	Western fescue	G
Melica	*subulata*	Alaska Oniongrass	G
Carex	*concinnoides*	Northwest sedge	G-L
Carex	*rossii*	Ross sedge	G-L
Alnus	*sinuate*	Sitka Alder	S
Berberis	*nervosa*	Cascade or Dull Oregongrape	S
Ceanothus	*sanguineus*	Redstem Ceanothus	S
Crataegus	***douglasii***	Black Hawthorn	S
Gaultheria	*humifusa*	Western Wintergreen	S
Holodiscus	*discolor*	Creambush Oceanspray	S
Lonicera	*involucrata*	Honeysuckle	S
Pachistima	***myrsinites***	Oregon Boxwood	S
Rosa	*gymnocarpa*	Bald Rose	S
Rubus	*parviflorus*	Western Thimbleberry	S
Vaccinium	*membranaceum*	Big Huckleberry	S
Abies	***grandis***	Grand Fir	T
Larix	***occidentalis***	Western Larch	T
Picea	***engelmannii***	Engelmann Spruce	T
Pinus	***monticola***	Western White Pine	T

Lodge Pole Pine Ecological Setting (lp)			
Genus	Species	Common Name	Life Form
Lupinus	***polyphyllus***	Big Leaf Lupine	F
Bromus	***carinatus***	Mtn. brome	G
Bromus	***vulgaris***	Columbia Brome	G
Danthonia	*intermedia*	Timber Oatgrass	G
Elymus	***glaucus***	Blue Wildrye	G
Alnus	*sinuata*	Sitka Alder	S
Carex	*geyeri*	Elk sedge	G-L
Carex	*concinnoides*	Northwest sedge	G-L
Carex	*rossii*	Ross sedge	G-L
Juncus	*parryi*	Parry Rush	G-L
Shepherdia	*canadensis*	Canada Buffaloberry	S
Sorbus	*scopulina*	Mountain Ash	S
Symphoricarpos	*alba*	Common snowberry	S
Vaccinium	*membranaceum*	Big Huckleberry	S
Vaccinium	*scoparium*	Grouse whortleberry	S

Larix	***occidentalis***	Western larch	T
Picea	***engelmannii***	Engelmann Spruce	T
Pinus	***contorta***	Lodgepole Pine	T

Cold, Dry Ecological Setting (cd)			
Genus	Species	Common Name	Life Form
Lupinus	*caudatus*	Tailcup Lupine	F
Lupinus	***polyphyllus***	Big Leaf Lupine	F
Bromus	***carinatus***	Mountain Brome	G
Bromus	***vulgaris***	Columbia Brome	G
Deschampsia	*elongata*	Slender hairgrass	G
Festuca	*viridula*	Green fescue	G
Phleum	*alpinum*	Alpine Timothy	G
Carex	*concinnoides*	Northwest sedge	G-L
Carex	*geyeri*	Elk sedge	G-L
Carex	*rossii*	Ross sede	G-L
Juncus	*parryi*	Parry rush	G-L
Alnus	*Sinuate*	Sitka Alder	S
Rosa	*woodsii*	Wood's Rose	S
Sambucus	*racemosa*	Black Elderberry	S
Sorbus	*scopulina*	Cascades Mountain Ash	S
Vaccinium	*membranaceum*	Big Huckleberry	S
Vaccinium	*scoparium*	Grouse Whortleberry	S
Abies	*lasiocarpa*	Subalpine Fir	T
Picea	***engelmannii***	Engelmann Spruce	T
Pinus	***contorta***	Lodgepole Pine	T

Grass/Shrub Steppe Ecological Setting (gs\ss)			
Genus	Species	Common Name	Life Form
Achillea	***millifolium***	Yarrow	F
Lupinus	*caudatus*	Tailcup Lupine	F
Lupinus	*lepidus*	Prairie Lupine	F
Lupinus	*sericeus*	Silky Lupine	F
Lupinus	*sulphureus*	Sulphur Lupine	F
Agropyron	*dasystachyum ssp. albicans*	Montana wheatgrass	G
Agropyrno	***spicatum***	Blue bunch wheatgrass	G
Elymus	***glaucus***	Blue wild rye	G
Festuca	***idahoensis***	Idaho fescue	G
Festuca	***rubra***	Red fescue	G
Festuca	***scabrella***	Rough fescue	G
Bromus	***carinatus***	Mountain Brome	G
Elymus	*cinereus*	Great Basin Wildrye	G
Koleria	***macrantha***	Prairie June grass	G
Poa	***secunda***	Sandberg's bluegrass	G

Grass/Shrub Steppe Ecological Setting (gs\ss)			
Genus	Species	Common Name	Life Form
Sitanion	***hystrix***	Bottle brush squirrel tail	G
Stipa	*lemmonii*	Lemmon's needlegrass	G
Stipa	*occidentalis*	Western needlegrass	G
Carex	*geyeri*	Elk sedge	G-L
Artemisia	*tridentata ssp. vaseyana*	Mtn. Big sagebrush	S
Artemisia	*rigida*	Rigid sage	S
Berberis	*repens*	Low Oregongrape	S
Cercocarpus	***ledifolius***	Curlleaf Mountain Mahogany	S
Crateagu	***douglasii***	Black hawthorne	S
Purshia	***tridentate***	Bitter brush	S
Symphoricarpos	*albus*	Common Snowberry	S
Symphoricarpos	*oreophilus*	Mountain Snowberry	S

Riparian/Riverine Ecological Setting (rv)			
Genus	Species	Common Name	Life Form
Cinna	*latifolia*	Drooping woodreed	G
Glyceria	*elata*	Tall mannagrass	G
Puccinellia	*pauciflora*	Weak alkali grass	G
Carex	*aquatilis*	Water Sedge	G-L
Carex	*deweyana*	Dewey's Sedge	G-L
Carex	*lanuginosa*	Woolly Sedge	G-L
Carex	*luzulina var. luzulina*	Wood rush sedge	G-L
Carex	*nebrascensis*	Nebraska Sedge	G-L
Carex	*utriculata*	Bladder sedge	G-L
Carex	*vesicaria*	Inflated sedge	G-L
Scirpus	*microcarpus*	Panicled bulrush	G-L
Alnus	***incana***	Mtn. alder	S
Alnus	*sinuata*	Sitka alder	S
Cornus	***stolonifera***	Red Osier Dogwood	S
Philadelphus	***lewisii***	Lewis Mockorange	S
Physocarpus	*capitatus*	Pacific Ninebark	S
Rhamnus	*alnifolia*	Alder-leaved Buckthorn	S
Ribes	***hudsonianum***	Stinking Current	S
Rosa	*gymnocarpa*	Baldhip Rose	S
Rubus	*parviflorus*	Western thimbleberry	S
Salix	***commutata***	Under green willow	S
Salix	***exigua***	Coyote Willow	S
Salix	***rigida var. mackenzieana***	Mackenzie willow	S
Salix	***sitchensis***	Sitka willow	S
Salix	***lasiandra var. lasiandra & caudata***	Pacific or Red Willow; Whiplash willow	S
Symphoricarpos	*albus*	Common Snowberry	S

Riparian/Riverine Ecological Setting (rv)			
Genus	Species	Common Name	Life Form
Abies	***grandis***	Grand fir	T
Acer	***glabrum***	Rocky-Mtn. Maple	T
Picea	***engelmannii***	Engelmann spruce	T
Pinus	***contorta***	Lodgepole pine	T
Pinus	***ponderosa***	Ponderosa pine	T
Betula	***occidentalis***	Water birch	T
Populus	***tremuloides***	Quaking aspen	T
Populus	***trichocarpa***	Black cottonwood	T

Meadow Complex Ecological Setting (mdw)			
Genus	Species	Common Name	Life Form
Bromus	***carinatus***	Mountain Brome	G
Calamogrostis	*canadensis*	Bluejoint reedgrass	G
Danthonia	*californica*	California danthonia	G
Danthonia	*intermedia*	Timber oat grass	G
Deschampsia	*caespitosa*	Tufted hairgrass	G
Deschampsia	*elongata*	Slender hairgrass	G
Elymus	*cinereus*	Great Basin Wildrye	G
Festuca	***idahoensis***	Idaho fescue	G
Koleria	***macrantha***	Prairie June grass	G
Phleum	*alpinum*	Alpine timothy	G
Trisetum	*spicatum*	Downy Oatgrass	G
Carex	*aquatilis*	Water Sedge	G-L
Carex	*deweyana*	Dewey's Sedge	G-L
Carex	*lanuginosa*	Woolly Sedge	G-L
Carex	*lenticularis*	Densely tufted sedge	G-L
Carex	*nebrascensis*	Nebraska Sedge	G-L
Juncus	*balticus*	Baltic rush	G-L
Scirpus	*microcarpus*	Panicled bulrush	G-L
Alnus	***incana***	Mtn. alder	S
Alnus	*sinuate*	Sitka alder	S
Cornus	***stolonifera***	Red Osier Dogwood	S
Crateagu	***douglasii***	Black hawthorne	S
Salix	***commutata***	Under green willow	S
Salix	***exigua***	Coyote Willow	S
Salix	***melanopsis***	Dusky willow	S
Salix	***rigida var. mackenzieana***	Mackenzie willow	S
Salix	***sitchensis***	Sitka willow	S
Salix	***lasiandra var. lasiandra & caudata***	Pacific or Red Willow; Whiplash willow	S
Populus	***tremuloides***	Quaking aspen	T
Populus	***trichocarpa***	Black cottonwood	T

Meadow Complex Ecological Setting (mdw)			
Genus	Species	Common Name	Life Form
Species in **bold** are currently in use on the Umatilla National Forest			

Culturally significant native plant species represent an important cultural resource for the Pomeroy District. Table 7-7 contains 78 species known to hold cultural significance. Species are ranked alphabetically by life form beginning with forbs (F), followed by shrubs (S), and trees (T). This is by no means an exhaustive list and only pertains to species currently identified within the analysis area. Species affinity values are based on abundance within the analysis area only. Eight ecological settings broadly represent species distribution and include (from left to right) ponderosa pine, hot-dry forested types; Douglas-fir, warm-dry forested types; grand fir, cool-moist dominated forest types; lodgepole pine dominated forest types; subalpine fir, cold-dry forest types; grass and shrub dominated steppe habitats; riparian and wetlands, and lastly meadow complexes.

Table 7-7. Culturally Significant Native Plant Species of the Tucannon Watershed Analysis Area

		Species Affinity by Ecological Setting 1=Uncommon; 2=Common; 3=Abundant								
Scientific Name	Common Name	PIPO	Warm, Dry	Cool, Moist	PICO	Cold, Dry	Steppe	Riparian	Meadow	Life Form
Achillea millefolium	Common Yarrow	2	2	1	2	2	3	1	3	F
Agastache urticifolia	Nettleleaf Horsemint	1	3	1	2	2	2	1	2	F
Agoseris aurantiaca	Orange Agoseris	1	3	2	2	3	0	0	1	F
Agoseris glauca	Pale Agoseris	3	2	1	1	1	3	0	1	F
Agoseris grandiflora	Large-flower Agoseris	2	2	1	2	2	3	1	1	F
Allium acuminatum	Tapertip Onion	0	0	0	0	0	3	0	0	F
Allium fibrillum	Fringed Onion	2	2	0	0	0	3	0	0	F
Allium macrum	Rock Onion	0	0	0	0	0	3	0	0	F
Allium madidum	Blue Mountain Onion	0	0	0	0	0	1	2	1	F
Allium tolmiei tolmiei	Tolmie's Onion	1	1	0	0	2	3	0	0	F
Balsamorhiza incana	Woolly Balsamroot	2	1	0	0	0	3	0	0	F
Balsamorhiza sagittata	Arrowleaf Balsamroot	2	2	0	1	1	3	0	0	F
Balsamorhiza serrata	Serrated Balsamroot	1	0	0	0	0	3	0	0	F
Brodiaea douglaii	Douglas' Brodiaea	1	1	0	0	0	3	0	1	F
Calochortus elegans	Northwestern Mariposa	2	2	0	1	0	1	0	0	F
Camassia quamash	Common Camas	1	1	0	0	1	3	3	2	F
Claytonia lanceolata lanceolata	Western Springbeauty	2	2	1	2	2	3	1	2	F
Dodecatheon conjugens	Slimpod Shootingstar	2	2	0	0	2	3	1	1	F
Dodecatheon pulchellum	Darkthroat Shootingstar	0	0	0	0	3	0	3	1	F
Epilobium angustifolium	Fireweed	2	2	2	2	2	0	3	1	F
Eriogonum compositum	Northern Buckwheat	1	1	0	0	0	3	0	0	F
Eriogonum douglasii	Douglas Buckwheat	0	0	0	0	1	3	0	0	F
Eriogonum flavum	Yellow Buckwheat	0	0	0	0	1	3	0	0	F
Eriogonum heracleoides	Wyeth's Creamy Buckwheat	1	1	0	0	0	3	0	0	F
Eriogonum strictum	Strict Buckwheat	0	0	0	0	0	3	0	0	F
Eriogonum umbellatum	Sulphur Buckwheat	0	0	0	0	0	3	0	0	F
Erythronium grandiflorum	Fawnlily or Glacierlily	3	3	3	1	1	3	1	1	F
Fragaria vesca	Woods Strawberry	1	3	2	3	2	0	1	1	F
Fragaria virginiana	Blueleaf or Broadpetal Strawberry	1	2	3	2	3	0	1	3	F
Frasera speciosa	Giant Frasera	3	3	1	1	0	1	0	1	F
Fritillaria pudica	Yellow Bell	2	1	0	0	0	3	0	0	F
Geum triflorum ciliatum	Red Avens	2	2	0	1	1	3	1	1	F
Hydrophyllum capitatum	Ballhead Waterleaf	3	2	0	0	1	3	1	0	F
Hydrophyllum fendleri	Fendler's Waterleaf	0	0	0	0	0	0	3	0	F
Lewisia pygmaea	Dwarf Lewisia	0	0	1	1	2	3	1	0	F
Lewisia triphylla	Three Leaf Lewisia	0	0	1	1	2	3	1	0	F
Ligusticum canbyi	Canby Licoriceroot	0	1	3	1	2	0	1	1	F

Scientific Name	Common Name	Species Affinity by Ecological Setting 1=Uncommon; 2=Common; 3=Abundant								Life Form
		PIPO	Warm, Dry	Cool, Moist	PICO	Cold, Dry	Steppe	Riparian	Meadow	
Lomatium cous	Cous Biscuitroot	0	0	0	0	0	3	0	0	F
Lomatium macrocarpum	Big Seed Biscuitroot	1	0	0	0	0	3	0	0	F
Lomatium triternatum	Nineleaf Desert Parsley	2	2	0	0	0	3	0	0	F
Orobanche uniflora	Oneflowered Broomrape	2	2	3	0	1	2	1	0	F
Perideridia bolanderi	Bolander's Yampah	1	3	2	0	0	0	0	1	F
Perideridia gairdneri	Gairdner's Yampah	0	0	0	0	0	3	0	0	F
Polygonum bistortoides	American or Western Bistort	0	0	0	0	0	3	3	0	F
Typha latifolia	Common Cattail	0	0	0	0	0	0	3	0	F
Urtica dioica	Stinging Nettle	2	3	3	1	2	1	3	2	F
Valeriana sitchensis	Sitka Valerian	0	1	3	2	0	0	1	0	F
Viola adunca	Early Blue Violet	2	2	3	2	1	0	3	0	F
Viola glabella	Stream Violet	0	0	0	0	0	0	3	0	F
Amelanchier alnifolia	Western Serviceberry	2	2	1	0	1	1	3	1	S
Berberis repens	Low Oregon grape	2	2	0	0	0	3	0	0	S
Berberis nervosa	Cascade Oregon grape	0	0	3	1	3	0	3	0	S
Crataegus douglasii	Black Hawthorn	1	1	3	0	1	1	3	1	S
Lonicera ciliosa	Western Trumpet Honeysuckle	2	2	1	1	0	0	3	0	S
Lonicera involucrata	Bearberry Honeysuckle	0	0	2	1	1	0	3	1	S
Lonicera utahensis	Utah Honeysuckle	0	0	2	3	1	0	3	0	S
Prunus virginiana	Common Chokecherry	2	2	0	0	0	2	1	1	S
Ribes hudsonianum	Stinking Currant	0	0	0	0	0	0	2	0	S
Ribes lacustre	Prickly Currant	0	2	3	0	1	0	3	1	S
Ribes viscosissimum	Sticky Currant	2	2	1	2	1	1	1	0	S
Rosa gymnocarpa	Baldhip Rose	2	3	3	1	1	0	1	1	S
Rosa nutkana	Nootka Rose	3	1	0	1	0	1	3	0	S
Rosa woodsii	Wood's Rose	1	1	3	1	1	1	3	1	S
Sorbus scopulina	Cascade Mountain Ash	0	0	3	1	3	0	3	0	S
Rubus idaeus	Red Raspberry	1	1	1	1	1	0	2	0	S
Rubus leucodermis	Whitebark Raspberry	1	1	1	1	1	0	2	0	S
Rubus parviflorus	Western Thimbleberry	0	0	3	0	0	0	3	0	S
Vaccinium membranaceum	Big Huckleberry	0	0	3	2	1	0	1	0	S
Vaccinium myrtillus	Dwarf or Low Bilberry	0	0	1	3	2	0	0	0	S
Vaccinium scoparium	Grouse Huckleberry	0	0	1	3	2	0	0	0	S
Viburnum edule	High-Bush Cranberry	0	0	0	0	0	0	1	0	S
Abies grandis	Grand Fir	1	3	3	1	1	0	2	1	T
Abies lasiocarpa	Subalpine Fir	0	0	1	1	3	1	2	1	T
Pinus contorta	Lodgepole Pine	1	2	1	3	2	1	2	1	T

CURRENT CONDITIONS AND RISK ANALYSIS FOR NOXIOUS WEEDS

Overview

This report examines the current status of noxious weed infestations in the Tucannon watershed. Priority species and treatment areas are identified, and past and ongoing noxious weed control efforts are summarized. Results of a risk model assessing the potential for future noxious weed invasion and spread are also presented. Information pertaining to the location, species composition, NEPA status, and treatment history of noxious weed infestations was obtained from the Forest's Noxious Weed database and current (2002) GIS coverage (fsfiles\ref\library\gis\uma\nw02).

Methods for Assessment

A Forest-wide noxious weed risk assessment was conducted in Spring 2000 to evaluate the risk and susceptibility of noxious weed invasion and spread, and to determine priority areas for prevention and control efforts (Umatilla National Forest 2000). The risk model was adapted from one developed by the Wallowa-Whitman National Forest and is based on (1) vegetation and climatic conditions, (2) proximity to existing noxious weed infestations, (3) proximity to roads, and (4) grazing activity. A high overall noxious weed rating was assigned to areas having a high risk of habitat and seed availability (e.g., warm to dry forest plant communities occurring within 5 miles of an existing noxious weed site) and a high potential for spread (e.g., active grazing allotment within 300 feet of an open road). Sources of data used in the model include corporate GIS coverages and databases relating to current (2002) noxious weed inventories, transportation layers, grazing allotments, existing vegetation, and potential vegetation groups. The Forest-wide GIS coverage is located in */fsfiles/gis/noxweeds/nwrisk*.

Current Conditions

A total of 160 noxious weed sites representing 1,023 acres have been inventoried in the analysis area (Table 7-8, Map 7-1). The average size of an infestation is 6.4 acres, with individual sites ranging from 0.13 to 125.2 acres. Twelve weed species are present, including diffuse and spotted knapweed, yellow starthistle, Canada thistle, bull thistle, Russian thistle, Scotch thistle, hound's tongue, Scotch broom, toadflax, Klamath weed (St. John's wort), and tansy ragwort. Of greatest concern are the 17 yellow starthistle sites, the 132 spotted/diffuse knapweed sites, and the 4 sites infested by tansy ragwort. Focal points for the expansion and spread of noxious weeds, particularly yellow starthistle and spotted and diffuse knapweed, coincide with major river corridors such as the Tucannon River, Little Tucannon River, and Panjab Creek (Map 7-1, Map Appendix).

Only 32 sites (313 acres) of diffuse knapweed and 2 sites (9 acres) of toadflax were included in the Forest's 1995 Decision implementing the Environmental Assessment (EA) for the Management of Noxious Weeds. The EA established site-specific guidelines for treating weed infestations, including hand, mechanical, and chemical control methods. High priority sites not covered in the 1995 EA, such as the yellowstar thistle infestations, will require additional analysis and new NEPA decision before any treatments other than hand-pulling can be implemented.

Susceptibility and Risk Assessment

Approximately 78 percent (57,541 acres) of the analysis area was classified as being moderately susceptible to noxious weed establishment and spread (Table 7-9). An additional 6 percent (4,157 acres) of the land base had a high susceptibility to noxious weed invasion. These acres are generally concentrated: (1) in major river corridors such as the Tucannon River, Little Tucannon River, and Panjab Creek, or (2) along primary transportation routes such as Rd. 4018 (Abel's Ridge), Rd. 40 near Scoggin Ridge, Rd. 4016 (Steven's Ridge), and Rd. 4022 near Sunflower Flat (Map 7-2, Map Appendix). Due to the relatively large number and acreage of knapweed and yellow starthistle infestations in the analysis area, the overall noxious weed risk rating for the watershed is HIGH.

Management Strategies and Recommended Actions

Noxious weeds will likely continue to be a persistent problem in the Tucannon watershed due to high habitat potential and seed availability. Containing noxious weed populations to current levels and preventing additional invasion and spread will require unrelenting attention and a strong focus on early detection and control methods. Personnel and financial resources should be directed toward the highest priority species and sites.

The management/statutory status and treatment priorities for the various noxious weed species occurring in the analysis areas are displayed in Table 7-10. "Established" species are widespread across the Forest in large populations and containment strategies are used to prevent their further spread. Species in the "New Invader/Established" category are species such as diffuse knapweed that are presently controllable, but which are approaching "Established" infestation levels. These species are rated high priority for early treatment. Species in the "New Invader" category have limited distributions at present, and can probably be eradicated if early treatment measures are implemented. All new invader species in the analysis area are classified by the State of Washington Weed Board as Class B, meaning that existing infestations are a high priority for treatment and containment in order to prevent spread to unifested areas. Species in Class C are widespread throughout the State, and have become established to such an extent that they are a low priority for control and suppression measures given current workforce and funding levels.

Obtaining NEPA clearance for weed infestations not covered by the 1995 Noxious Weed EA is a high priority, especially for new invader species such as tansy ragwort, yellow starthistle, and diffuse/spotted knapweed. Infestations lacking NEPA clearance could be addressed in a new District or Forest Noxious Weed EA or possibly incorporated into NEPA documents dealing with other projects in the vicinity (e.g., road rehabilitation, prescribed fire, vegetation management projects). Integrating diverse projects into umbrella NEPA documents may be an effective approach for decreasing the lag time between weed introduction and control.

To help stretch scare resources and enhance noxious weed management in the analysis area, cooperative agreements for weed inventory and control should be maintained and expanded. Key players include private landowners, federal and state agencies, counties, watershed associations, conservation groups, and other noxious weed managers. It should be noted, however, that cooperative efforts can be quite difficult and complicated due to the different requirements and restrictions on NFS lands in terms of the type of control activities that can be performed, the types of chemicals used, and the level of analysis required prior to treatment.

An additional component of effective noxious weed management is educating and increasing awareness among the public, private landowners, resource managers, and other decision makers as to the adverse impacts of noxious weeds and the consequences of inaction. This can be accomplished through the development of education materials (e.g., “A Pocket Guide to the Weeds of the Umatilla National Forest”), and by cooperating and sharing information with County Weed Boards, State Department of Agriculture, and other landowners and federal agencies.

Table 7-8. Summary of noxious weed sites (2002 inventory) occurring in the Tucannon watershed.

			Total		NEPA Cleared	
Common Name	Scientific name	Alpha Code	# sites	#acres	# sites	#acres
Yellow starthistle	*Centaurea solstitialis*	CESO3	17	336	0	0
Diffuse knapweed	*Centaurea diffusa*	CEDI3	121	896	0	0
Spotted knapweed	*Centaurea maculosa*	CEMA	11	99	0	0
Canada thistle	*Cirsium arvense*	CIAR	36	365	0	0
Bull thistle	*Cirsium vulgare*	CIVU	8	43	0	0
Scotch thistle	*Onopordum acanthium*	ONAC	10	174	0	0
Russian thistle	*Salsola kali*	SAKA	1	0.6	0	0
Common houndstongue	*Cynoglossum officinale*	CYOF	1	0.4	0	0
Klamathweed	*Hypericum perforatum*	HYPE	16	86	0	0
Tansy ragwort	*Senecio jacobaea*	SEJA	4	201	0	0
Scotch broom	*Cytisus scoparius*	CYSC4	1	0.4	0	0
Dalmation toadflax	*Linaria dalmatica*	LIDA	11	171	0	0
		Total	160	1023	0	0

Note: *Individual species data do not sum to the overall totals because inventoried noxious weed sites may be comprised of more than one species.*

Table 7-9. Noxious weed susceptibility and risk rating for the Tucannon watershed.

		Acres	
HUC5 Watershed	Low	Medium	High
Upper Tucannon	12,129	50,265	2,950
Tucannon/Pataha	<1	7,276	1,207
Total	12,129	57,541	4,157

Overall Risk/Susceptibility Rating: HIGH

[1] Risk model acreages do not sum to total in watershed due to unclassified acres in riparian areas and incomplete PNV cover.

Table 7-10. Status and treatment priorities for noxious weeds species occurring in the Tucannon watershed.

Common Name	Management Status	Statutory Status[1]	Spread Potential	Treatment Priority
Yellow starthistle	New Invader/Established	Class B	Very High	Very High
Diffuse knapweed	New Invader/Established	Class B	Very High	Very High
Spotted knapweed	New Invader/Established	Class B	Very High	Very High
Canada thistle	Established	Class C	Moderate	Low
Bull thistle	Established	Class C	High	Low
Scotch thistle	New Invader	Class B	Moderate	High
Houndstongue	New Invader	Class B	High	High
Klamathweed	Established	Class C	Very High	Low
Tansy ragwort	New Invader	Class B	Very High	Very High
Scotch broom	New Invader	Class B	High	High
Dalmation toadflax	New Invader/Established	Class B	High	High

[1] Washington State Noxious Weed Categories: Class B=non-native species limited to portions of WA; designated for control in regions where not yet widespread; C=non-native species which may be widespread in WA; long-term suppression and control are a local option.

CURRENT AND REFERENCE CONDITIONS FOR TERRESTRIAL WILDLIFE

Habitat Condition & Distribution

Changes in habitat conditions were evaluated using data from the upland vegetation analysis in this report. In the forested types, the most obvious changes include a decrease in lodgepole pine and ponderosa pine stands along with an increase in grand fir and mixed conifer stands since 1935 (Table 8-1 and Maps 5-7 & 5-2, Map Appendix). The non-forest type, including grasslands and shrubs, has changed with an apparent reduction in area particularly north of the junction of Panjab Creek and Tucannon River. Shrub-dominated communities are scarce across the National Forest portion of the watershed, although shrubs associated with forested stands are widespread throughout most of the drainage. Other vegetative cover types, as subalpine fir has remained relatively unchanged. The vegetation analysis also showed important changes in structural stage in the watershed over the same time period (Table 8-2). The most obvious change since 1935 is the increase in the amount of stem exclusion (SEOC), young forest multi-strata (YFMS), and understory reinitiation (UR). Conversely, decreases have occurred in stand initiation (SI) and old forest structural (OFMS an OFSS) stages since 1935. All structural stages are represented in the 2002 and 1935 vegetative data however; the 1935 data shows stem exclusion open-canopy (SEOC), young forest multi-strata, and understory reinitiation occurring in less than one percent of the watershed. Maps 5-9 (1935) and Map 5-5 (existing) show the distribution of structure stages for current and historical conditions. Since 1935, the changes in habitat composition have resulted in additional cover types, a loss of distinct habitat types, an imbalance of structural diversity, and the increasing number of small patches of habitat scattered across the landscape. These changes can lead to a reduction in habitat quality for terrestrial vertebrate species that are associated with a variety of structures, distinct habitat types, and large patches of habitat across the landscape. Conversely, the existing habitat condition has resulted in an increase in habitat quality and quantity for terrestrial species associated with early successional habitats or small habitat patches (i.e. deer, barred owls, etc.).

***Table 8-1**: Historical (1935) and existing habitat types (dominate forest species) in the Tucannon analysis area.*

Code	Dominant Vegetative Cover	1935		Existing	
		Acres	%	Acres	%
ABLA2	Subalpine fir	309	*<1*	281	*<1*
PIEN	Englemann spruce	0	*0*	298	*<1*
PICO	Lodgepole pine	762	*1*	63	*<1*
ABGR	Grand fir	38	*<1*	3,945	*5*
Mix	Mixed conifer	43,889	*57*	53,015	*69*
PSME	Douglas-fir	0	*0*	6,738	*9*
LAOC	Western larch	0	*0*	857	*1*
PIPO	Ponderosa pine	23,217	*30*	4,208	*5*
JUOC	Juniper Woodland Mix	0	*0*	37	*<1*
“Burned”	Area burned by wildfire	391	*<1*	0	*0*
NF	Grass/Shrub	8,529	*11*	7,702	*10*

*Percent of vegetation (tree/grass/shrub) in the analysis area.

Table 8-2. Historical (1935) and existing forest structural stages (percent) in the Tucannon analysis area.

Structural Stage	1935		Existing	
	Acres	%*	Acres	%*
"Burned"/"Bareground"	391	*<1*	159	*<1*
Stand Initiation	17,870	*26*	9,325	*13*
Stem Exclusion Open-canopy	133	*<1*	16,086	*23*
Stem Exclusion Closed-canopy	8,166	*12*	9,037	*13*
Young Forest Multi-strata	71	*<1*	12,297	*18*
Understory Re-initiation	103	*<1*	1,506	*2*
Old Forest Single-stratum	22,592	*33*	10,901	*15*
Old Forest Multi-strata	19,669	*28*	10,289	*15*

* *Percent of forest vegetation in the analysis area.*

Late Old Structure

Although changes in LOS have occurred since 1935, the total amount of LOS currently in the analysis area is below "desirable levels" for terrestrial wildlife in the watershed. The comparison of habitat availability for the two years of data indicate that gross acres of late and old forest habitat have declined across the landscape when compared to the 1935 vegetative data (Table 8-2). Old forest habitat types that have declined since 1935 include ponderosa pine (single-stratum) and mixed conifer (multi-strata). Some of these changes can be attributed to natural events like insect and disease, drought, wind-throw, and wildfire. However, the majority of change is attributed to harvest and fire suppression since the 1940's.

Other changes in old forest structure include the reduction in patch size and arrangement of old forest stands from historic conditions. In general, LOS in 1935 occurred as large blocks on the landscape, contained a large amount of interior habitat, was well connected to similar habitats, and occupied about 60 percent of the forested area in the watershed (Map 8-1, Map Appendix). Present day data shows, old forest habitat occurring in moderate to small patches, along with some interior habitat, widely scattered small patches but mostly connected to similar habitats (Map 8-2, Map Appendix). Late and old forest habitat currently occupies about thirty percent of the forested area in the Tucannon analysis area. Depending upon the plant association group and the species associated with old forest habitats, current conditions could lead to larger home ranges for some species, an increase in their susceptibility to predation, and greater energy expenditure for survival. Ultimately, the reduced habitat quality could lead to reduced or low population viability for some species. The high historic levels of LOS condition may have supported a larger population of species associated with late and old habitats than are present today.

With the intent to improve LOS condition in the Tucannon analysis area, restoration should focus on maintaining current LOS levels, expanding the size of old forest patches, and increasing LOS in deficient PAG. Appendix B outlines a management strategy to sustain desirable levels of LOS in the Tucannon watershed. To develop viable habitat for LOS associated species, 35 to 40 percent of the forested vegetation should be at an old forest stage (single stratum and/or multi-strata). Limit further reductions in existing old forest stands in the watershed until the appropriate distribution and patch size is obtained. Opportunities to develop old forest structure should focus on growing forested stands adjacent to existing LOS stands, increase patch size, and replace current LOS stands that could "fall apart" in the short term. In the Tucannon watershed, improvements in LOS could occur in the northeast portion of the analysis area to improve and maintain distribution and connectivity in the watersheds. Maintain the quantity (amount), patch size, and connectivity of LOS stands in the southern portion of the analysis area.

Snag and Down Wood Habitat

Historic information on dead wood (standing and down) habitats does not occur for the Tucannon watershed. However, general assumptions based on the vegetative condition in 1935 include, snags and down logs were most likely more abundant in true fir and mixed conifer stands across the watershed, but less abundant in fire-regulated pine communities. Dead wood densities fluctuated with "natural" mortality and the frequency and intensity of large and small-scale disturbances, such as fires, insect and disease, ice storms, and drought that have historically occurred throughout the area.

Present day snag and down wood habitat was assessed using the USFS current vegetation survey (CVS) inventories from 1993-1995. The CVS inventory is a permanent plot grid system at 1.7 miles intervals that samples vegetative conditions across the National Forest. Each plot collects a variety of vegetative information including plant association, live trees, dead trees, down wood, along with the diameters and heights for each species tallied. The data used here were collected between 1993 and 1997, and included 174-forested points/subplots. Dead standing trees (DST) were tallied for each 2" diameter class then divided by the total number of plots sampled to arrive at an average DST density for each diameter class. Sample plots were stratified by potential vegetation groups (PVG) in the watershed and size classes were summed to arrive at size class groups for comparison with Forest Plan standards and guides.

Generally, dead standing trees occurred in all size classes from 2" to 48" in diameter at breast height (DBH). The density of dead trees ranged from 0.4 to 3,400 trees per acres (TPA). The highest density of dead trees occurred in the 2" diameter class and lowest density occurred in size classes greater than 40" DBH. Overall, the higher densities of dead trees occurred on the moist forest types in the watershed.

In the Dry Forest PVG, dead standing trees occurred in most size classes from 2" to 42" diameter classes. Densities ranged from 0.4 to 800 TPA with the highest densities occurring in the 2"- 4" diameter class and lower densities occurring in the 42", 36", and 34" size classes. The Moist Forest group contained DST in all size classes from 2" to 48" DBH. Densities ranged from 0.4 to 1,500 TPA with the higher densities occurring in the 2" and 4" diameter classes. The lower densities occurred in the 48", 46", 44", 40", and 34" size classes. In the Cold Forest types, DST occurred in most size classes from 2" to 26" DBH. Densities ranged from 5.3 to 1,100 TPA with the higher densities occurring in the 2" through 6" diameter classes. The lower densities occurred in the 26" and 22" diameter classes.

Standards and guidelines for dead trees and down wood have evolved over the years as new information became available. Current Forest Plan (Forest Service 1990) direction for snag management is based on the Regional Forester's Forest Plan Amendment #2 (Forest Service

1995) and Interim Snag Guidance for Salvage Operation (Forest Service, Umatilla NF 1993). Forest interim guidelines for dead standing trees are identified in Table 8-3 below.

Table 8-3. Average dead standing tree (snags) density in the Tucannon analysis area.

LMRP, Umatilla NF Guidelines		Tucannon CVS Data	
Working Group	Density	Potential Vegetation Group	Density
Ponderosa pine	0.75 snags/ac. >10" dbh 1.36 snags/ac. >12" dbh 0.14 snags/ac. >20" dbh *2.25 snags/ac. Total*	*Dry Forest*	2.7 snags/ac. >10" dbh 8.3 snags/ac. >12" dbh 3.0 snags/ac. >20" dbh *14.0 snags/ac. Total*
South Associated (Mixed conifer)	0.75 snags/ac. >10" dbh 1.36 snags/ac. >12" dbh 0.14 snags/ac. >20" dbh *2.25 snags/ac. Total*	*Moist Forest*	3.7 snags/ac. >10" dbh 10.7 snags/ac. >12" dbh 3.9 snags/ac. >20" dbh *18.3 snags/ac. Total*
North Associated (Grand fir)	0.30 snags/ac. >10" dbh 1.36 snags/ac. >12" dbh 0.14 snags/ac. >20" dbh *1.80 snags/ac. Total*		
Lodgepole pine	1.21 snags/ac. >10" dbh 0.59 snags/ac. >12" dbh *1.8 snags/ac. Total*	*Cold Forest*	5.5 snags/ac. >10" dbh 10.2 snags/ac. >12" dbh *15.7 snags/ac. Total*
Subalpine Zone	1.21 snags/ac. >10" dbh 0.59 snags/ac. >12" dbh *1.8 snags/ac. Total*		

The CVS snag densities were tallied for the watershed to compare average densities in the watershed with the Forest Plan standards and guidelines. As noted by the results on Table 8-3, snag densities far exceed Forest Plan standards. Snag densities from the CVS data are lowest in the dry forest group when compared to densities in the moist forest or cold forest groups. Apply caution when interpreting CVS snag data; CVS snag densities are not an interpretation of snag densities for any specific site or for each acre in the watershed. It would be wrong to assume that snag distribution is even across the watershed. In the most pristine settings, snags are not evenly distributed in the landscape. Tree mortality generally occurs randomly on the landscape as singles, groups, clumps, and/or patches.

Snag replacement trees were analyzed to determine if dead trees can be recruited (or maintained) through time across the landscape. As identified in current Forest Plan direction, standards for “green” replacement trees (GRT) densities are based on the Regional Forester’s Forest Plan Amendment #2 (Forest Service 1995) and Interim Snag Guidance for Salvage Operation (Forest Service, Umatilla NF 1993). Table 8-4 identifies Forest interim guidelines for replacement trees.

Table 8-4. Average “green” replacement tree density in the Tucannon analysis area.

LMRP, Umatilla NF Guidelines		Tucannon CVS Data	
Working Group	Density	Potential Vegetation Group	Density
Ponderosa pine	7.5 trees/ac. >10" dbh 13.6 trees/ac. >12" dbh 1.7 trees/ac. >20" dbh *22.8 trees/ac. Total*	*Dry Forest*	15.3 trees/ac. >10" dbh 28.0 trees/ac. >12" dbh 8.4 trees/ac. >20" dbh 51.7 trees/ac. Total

LMRP, Umatilla NF Guidelines		Tucannon CVS Data	
Working Group	Density	Potential Vegetation Group	Density
South Associated (Mixed conifer)	5.6 trees/ac. >10" dbh 9.1 trees/ac. >12" dbh 1.1 trees/ac. >20" dbh *15.8 trees/ac. Total*	*Moist Forest*	18.3 trees/ac. >10" dbh 35.4 trees/ac. >12" dbh 9.4 trees/ac. >20" dbh 63.1 trees/ac. Total
North Associated (Grand fir)	1.5 trees/ac. >10" dbh 6.8 trees/ac. >12" dbh 1.1 trees/ac. >20" dbh *9.4 trees/ac. Total*		
Lodgepole pine	10.1 trees/ac. >10" dbh 4.3 trees/ac. >12" dbh *14.4 trees/ac. Total*	*Cold Forest*	37.0 trees/ac. >10" dbh 56.3 trees/ac. >12" dbh 93.3 trees/ac. Total
Subalpine Zone	13.9 trees/ac. >10" dbh 5.3 trees/ac. >12" dbh *19.2 trees/ac. Total*		

Generally, green replacement trees occurred in all size classes from 2” to 50” in diameter at breast height (DBH). The density of live trees ranged from 0.4 to 17,000 trees per acres (TPA). The highest density of green trees occurred in the 2” diameter class and lowest density occurred in size classes greater than 46” DBH. Overall, the higher densities of live trees occurred on the moist forest types in the watershed.

In the Dry Forest PVG, green replacement trees occurred in most size classes from 2” to 38” diameter classes. Densities ranged from 0.4 to 2,300 TPA with the highest densities occurring in the 2”- 6” diameter class and lower densities occurring in the 36” size classes. The Moist Forest group contained live trees in all size classes from 2” to 50” DBH. Densities ranged from 0.4 to 9,200 TPA with the higher densities occurring in the 2” and 12” diameter classes. The lower densities occurred in the 50” through 46” size classes. In the Cold Forest types, replacement trees occurred in most size classes from 2” to 46” DBH. Densities ranged from 0.4 to 6,200 TPA with the higher densities occurring in the 2” through 10” diameter classes. The lower densities occurred in the 42”, 36” and 34” diameter classes.

The CVS replacement tree data was tallied to compare average densities in the watershed with the Forest Plan standards and guidelines. As noted by the results on Table 8-5, “green” replacement tree densities greatly exceed Forest Plan standards. The highest densities occurred in the >10” diameter class for all potential vegetative groups and the lowest densities occurred in the >20” diameter class. Once again, CVS data should be used cautiously and is not an interpretation of “green tree” densities for any specific site or for each acre in the watershed. It would be wrong to assume that “green trees” densities are evenly distributed across the watershed. Typically, high densities of ‘green trees” would most likely occur in young forest stands, the cooler moister forest types, and stands that have not had harvest activities. Low densities of “green trees” would generally occur on drier sites and where recent harvest activities have occurred.

Down wood densities were not calculated from CVS plots in the watershed, and data supporting down wood densities in the watershed are not available. However, current Forest Plan direction, for down wood densities can be found in the Regional Forester’s Forest Plan Amendment #2 (Forest Service 1995).

In a broader context, dead standing tree and "green tree" densities appear to satisfy or exceed the Forest Plan standards and guidelines for all size class groupings for snags and replacement trees. However, as identified in the Forest Plan (Forest Service 1990, p4-57), snag densities are to be maintained "… for each logical harvest size unit (or no larger than 40 acres units)." While snag and replacement tree densities may appear to be above standards and guidelines across the watershed, densities may be far below standards in many locations and at the project level. Therefore, conduct inventories to assure Forest Plan guidelines for dead standing wood, replacement trees, and downwood met project (treatment) level standards.

Riparian, Wetland, and Aspen Habitats

Historic information for riparian habitats, wetlands, and aspen stands in the Tucannon watershed is sketchy and limited to anecdotal accounts. Wetland habitats were probably always limited in both size and distribution across the Blue Mountains, including the analysis area. Many wet meadows, springs and seeps were most likely spread across the analysis area. Unrestricted grazing in the late 1800's and early 1900's resulted in degraded wetland vegetation and lower water tables, reducing the size and distribution of wetland habitats. Old photographs and remnant stands suggest that aspen in the Blue Mountains was more widespread at the turn of the century than today, but mostly occurred in small patches (<25 ac.). Riparian broadleaf communities of cottonwood, alder, and willows occurred along all the major stream and river corridors in the watershed and most likely occurred in large patches and contained large diameter trees.

The existing vegetation database used in this analysis did not contain riparian, wetland, and aspen communities. These communities do occur in the watershed on a limited basis, however, the extent of individual stands is less than the 5-acre minimum stand size that is recognized in the vegetation database. The watershed does contain a few small wetlands (moist meadows), generally less than 5 acres in size. Broadleaf communities are limited primarily along the Tucannon River and the major tributaries. Aspen communities in the Tucannon analysis area are extremely limited to nonexistent. Current impacts to riparian, wetland, and aspen communities include elk and livestock utilization, invasive conifers, recreation, and fire suppression in the watershed for the last 60 years.

With the intent to improve riparian, wetland, and aspen communities in the Tucannon watershed, restoration should focus on increasing the amount of habitat and the broadleaf composition in moist and wet areas along streams and seeps and in wet meadows. Enhance wetland and riparian communities currently in the watershed and prevent further degradation of the community. Regenerate suitable sites adjacent to existing communities to expand and develop wetland communities in the analysis area.

"Special/Unique" Habitats

Rocky outcrops and talus slopes within the drainage have changed very little since the early 1900's. However, access (roads and trails) to these areas and the availability of cover (conifer, shrubs, etc.) around and adjacent to these areas can change the character and resultant habitat suitability of the area. While the significance of cover around these sites is not clear, intuitively it affords a degree of security to move between areas and provides screening from an increasing human presence (i.e. roads, site development, etc.) that could affect survival and reproduction for some species. Large expanses of rock outcrops or "non-forest" areas should remain unroaded as much as possible.

Current and Reference Conditions for Selected Wildlife Species

Overview

Some 192 terrestrial vertebrates species have the potential to occur in the area (Appendix A). This includes 123 birds, 56 mammals, 8 reptiles, and 5 amphibians. In terms of relative abundance, 88 species are common, 91 uncommon, and 13 are rare (Guenther and Kucera. 1978). Among these species there are migrants, predators, carnivores, raptors, primary cavity excavators, and prey species. There are 5 Forest Plan management indicator species or groups, 1 endangered, 2 threatened species, 1 candidate species, and 6 Regional Foresters' sensitive species. There are 2 endangered, 2 threatened, and 13 State candidate species that are on the Washington State list that have the potential to occur in the watershed. In addition, there are numerous species of "interest" or "concern to the public, groups, or organizations that could occur in the watershed.

Most wildlife species that occur or have the potential to occur in the Tucannon watershed also occurred historically in the drainage. Grizzly bear and gray wolves, once native to southeast Washington and the Blue Mountains, no longer occur in the area. Some species (bald eagle, wolverine, etc.) may have been widely distributed in the Blue Mountains historically but occur now in limited numbers and at few locations. On the other hand, species like elk and starlings have increased in numbers and distribution since the early 1900's.

The overall goal of wildlife management on the Forest is to maintain "viable populations" of species at the planning scale (36 CFR 219.19). Historic and current population estimates for most species in the watershed is not available. Historical information on species and their distribution is limited to anecdotal accounts from explorers, trappers, and pioneers passing through the region. The only reliable estimates for current populations are from the Washington Department of Fish and Wildlife big game surveys. Without population estimates, the evaluation of species distribution and their probable occurrence can only be derived through habitat modeling. The results and discussion that follow are based on a compilation of several data sources, with the intent to display broad trends in habitat quality and quantity for different periods in time that span 67 years (1935 to 2002) for a few selected species. Results of this evaluation should not be viewed as having statistical reliability and, therefore, should be interpreted cautiously. Table 8-5 identifies the parameters used to query various vegetative and topographic conditions that represent habitat feature for this analysis.

Table 8-5. Selected species with habitat indicators used to model existing and historic habitat availability in the Tucannon watersheds.

Species	Habitat	Cover Type	Structural Stage	Tree Cover	Other Habitat Features
Rocky Mountain Elk	SC	ABLA2, PIEN, PICO, ABGR, Mix, PSME	SEOC, SECC, YFMS, UR, OFSS, OFMS	>= 70%	Canopy Layers: 2 or 3
	MC	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO		>= 40%	Canopy Layers: > 1
	F1	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC, NF, BU	SI, NF, BG		
	F2	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC, BU	SEOC, UR, OFSS	<=40%	
Pileated Woodpecker	R1	PIEN, ABGR, Mix, PSME, HC	OFMS	>=70%	
	R2	PIEN, ABGR, Mix, PSME, LAOC, PIPO, HC	YFMS, OFSS, OFMS	>=50%	
	F1	PIEN, ABGR, Mix, PSME, HC	OFMS		
	F2	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC	YFMS, UR, OFSS, OFMS		
Northern three-toed Woodpecker	R1	ABLA2, PICO	OFMS		Elev. >= 4,500 ft.
	R2	PIEN, Mix			
	F1	ABLA2, PIEN, PICO	OFMS, OFSS		
	F2	ABGR, Mix, PSME			
Pine Marten	R1	ABLA2, PIEN, PICO	OFMS	Total Cover >= 40%	Elev. >= 4,000 ft.
	R2	Mix, PSME			
	F1	ABLA2, PIEN, PICO	YFMS, OFMS		
	F2	Mix, PSME	YFMS, OFSS, OFMS		
Primary Cavity Excavators	Primary	ABLA2, PIEN, PICO, ABGR, Mix, PSME, LAOC, PIPO, HC	OFSS, OFMS		
	Secondary		YFMS, UR		
Lynx	Potential	Cold Very Moist, Cold Moist, Cold Dry, Cool Very Moist, Cool, Moist, and ABLA2/STAM	N/A	N/A	
	Unsuitable	All (w/n potential)	SI	N/A	
			SEOC	<50%	
	Denning	All (w/n potential)	OFMS, OFSS	>49%	
	Foraging	All (w/n potential)	Various	N/A	
Wolverine	Natal Denning	NF, Rock, Talus	N/A	N/A	Aspects: N, NE, NW, & E Elev. >= 5,000 ft.
	F1	ABLA2, PIEN, PICO	SEOC, SECC, YFMS, UR, OFSS, OFMS		Elev. >= 4,000 ft.
	F2	ABGR, Mix, PSME, LACO, PIPO, HC			
Northern Goshawk	R1	ABGR, Mix, PSME, LACO, PIPO	OFSS, OFMS	>= 50%	
	R2	ABLA2, PIEN, PICO			
	F1	ABGR, Mix, PSME, LACO, PIPO	SI, SEOC, SECC, YFMS, UR, OFSS, OFMS		
	F2	ABLA2, PIEN, PICO			

SC= Satisfactory Cover, MC= Marginal Cover, F1= Primary Foraging Habitat, F2= Secondary Foraging Habitat, R1= Primary Reproductive Habitat, R2= Secondary Reproductive Habitat, NF= NonForest HC= Cottonwood, BU= Burned Area

Management Indicator Species (MIS)

A list of Forest management indicator species (Forest Service 1990) with the potential to occur in the Tucannon watershed are found in Table 8-6 along with the representative habitat requirement/condition. The habitat requirements of the selected indicator species are presumed to represent a larger group of wildlife species.

Table 8-6. Management indicator species expected to occur in Tucannon watershed.

Species	Preferred Habitat Types
Rocky Mountain elk	General forest habitat and winter ranges.
Pileated woodpecker	Dead/down tree habitat (mixed conifer) in mature and old stands.
Northern three-toed woodpecker	Dead/down tree habitat (lodgepole pine) in mature and old stands.
Pine marten	Mature and old stands at high elevations (>4000').
Primary cavity excavators	Dead/down tree (snag) habitat.

Overall, the total amount of available habitat, for most MIS, has decreased in various amounts since 1935 in the Tucannon analysis area (Table 8-7). The exception is the Rocky Mountain elk where habitat availability has remained constant. Declines in primary habitat are apparent for all MIS in analysis area. In contrast, increases in secondary habitat have occurred for all MIS except the pileated woodpecker. The shift from primary habitat to secondary habitat availability, since 1935, denotes a loss or deterioration of habitat quality for MIS in the analysis area. Based on the parameters used in Table 8-5, a reduction in large trees and a limited amount of distinct habitat communities occurred when compared to the 1935 vegetative data. Changes in the vegetative condition would be the result of natural disturbance, successional process, and management actions since 1935. A more specific discussion of historic and current habitat conditions for each MIS in the analysis area follows.

Table 8-7. Available habitat for Management Indicator Species (MIS) in the Tucannon analysis area in 1935 and 2002.

Species	Habitat	1935		2002	
		Acres	***%****	**Acres**	***%****
Rock Mountain Elk	*Primary Habitat*	48,966	*63*	42,210	*55*
	Secondary Habitat	28,168	*37*	34,933	*45*
	Total	77,134	*100*	77,143	*100*
Pileated Wood pecker	*Primary Habitat*	38	*<1*	3,834	*5*
	Secondary Habitat	42,344	*55*	31,159	*40*
	Total	42,382	*55*	34,993	*45*
Northern Three-Toed Woodpecker	*Primary Habitat*	16,670	*22*	787	*1*
	Secondary Habitat	38	*<1*	11,695	*15*
	Total	16,708	*22*	12,472	*16*
Pine Marten	*Primary Habitat*	16,670	*22*	3,087	*4*
	Secondary Habitat	0	*0*	5,598	*7*
	Total	16,670	*22*	8,685	*11*
Primary Cavity Excavators	*Primary Habitat*	42,261	*55*	21,190	*27*
	Secondary Habitat	174	*<1*	13,803	*18*
	Total	42,435	*55*	34,993	*45*

*Percent of vegetation (tree/grass/shrub) in the analysis area

Rocky Mountain Elk

The historic population density and distribution of elk in the watershed is not well known. However, antidotal accounts of elk in Bailey 1936 provide some insight on the elk population in the Blue Mountains and southeast Washington. Accounts from "old settlers" noted, "35 years ago (from 1919) elk were plentiful almost everywhere throughout this section of the (Blue) mountains." And "In crossing the Blue Mountains from the north in 1895-96, they saw old elk horn at the ranches and was told that there were still a few elk in the wildest parts of these mountains." Elk reached their lowest numbers about 1910. Reintroduction from Yellowstone National Park began in 1912 and 1913 (Bailey 1936). By 1926, the elk population on the Umatilla NF was estimated at 2,035 animals and grew to 3,080 animals in 1933 (Bailey 1936).

The Tucannon watersheds occur in five Washington Department of Fish and Wildlife (WDFW) game management units (gmu). Less than 5 percent of the Dayton (#162) and Peola (#178) units occur in the watersheds. Most of the Marengo (#163) unit, about a third of Lick Creek (#175) unit and all of the Tucannon (#166) occur in the watersheds. However, the western two-thirds of the Tucannon analysis area (west of FSR 40) primarily occurs in the Tucannon (#168) unit while the eastern third occurs in the Lick Creek (#175) unit. Therefore, elk and deer population trends for the Tucannon and Lick Creek units will only be addressed in this document because of the overlap with the analysis area and Forest Service land in the watershed. In addition, an "elk fence" occurs along the Forest Service boundary of the analysis area. The fence was put in place to keep elk on public land and reduce impacts on farmland. The Washington Department of Fish and Wildlife (WDFW) maintains the fence.

The Tucannon (#166) and Lick Creek (#175) units contain about eight to ninety percent National Forest Lands. As noted in Figure 8-1, deer populations have remained stable in both units over the last few years, while elk populations have slightly increased or remained stable. However, population estimates for both deer and elk are far below state management objectives (personnel communications, Pat Fowler). Management objectives (MOs) for the Tucannon and Lick units combined are 1,700 elk and 900 deer. Currently, elk populations are about 25 percent below the state management objective and deer are 64 percent below their objective. The elk herd composition has remained somewhat stable over the last few years (Forest Service 2000, personnel communications, Pat Fowler). The number of bulls per 100 cows has average bout 12 bulls in the last 3 years while the number of number of calves per 100 cows has averaged about 18 calves. Over the last 6-8 years, calves per cow ratio have been very low in the Tucannon and Lick units. Concern for the low elk population centers around three areas of thought: 1) high predation from cougars and bear on calves resulting in low calf survival as; 2) changes in habitat suitability that lead to seasonal (summer/fall) shifts in the herd followed by an increase in vulnerability during hunting season; and 3) the efficient harvest of cow elk during antlerless hunts in Oregon and Washington (Pat Fowler, WDFW; Personal com.). In addition, there is concern that elk population objectives are higher than what the habitat is capable of supporting, over an extended period (Rod Johnson, USFS-Walla Walla RD. Personal comm.).

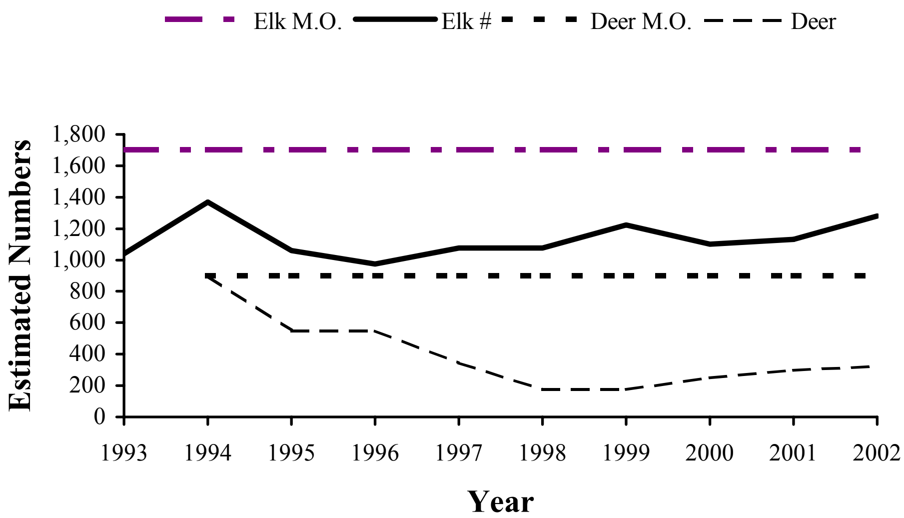


Figure 8-1. Elk and deer population trends on public lands for the Tucannon and Lick Creek game management units.

Preferred habitat for elk consists of a mixture of forest and non-forest habitat types and a variety of forest structure to provide cover and forage for summer or winter usage (FEIS 1998). The Tucannon analysis area contains both summer and winter habitats. Summer range (forest habitat) occurs throughout the area at mid and high elevations. Winter range (grassland/grass tree mosaic habitat) occurs in the central and northern portion of the watershed, at lower elevations, and adjacent to the Tucannon River. Approximately 10-15 percent of the analysis area consists of winter range. The essential habitat components for elk include satisfactory cover, winter range, and cover to forage ratios.

Table 8-8. The availability of "essential" habitat for Management Indicator Species (MIS) in the Tucannon analysis area.

Species	"Essential" Habitat	1935		2002	
		Acres	%*	Acres	%*
Rocky Mountain Elk	*Cover* *Forage* *Satisfactory Cover*	50,649 26,485 22,567	*66* *34* *30*	46,627 30,516 25,183	*60* *40* *33*
Pileated Woodpecker	*Primary Reproductive (nesting)*	38	*<1*	3,834	*5*
Northern Three-Toed Woodpecker	*Primary Reproductive (nesting)*	16,670	*22*	107	*<1*
Pine Marten	*Primary Reproductive (natal den)*	16,670	*22*	1,323	*2*
Primary Cavity Excavators	*Primary Nesting (large trees)*	42,261	*55*	21,190	*27*

* Percent of vegetation (tree/grass/shrub) in the analysis area.

The overall trend in total habitat availability for elk has not changed in the analysis area when compared to 1935 (Table 8-8). However, the availability of satisfactory cover and primary foraging habitat (primary habitat) has changed from sixty-three percent of the area in 1935 to approximately 55 percent for the present condition. Table 8-8 identifies the gross changes in cover from 1935 to the present. The current level of cover (60%) in the analysis area is near desirable levels. The amount of satisfactory cover increased 3 percent, when compared to 1935 (Table 8-8), and generally remains above desirable levels (15-20 percent) for the analysis area. However, the analysis for satisfactory cover occurs at the subwatershed level. To assess Forest Plan standards and guidelines implications at the project level, further analysis is needed. Since 1935, the total amount of marginal cover has declined somewhat in the analysis area but remains at a high level. With the presence of "good" cover in the Tucannon analysis area, efforts should focus on maintaining desirable levels of satisfactory cover (15-20 percent) and marginal cover (10-15 percent) as identified in the Forest Plan standards and guidelines for each subwatersheds.

The Rocky Mountain Elk habitat availability Map for 1935 (Map 8-3, Map Appendix) shows satisfactory and marginal cover as large, distinct blocks of habitat. Both cover types were widely dispersed across the landscape. Satisfactory cover occurred predominately at high and mid elevations in 1935. The 2002 Rocky Mountain Elk habitat availability Map (Map 8-4, Map Appendix) shows satisfactory cover in large, well connected patches, in the southern portion of the analysis area. In the central and northern portion of the analysis area, marginal and satisfactory cover occurs as relatively connected, small-moderate size patches, which are well-distributed across the landscape. Satisfactory cover occurs mostly at the high and mid elevations with lesser amounts at the lower elevations. Cover is "naturally" limited in the north west section along the Tucannon river were the primary vegetation is "grass-tree" mosaic, with grass and shrubs dominating the area between river and ridges and conifer trees occurring along the drains and ridge tops. While this analysis has identified some changes in cover since 1935, a site-specific analysis is needed to determine quantity, quality, and distribution of cover for each planning area. This analysis should take place at the subwatershed scale or management area level where activities occur.

In the Tucannon analysis area, the availability of forage habitat for elk has increased approximately six percent when compared to 1935 (Table 8-5). The foraging habitat in the analysis consist of grasslands, meadows, a moderate amount of "grass-tree" mosaic, and past harvest practices that increased the amount of the early successional habitat (i.e. grasses and shrubs) in forested stands. The forage component in the analysis area appears to be plentiful in the summer but could be limited in the winter because of the moderate amount of winter range available in the area. When comparing the Vegetative Community maps for 1935 and 2002 (Map 8-3 & 8-4, Map Appendix), a large patch of "winter range" (grass/shrub or non-forest) appears on the 1935 map adjacent to the Tucannon River, north and east of confluence of Panjab. This patch of habitat is not evident on the 2002 map. Returning this sites to grass/shrub types would increase the amount of winter range in the watershed.

Based on the 1935 Elk habitat availability (Map 8-3, Map Appendix) primary forage habitat occurred in large blocks, throughout the analysis area. Primary foraging habitat occurred predominately at mid and low elevations in 1935. Little or no secondary foraging habitat occurred on the 1935 elk habitat map. In 2002, primary foraging habitat is mostly scattered and occurs in smaller patches (Map 8-4, Map Appendix). Primary foraging habitat occurs at all elevations but primarily at the lower elevation. Even with winter and summer range available in the analysis area, some elk forage on private lands adjacent to NFS lands. Utilization off-Forest occurs mostly in the winter and spring, when forage is limited or at lower elevations where "green-up" occurs first. Typically, only small groups of elk are observed. However, larger groups do move onto private lands when the demand for green forage is greatest. Some of the off-Forest use is adjacent to NFS lands, but most of the use occurs farther from the Forest boundary (Personal Com.). While searching for forage, it is not unusual for elk to move outside of their "normal" range. Some herds have acquired a taste for wheat and alfalfa crops on nearby agricultural lands and tend to migrate to those areas when forage is limited. The recent prescribed burns in the watershed may help "hold" more elk on public lands and reduce impacts to agriculture and private lands. While that effort has improved forage conditions and resulted in some success at reducing impacts on private lands, some elk will continue to seek green lush forage wherever it occurs, regardless of ownership boundaries.

With the intent to improve elk habitat in the Tucannon analysis area, restoration should focus on maintaining a high level of satisfactory cover, improving winter range, and maintaining low open road densities. Standards for satisfactory and marginal cover are identified in the Forest Plan for each management area. A planning area analysis should be conducted to determine quantity, quality, and distribution of cover. This analysis should take place at the subwatershed scale or management area level where activities occur. Each subwatershed, were the potential occurs to sustain cover, should maintain 15-20 percent of the subwatershed in satisfactory cover and 30 percent of the subwatershed in total cover (satisfactory + marginal cover). Efforts should also be made to maintain and/or enhance winter range habitat in the analysis area. This could be met by restoring winter range (grass tree mosaic) to a more desirable historic forage condition. In addition, current winter range habitat should be burned periodically to maintain a suitable habitat condition, improve forage quality, and reduce foraging impacts on private lands. Finally, maintain low open road densities in the analysis area at levels identified in the District Access/Travel Management Plan and Forest Plan. This is generally at 2 miles per square mile.

Pileated Woodpecker

The historic population densities and distribution of pileated woodpecker is unknown. Based on the assessment of available habitat for 1935, this species would have occurred in the Tucannon watershed in relatively low-moderate numbers that maintained a population over time. Current population status and distribution of pileated woodpecker in the watershed is unknown. Formal inventories (presence/absence/nesting sites) have not been conducted for this species, however avian point count surveys have been conducted at various locations and habitats across the Forest since 1992. Since that time, the pileated woodpecker has been observed during those surveys in habitats similar to those found in the analysis area. In addition, the Zone Biologist has made general observations on the occurrence of this species in the analysis area and throughout the District.

Preferred habitat for the pileated woodpecker consists of large blocks of grand fir and mixed conifer stands in late and old structural stages with large diameter snags and down wood (Bull and Holthausen 1993 and Bull and et al 1992). This habitat can be found in the mid and upper elevations of the Tucannon analysis area. In general, the northwest portion of the analysis area is less suitable for pileated woodpecker than southern and eastern sections of the area. Essential habitat components for the pileated woodpecker identified in this analysis include primary reproductive habitat for nesting.

The overall trend for total habitat available, for the pileated woodpecker (Table 8-8), has declined by 10 percent in the analysis area when compared to 1935. However, the availability of primary habitat (nesting and foraging) has actually increased from less than 1 percent to 5 percent of the watershed in 2002. More specifically, the increase occurred in reproductive habitat (nesting) from 1935 to current condition (Table 8-9). Secondary habitat was the most abundant (55%) habitat for pileated woodpecker in 1935, but decreased 15 percent since 1935. The greatest potential for nesting habitat, in the Tucannon analysis area occurred in southern and eastern portion.

Based on the 1935 map for Pileated woodpecker habitat availability (Map 8-5, Map Appendix), little or no primary reproductive and foraging habitat occurred. Secondary habitat (foraging and nesting) occurs in large connecting blocks and at high-mid elevations. In 2002, the Pileated woodpecker habitat availability map (Map 8-6, Map Appendix) shows primary reproductive habitat occurring in small-scattered patches that are relatively connected by secondary habitat throughout most of the area. Primary reproductive habitat (nesting) is scattered across the landscape. Overall, the habitat quality for the pileated woodpecker in the Tucannon analysis area is fair to good, because of the increase in primary reproductive habitat and the moderate-large patch size of reproductive habitat. However, habitat capability for pileated woodpecker in the analysis area is low because of the limited amount of primary habitat available for 1935 and the existing condition.

With the intent to improve and maintain pileated woodpecker habitat in the Tucannon analysis area, restoration should focus on maintaining the availability of primary nesting habitat. Existing patches of nesting habitat should be maintained and used as building blocks to increase patch size. Thinning large blocks (>300 ac.) of grand fir and mixed conifer stands, from below, would move the stand to an LOS condition.

Northern Three-toed Woodpecker

Historic population densities and distribution of the northern three-toed woodpecker is unknown. Based on the habitat availability assessment for 1935, the assumption is this species would have occurred historically in the Tucannon watershed, although in moderate numbers. Current population status and distribution of the three-toed woodpecker in the watershed is unknown. Formal inventories have not been conducted for this species, however, avian point count surveys have been conducted at various locations and habitats across the Forest since 1992. During the survey effort, in habitat similar to that found in the analysis area, the northern three-toed woodpecker was observed. In addition, the Zone Biologist has made general observations on the occurrence of this species throughout the District.

Preferred habitat for the three-toed woodpecker consists of mature and old lodgepole pine stands with snags and down wood (ABI 2000). This habitat occurs in scattered patches at higher elevations of the Tucannon analysis area primarily along the eastern and southern edge. A relatively small amount of potential habitat occurs in the watershed. Essential habitat components for the northern three-toed woodpecker identified in this analysis include primary reproductive habitat for nesting.

The trend in total available habitat, for the three-toed woodpecker has declined six percent in the analysis area when compared to 1935 (Table 8-8). The availability of primary habitat (nesting and foraging) has declined, from about 22 percent of the analysis area in 1935 to 1 percent in 2002. In contrast, secondary habitat has increased in the analysis area, from less than 1 percent in 1935 to 15 percent in 2002. Table 8-9 identifies the change in essential habitat (reproductive) for the three-toed woodpecker in the Tucannon analysis area. Since 1935, primary reproductive habitat has declined approximately 22 percent in the analysis area. Historic nesting habitat occurred mostly along the southern edge of the watershed.

Based on the 1935 map of Northern Three-toed Woodpecker habitat availability (Map 8-7) primary reproductive and foraging habitat occurred in several moderate-large blocks, at high elevations, and somewhat connected. The primary reproductive habitat, in the southwestern portion of the analysis area, appears to connect with similar habitat in the adjacent watershed, creating an even larger block of habitat. Very little or no secondary habitat occurs in the analysis area. In 2002, the Northern Three-toed woodpecker habitat availability map (Map 8-8) shows primary reproductive and foraging habitat as widely scattered, relatively small patches, and at high elevations. Primary reproductive habitat occurs as one small patch, along the southwestern edge of the watershed. The stand connects to secondary habitat. Overall, the habitat quality for the three-toed woodpecker in the Tucannon analysis area is poor to marginal, because of the widely scattered small patches, and the reductions in old forest condition in the cold and cool forest types. The changes in reproductive habitat for the three-toed woodpecker, parallel reductions in late and old structure and changes in vegetative types in the analysis area since 1935. Habitat capability for northern three-toed woodpecker in the analysis area is moderate because of the large amount of primary habitat available in 1935.

With the intent to improve three-toed woodpecker habitat in the Tucannon analysis area, restoration should focus on increasing the availability of primary nesting habitat. Maintain existing patches of nesting habitat and use as building blocks to increase patch size. Develop large blocks (>75 ac.) of lodgepole pine and subalpine fir to help move the stands to a LOS condition, see Appendix B. In the long term, habitat could improve through prescribed burning in lodgepole pine stands for regeneration.

Pine Marten

The historic population density and distribution of marten is unknown. Based on the assessment of available habitat for 1935, this species could have occurred historically in the Tucannon watershed, but in low to moderate numbers. Current population status and distribution of the pine marten in the watershed is unknown. Formal inventories have not been conducted for this species, however general observations on the occurrence of this species throughout the Forest have been made by biologists on the Forest.

Preferred habitat for the marten consists of high elevation (> 4000’) stands of dense conifer and down wood often associated with streams (Forest Service 1994). This habitat occurs primarily in the southeastern corner of the watershed. A relatively moderate amount of habitat potential occurs in the watershed. Essential habitat components for the pine marten identified in this analysis include natal denning habitat (primary reproductive).

Overall, the trend in total available habitat for the marten, identified in Table 8-8, has decreased 11 percent in the analysis area when compared to 1935. Primary habitat availability has declined 18 percent in the analysis area since 1935. In sharp contrast, secondary habitat has increased, from 0 percent of the analysis area in 1935 to 7 percent in 2002. Table 8-8 notes the changes in essential reproductive habitat (natal denning) for the marten in the analysis area. Since 1935, primary reproductive habitat (natal denning) has declined 20 percent in the analysis area. Historic denning habitat occurred mostly along the southern edge of the analysis area.

Based on the 1935 map of Marten habitat availability (Map 8-9), primary reproductive and foraging habitat occurred in large-moderate connective blocks at the southern end of the analysis area. This habitat patch could have been connected to similar habitat in the adjacent watershed, to create a larger block of habitat. Primary reproductive habitat (natal denning) was well connected to similar habitat but limited to the east-central portion of the watershed. Little or no secondary reproductive and foraging habitat occurred in the analysis area. In 2002, the Marten habitat availability map (Map 8-10) shows primary habitat widely scattered, small patches, along the eastern and southern edge of the analysis area. Primary reproductive habitat occurs as one large patch in the southeast corner and one small patch in the southwest corner. Primary reproductive habitat connects to similar habitat or secondary habitat. Overall, the habitat quality for the marten in the Tucannon analysis area is poor, because of the widely scattered distribution of small patches of habitat, and declines in habitat quantity and quality in the watershed. The dramatic change in marten reproductive habitat reflects the changes in late, old structure, and the change in vegetative communities in the analysis area since 1935. Habitat capability for marten in the analysis area is moderate because of the large amount of primary habitat available in 1935.

With the intent to improve marten habitat in the Tucannon analysis area, restoration should focus on increasing the availability of natal denning habitat (primary reproductive habitat). Maintain existing patches of reproductive habitat and used them as building blocks to increase patch size and distribution across the landscape. Develop large stands (>160 ac.) of coniferous forest to help move stands to an LOS condition. In the long term, habitat could be improve through prescribed burning in conifer stands to regenerate and develop the stand. Restoration of marten habitat could occur in eastern portion of the analysis area.

Primary Cavity Excavators (PCE)

The group of primary cavity excavators (PCE) includes16 bird species (Table 8-9) capable of carving out cavities in dead standing trees, although some species are capable of creating cavities in green trees. These species are important to the landscape because they provide cavities (nesting/denning habitat) for a much larger group of secondary cavity nesters and users.

Table 8-9. Primary cavity excavator and their habitats in the Tucannon watershed.

Common Name	Habitat Community*	Minimum Nest Tree Size
Lewis' woodpecker	Open ponderosa pine, riparian cottonwood, and burned stands.	*12" dbh.*
Red-napped sapsucker	Aspen and mixed deciduous-coniferous stands.	10" dbh.
Williamson's sapsucker	Montane conifer forest especially fir, lodgepole pine and aspen.	12" dbh.
Downy woodpecker	Deciduous and mixed deciduous-conifer woodlands and riparian woodlands.	6" dbh.
Hairy woodpecker	Deciduous or coniferous forest, woodland, and bottomlands.	10" dbh.
White-headed woodpecker	Primarily ponderosa pine forest with 40-70% canopy cover.	10" dbh.
Three-toed woodpecker	Coniferous, mixed conifer-deciduous forests. Prefer burned tracts and montane spruce or aspen.	12" dbh.
Black-backed woodpecker	Coniferous forests especially burn over stands.	12" dbh.
Northern flicker	Open forested and woodland areas or adjacent to openings.	12" dbh.
Pileated woodpecker	Mature coniferous, deciduous, and mixed forests.	20" dbh.
Black-capped chickadee	Mixed woodland, deciduous and coniferous forests.	4" dbh.
Mountain chickadee	Open coniferous forests at high elevations.	4" dbh.
Chestnut-backed chickadee	Prefers low elevation, mesic coniferous forest of pine.	4" dbh.
Red-breasted nuthatch	Coniferous forests or mixed, deciduous, and aspen woodlands.	12" dbh.
White-breasted nuthatch	Deciduous and mixed, and coniferous forests.	12" dbh.
Pygmy nuthatch	Open pine forests.	12" dbh.

* Based on Thomas 1979, Ehrlich 1988, and Degraaf 1991.

The historic population density and distribution of primary cavity excavators is unknown. Based on the assessment of available habitat in 1935, the assumption is group of species would have occurred in the Tucannon watershed in sufficient numbers to maintain their population over time. Assuming all habitat components for the species was present in the analysis area. Current population status and distribution of primary cavity excavators in the watershed is also unknown. Formal inventories have not been conducted for this group of species, however, avian point count surveys have been conducted at various locations and habitats across the Forest since 1992. Since that time, PCE have been observed during the survey effort in habitat similar to those found in the analysis area. In addition, the Zone Biologist has made general observations on the occurrence of these species, throughout the District.

Habitat for primary cavity excavators includes coniferous and hardwood stands in a variety of structural stages and the availability of dead trees in various size and decay classes (Thomas 1979). Primary habitat has the potential to provide snags greater than 15” dbh, while secondary habitat can provide snags greater than 8” dbh but less than 15” dbh. The Tucannon watershed contains potential throughout the areas, except for non-forest areas and regenerating forest stands (stand initiation, and stem exclusion). Essential habitat components for most primary cavity excavators identified in this analysis include large dead trees for cavity development and nesting.

The trend in total available habitat for primary cavity excavators (Table 8-8) has declined 10 percent when compared to 1935. The availability of primary habitat has declined, from 55 percent in 1935 to 27 percent in 2002. On the other hand, secondary habitat has increased from less than 1 percent in 1935 to 18 percent in 2002. Table 8-9 identifies the changes in essential reproductive habitat (large tree for nesting) for PCE in the Tucannon analysis area. Historically, primary nesting habitat was plentiful throughout the analysis area. Large trees for nesting and potential cavity development are available in the current condition but are not widely scattered across the analysis area.

Based on the 1935 map of Primary Cavity Excavator habitat availability (Map 8-11), primary nesting habitat occurred in very large blocks, widely distributed across the analysis area. Habitat was well connected to similar habitat and occurred from high to low elevations. Secondary nesting habitat was relatively limited and occurred in small size patches of habitat in the southern portion of the analysis area. Secondary habitat connects to primary habitat in the analysis area. In 2002, the Primary Cavity Excavator habitat availability map (Map 8-12) shows primary nesting habitat widely scattered, small to large size patches, and distributed throughout the analysis area at all elevations. Secondary nesting habitat is widely scattered, with small to medium size patches, and distributed throughout the analysis area. Both primary and secondary habitat is well connected across the landscape. Overall, the quality of habitat in the Tucannon analysis area for the primary cavity excavators is considered fair, because less than 50 percent of the analysis area provides potential habitat however, habitat is well distributed and connected across the landscape. While the current number of snags may provide habitat for PCE in the short term, the limited quantity of mature and old forest structure suggests that large diameter snags may be limiting in the short term.

With the intent to improve primary cavity excavator habitat in the Tucannon analysis area, restoration should focus on increasing the availability of large tree habitat throughout the landscape.

Threatened, Endangered and Sensitive (TES) Species

Federally listed (FWS) endangered, threatened, proposed, candidate species (Fish & Wildlife Service 2002 and 2000) and Regional Forester’s sensitive species (Forest Service 2000) with the potential for occurrence in the Tucannon watershed include the Bald eagle, gray wolf, Canada lynx, spotted frog, peregrine falcon, great gray owl, green-tailed towhee, Pacific western big-eared bat, and the wolverine (Table 8-10). In addition, there are numerous species on the Washington Department of Fish and Wildlife, Species of Concern list (June 21, 200) that have the potential to occur in the watershed. Table 8-10 lists those species of "concern" or "interest" that could occur within the watershed. Habitat requirement and current population levels for some of these species are described below.

Table 8-10. Species of "concern" and or "interest" that have the potential to occur in the Tucannon watershed.

Species	U.S. Fish & Wildlife Service (2002 & 2000)	Regional Forester's Sensitive Species (2000)	Washington State Status (WDFW,1998)
Western toad			Candidate
Columbia spotted frog	Candidate		Candidate
Golden eagle			Candidate
Bald eagle	Threatened		Threatened
Northern Goshawk			Candidate
Peregrine falcon		Sensitive	Endangered
Flammulated owl			Candidate
Great gray owl		Sensitive	
Vaux's swift			Candidate
Lewis' woodpecker			Candidate
White-headed woodpecker			Candidate
Black-backed woodpecker			Candidate
Pileated woodpecker			Candidate
Gray flycatcher		Sensitive	
Green-tailed towhee		Sensitive	Candidate
Pacific western big-eared bat		Sensitive	Candidate
Gray wolf	Endangered		Endangered
Canada Lynx	Threatened		Threatened
Wolverine		Sensitive	Candidate

Columbia Spotted Frog

The historic population and distribution of spotted frog in the analysis area are unknown. However, the frog most likely occurred in the watershed, particularly wetland habitats along the Tucannon River. Current population density and distribution of spotted frogs is unknown. Formal inventories have not been conducted for this species, however, Biologist has made general observation on the occurrence of habitat across the Forest. Along the west slope of the Blue Mountains between Walla Walla and Dayton, spotted frogs have been observed (Karen Kronner, Personal Com. 2002) but none are known to occur in the Tucannon watershed

The preferred habitat for the frog consists of marsh and permanent ponds, and slow streams, usually with abundant aquatic vegetation. Flooded or wet meadows near a pond or stream can provide breeding habitat (Corkran & Thomas 1996). Suitable habitat for the spotted frog can be found in the analysis area along the numerous streams and a few wet meadows or seeps. The limiting factor for spotted frogs in the area could be insufficient aquatic vegetation for cover and foraging.

With the intent to improve spotted frog habitat in the Tucannon analysis area, restoration should focus on increasing and maintaining riparian and aquatic vegetation around moist and wet areas (streams, seeps and wet meadows). Wetland communities currently in the watershed should be maintained and prevented from further vegetative degradation. Suitable sites adjacent to wetland communities could be regenerated with aquatic and wetland species to expand and develop these sites.

Bald Eagle

The historic population density and distribution of bald eagles in the analysis area is unknown. However, it is assumed that both wintering and nesting eagles were common in the watershed along the Tucannon River. Current population densities and distribution of bald eagle in the watershed is sketchy. Wintering bald eagles have been documented along the Tucannon River; however, nesting bald eagles are not known to occur on National Forest lands in the watershed.

Preferred nesting habitat for bald eagles is predominately coniferous, uneven-aged stands with an old growth component or large cottonwood trees along a riparian corridor. Nest sites are typically near a large body of water (rivers, lakes, etc.) that supports an adequate food supply (FWS 1986). The nest tree is characteristically one of the largest in the stand and usually provides an unobstructed view of a body of water. In Oregon, the majority of nests are within 0.5 miles of the shoreline (Anthony and Isaacs 1981).

Wintering eagles tend to perch on dominant trees that provide a good view of the surrounding area and close to a food source such as carrion, fish, etc. (FWS 1986). Communal night roosts are generally near a rich food source (high concentrations of waterfowl or fish) and in forested, uneven-aged stands with a remnant old growth component (Anthony et al. 1982). Communal winter roosts tend to be isolated from disturbance and offer more protection from the weather than diurnal roosts (FWS 1986).

Overall, the quality of nesting habitat for bald eagles in the analysis area is poor to fair, because of the amount recreational activity along the Tucannon River. Wintering habitat is good along the river because of the availability of large trees and the proximity of winter range to the river, providing a potential source of carrion.

Opportunities to improve bald eagle habitat in the Tucannon analysis area are limited. Most of the good riparian habitat along the Tucannon River is owned by private land holders, however some good habitat occur in the upper end of the river on Forest Service land. Restoration should focus on recovery of riparian habitat along the river and its tributaries, where large tree development is suitable and appropriate. Cottonwood plantings at suitable locations along major stream courses could eventually lead to the restoration of old forest structure in riparian ecosystems.

Peregrine Falcon

The historic population density and distribution of peregrine falcon in the watershed is unknown. Based on the assessment of available habitat condition and composition for 1935, this species had the potential to occur historically in the watershed. Eyrie habitat is limited to a few sites in the Tucannon River drainage, while foraging habitat occurs in the uplands. Current population densities and distribution of peregrine falcon in the watershed is unknown. General observations have occurred throughout the District in potentially suitable habitat without the detection of a single eyrie. In recent times, falcons have been observed east of the watershed in the Asotin Creek drainage.

Preferred peregrine falcon habitat includes various open habitats from grassland to forested in association with suitable nesting cliffs. The falcon often nests on ledges or holes on the face of rocky cliffs or crags. Ideal locations include undisturbed areas with a wide view, near water, and close to plentiful prey. Foraging habitats of woodlands, open grasslands, and bodies of water are generally associated with the nesting territory (FEIS 1998 and ABI 2000). Falcons are known to forage over large areas, often 10 to 15 miles from the eyrie. A limited amount of nesting habitat for this species does exist within the watershed along the Tucannon River. Additional habitat occurs in the Wenaha-Tucannon Wilderness, south and east of the watershed. Habitat quality is poor to fair and habitat capability is low because of the limited amount of shear-cliffs to provide nesting habitat in the watershed.

With the intent to improve foraging habitat for peregrine falcon in the Tucannon analysis area, restoration should focus on maintaining a low open road density, particularly near potential nesting sites. Potential falcon habitat should be surveyed for occupancy prior to implementation of activities that are in or adjacent to potential nesting habitat.

Pacific western big-eared bat (Townsend's big-eared bat)

The historic density and distribution of big-eared bats in the watershed is unknown. The bat could of occurred in the analysis area historically, but to a limited extent. Current population status and distribution of the bat in the Tucannon watershed is unknown. Formal inventories have not been conducted for this species, however general observation of the occurrence of habitat has been made by the Zone Biologist. The closest known Pacific western big-eared bat colony is off the Forest and along the Umatilla River (Oregon).

The Pacific western big-eared bat occurs in a wide variety of habitats including coniferous forests (Norwak 1994). Bat occurrence correlates with the availability of caves or cave-like roosting habitat (mines, buildings, etc. Perkins and Schommer 1992). Individuals or small groups (3-5 individuals) of bats may day-roost in hollow and creviced trees and snags for a limited time. The most significant roosts are those with large congregations of bats, summer maternity roosts, and winter hibernacula (Norwak 1994 and ISCE 1995). These sites are highly sensitive to disturbance and human interference. Foraging occurs after dark in a variety of habitats including, open areas as well as forested areas. The bats forage within tree canopies and glean insects from vegetation (Perkins and Schommer 1992 and Nowak 1994). This bat can forage up to 8 miles from day roosts, but tends to forage within a few miles of colonial roosts (Perkins and Schommer 1992). Potential habitat in the watershed includes out buildings, rocky areas with deep crevices, hollow trees, and snags near water. Suitable habitat would most likely occur adjacent to the Tucannon River and its major tributaries.

With the intent to improve bat habitat in the Tucannon watershed, restoration should focus on maintaining snag densities along the Tucannon River and its major tributaries. An inventory should be conducted in the watershed to evaluate potential colonial roosts and hibernacula habitat. Buildings should be surveyed for potential bat roots prior to any renovation or reconstruction activities.

Gray Wolf

The historic population density and distribution of gray wolf in the watershed is unknown. A general observation noted in Bailey (1936) follows, "In 1854 Suckley reported them (wolves) very numerous in Oregon and Washington from the Cascades to the summit of the Rocky Mountains, and especially in the Blue Mountains, country." Basically, the wolf was extirpated from the region by the early 1900's. Based on the assessment of available habitat and probable low road density in 1935, this species did have the potential to occur in the area, but was extinct at that time. Current population densities and distribution of wolf in the watershed is unknown. However, it is generally assumed that it is only a matter of time until wolves reoccupy sites on the Forest. Successful reintroduction and management programs in Idaho and Montana have increased wolf populations in the northern Rocky Mountains, allowing wolves to disperse and potentially propagate in Oregon and Washington.

Habitat preference for the gray wolf appears to be more prey dependent than cover dependent. The wolf is more of a habitat generalist inhabiting a variety of plant communities, typically containing a mix of forested and open areas with a variety of topographic features. Wolves are strongly territorial, defending an area of 75-150 square miles. Territory size and location is strongly related to prey abundance. Wolves prey mainly on large ungulates, such as deer and elk and to a lesser extent on small mammals. The gray wolf does prefer areas with few roads, generally avoiding areas with an open road density greater than one mile per square mile. Natal dens typically occur as underground burrows, but can also be caves, or other types of shelter. Rendezvous sites are generally open areas (FEIS 1998 and ABI 2000). Habitat for this species does exist throughout the analysis area. However, the best habitat for the wolf occurs in the Wenaha-Tucannon Wilderness, south and east of the watershed. Habitat quality is considered good, because of the low open road densities, moderate ungulate population, and proximity to the Wilderness.

With the intent to improve habitat for gray wolf in the Tucannon analysis area, restoration should focus on maintaining a low open road density. Maintain a low open road density (one mile per square mile) in subwatersheds currently at this level or lower. As opportunities occur, closed roads should be obliterate/decommission in all the subwatersheds to improve habitat for gray wolf.

Canada Lynx

The historic population density and distribution of lynx in the watershed is unknown. Based on the assessment of available habitat for 1935, this species could have occurred historically in the watersheds but to a limited extent. Current population status and distribution of the lynx in the watershed is unknown. A lynx survey, conducted in 2000, used the FWS protocol (Weaver) to detect presence of lynx, near Elk Flat, southeast of the analysis area. The survey did not detect the presence of lynx in the area. However, lynx sighting (5) have occurred south of the watershed around Tollgate in the last 10 years. The southern portion of the Tucannon analysis area occurs in the Asotin Lynx Analysis Unit (#1).

Preferred habitat for the lynx consists of high elevation (> 4500') stands of cold and cool forest types with a mosaic of structural stages for foraging and denning. Primary habitat consists of subalpine fir, Englemann spruce, and lodgepole pine (Ruediger et al 2000 and Ruggiero 2002). This habitat can be found primarily along the western edge of the Tucannon watershed. A relatively small amount of habitat potential occurs in the watershed. However, habitat in this watershed could be connected to similar habitat in adjacent watersheds, particularly to the southwest.

The 1935 vegetative databases did not provide potential habitat coverage (PAG) for that period. Therefore, an analysis of the trend in historic available habitat did not occur. Currently, 59 percent of the analysis area contains lynx habitat with about 23 percent of this habitat considered primary habitat (fir/spruce/lodgepole pine (Table 8-11)). Habitat availability for lynx in the watershed consists mostly of foraging habitat and denning habitat (Table 8-12). Unsuitable (capable) habitat occurs in six percent of the vegetation in the watershed. Approximately, 80 percent of the Asotin Lynx Analysis Unit (LAU) #1 occurs in the Tucannon watershed.

Table 8-11. Habitat availability in 1935 and 2002 for selected TES species and species of "interest" in the Tucannon analysis area.

Species / Habitat	1935		2002	
	Acres	**%***	**Acres**	**%***
Canada Lynx				
Primary Habitat	N/D	*N/D*	17,400	*23*
Secondary Habitat	N/D	*N/D*	22,398	*29*
Total	N/D	*N/D*	39,798	*52*
Wolverine				
Primary Habitat	23,366	*30*	6,662	*9*
Secondary Habitat	27,266	*35*	38,339	*50*
Total	50,632	*65*	45,001	*59*
Northern Goshawk				
Primary Habitat	27,450	*36*	61,947	*80*
Secondary Habitat	40,660	*53*	7,457	*10*
Total	68,110	*89*	69,404	*90*

* Percent of vegetation (tree/grass/shrub) in the analysis area

Based on the 1935 map of Canada Lynx habitat availability (Map 8-13), denning habitat was widely scatted in large to moderate size patches, foraging habitat primarily consisted of smaller patches scattered across the south central portion of the watershed. Unsuitable habitat was widely scattered. The 2002 Canada Lynx habitat availability map (Map 8-14) shows denning habitat is widely scattered in the watershed and predominately along the upper drainages and higher elevation of the analysis area. Foraging habitat occurs in large blocks throughout the analysis area. Unsuitable habitat is also widely scattered and mostly adjacent to foraging habitat and in generally a smaller patch size than foraging or denning habitat. This habitat connects with addition lynx habitat to the east and south of the analysis area forming a habitat block about 49,200 acres in size. Overall, the habitat quality for the lynx, in the Tucannon watersheds is good, because of the limited amount of unsuitable habitat and the distribution of denning and foraging habitat in the analysis area.

With the intent to improve lynx habitat in the Tucannon analysis area, restoration should focus on maintaining a low proportion of unsuitable habitat and maintaining a good distribution of denning and foraging habitat in the analysis area. Sustaining habitat suitability for lynx should be a priority for management actions in watershed. Use conservation measures identified in the Canada Lynx Conservation Assessment and Strategy (LCAS) Rudiger 2000) to manage for lynx habitat in the analysis area. Defer to the most recent lynx habitat map when evaluating effects on lynx habitat.

Table 8-12. "Essential" habitat components for selected TES species and species of "interest," in the Tucannon analysis area for 1935 and 2002.

Species / "Key Habitats"	1935		2002	
	Acres	%*	Acres	%*
Canada Lynx				
Denning	No Data		11,42	*15*
Foraging	No Data		8	*29*
Unsuitable	No Data		22,13	*8*

			5 6,235	
Wolverine *Primary Foraging*	23,366	*30*	6,662	*9*
Northern Goshawk *Primary Reproductive (Nesting)*	25,591	*33*	15,48 4	*20*

* Percent of vegetation (tree/grass/shrub) in the analysis area.

California Wolverine

The historic density and distribution of wolverine in the watershed is unknown. The wolverine was probably never common in the analysis area, owing to the species large territory size (Banci 1994) and the limited amount of natal denning habitat. The historic presence of wolverine in the watershed mostly occurred while foraging. Natal denning habitat was most likely located in the Wenaha-Tucannon Wilderness, out site of the watershed. Current population status and distribution of wolverine in the Tucannon watershed is unknown. Winter snow-track surveys conducted in 1991 and 1992, across the District, for wolverine, fisher, American marten and lynx, did not provide verifiable sightings or tracks. However, miscellaneous sighting have occurred near the western and southern boundary of the Wenaha-Tucannon Wilderness area within the last 10 years.

The wolverine prefers high elevation conifer forest types, with a sufficient food source, and limited exposure to human interference (Forest Service 1994). Natal denning habitat includes open rocky slopes (talus or boulders) surrounded or adjacent to high elevation forested habitat that maintains a snow depth greater than 3 feet into March and April (Forest Service 1994). The wolverine is an opportunistic scavenger, with large mammal carrion the primary food source year-round. While foraging, they generally avoid large open areas and tend to stay within forested habitat at the mid and high elevations (>4,000') and typically travel 18-24 miles to forage/hunt (Forest Service 1994). The majority of the analysis area is suitable for foraging, except for that portion in the grass-tree mosaic community adjacent to the Tucannon River.

The trend for the total habitat availability for wolverine in the analysis area has declined slightly (6%) when compared to 1935 (Table 8-11). The availability of primary foraging habitat has declined, from 30 percent of the watershed in 1935 to 9 percent in 2002. In contrast, secondary habitat has increased in the analysis area when compared to 1935. Table 8-12 further documents the change in "key" foraging habitat for wolverine in the analysis area. Since 1935, primary foraging habitat has declined approximately 6 percent in the analysis area. Historic primary foraging habitat occurred mostly in southern and central portion of the watershed.

Based on the 1935 map of Wolverine habitat availability (Map 8-15), primary foraging habitat occurred a several large blocks, but also included some smaller patches at the north and west end of the analysis area. Secondary habitat was just as widespread and occurred in large blocks across the central and northern portion of the analysis area. Primary and secondary foraging habitat connects across most of the analysis area. In 2002, the Wolverine habitat availability map (Map 8-16) shows primary foraging habitat as scattered patches forming clusters along the eastern section and southern edge of the analysis area. Very little "prime" forage habitat occurred to the north and west of the analysis area. Secondary habitat is much more wide spread and is interspersed with primary foraging habitat. Foraging habitat in 2002 in well connected in the analysis area. Potential natal denning habitat could occur in the Tucannon-Wenaha Wilderness area near Table Rock Mountain and southeast of the watershed between Clearwater and Misery Spring. Overall, the current habitat quality for wolverine in the Tucannon analysis area is considered poor-fair, because of the lack of potential denning habitat and the moderate to quantity and distribution of primary foraging habitat in the analysis area.

With the intent to improve foraging habitat for wolverine in the Tucannon analysis area, restoration should focus maintaining a low open road density (two miles per square mile) and maintaining habitat connectivity across forest habitat types.

Species or Groups of Species that are of "Interest/Concern"

General

Historic information for birds, small mammals, reptiles and amphibians is almost totally anecdotal. As noted in the Ochoco National Forest Viable Ecosystems Management Guide (1994), higher water tables, more extensive riparian vegetation and aspen groves, and more beaver activity no doubt provided more suitable habitat for amphibians, water birds, songbirds, and riparian-associated small mammals such as shrews and mink, than do current conditions. While suitable habitat for these species occurs in the watershed, it is not know how many or what kinds of species actually occur in the area. Species inventories and habitat evaluations are needed to determine the extent of populations and habitat capability on the Forest.

Carnivores like the black bear and cougar may actually be more common today than in the early 1900s, as a result of prey bases recovering to higher densities and restrictions on hunting predators. Coyotes and bobcats are common throughout the Blue Mountains and most likely in the watershed. Both of these species are trapped regularly for predator control or for their fur throughout the Forest. Occasionally, these carnivores are observed but population numbers and distribution are unknown. (Witmer 1998)

Evidence of past and/or present beaver activity is found along the Tucannon River and many of its tributaries. The Tucannon drainages almost certainly lost the bulk of their beaver populations during the fur-trading era of the late 18th and early 19th centuries. Typically, with present day condition, beaver occur as singles or small groups that are widely distributed across the Forest. Occurrence and distribution in the Tucannon watershed is limited.

Ruffed grouse occur in the analysis area, although no information on current population status or distribution is available. Wild turkey populations, introduced in the Tucannon watershed by WDFW are observed often (Pat Fowler, WDFW. personal comm.).

The historic population density and distribution of the white-headed woodpecker in the watershed is unknown. The white-headed woodpecker was most common in extensive stands of late and old ponderosa pine. Based on the assessment of vegetative habitat and structural conditions for 1935, the species could have occurred in the Tucannon analysis area, although not in large numbers because of the limited amount of capable habitat in the watershed. The current population of white-headed woodpeckers in the Tucannon analysis area is unknown. In Washington and Oregon, even in favorable habitat, it is not as common as several other woodpecker species, however the breeding range includes Wallowa and several counties in southeastern Washington (Marshall 1997). Sightings of the white-headed woodpeckers in the watershed have not been documented. Based on the current assessment of vegetative conditions, the species could occur in the Tucannon analysis area, although not in large numbers. The species is still limited by the small amount of potential habitat in the analysis area.

Neotropical Migratory Birds (NTMB)

Neotropical migrant birds (NTMB) include species which nest in North America and migrate to Central and South America for the winter. Over the past two decades, declines in many NTMB species have been noted, including many songbirds that nest in the Blue Mountains. Causes for the declines include habitat degradation in winter and summer habitats and the continued use of toxic pesticides in Latin America (Sharp 1992).

Neotropical migrants account for a significant portion of the avian biological diversity in the Tucannon watersheds. Of the 123 species of birds known or suspected to occur in this analysis area, roughly 55 to 65 percent are NTMB. These species occupy a variety of habitats but most are closely associated with riparian habitats and/or late and old structure. Few of the NTMB species are associated with early successional stages.

The Monitoring Avian Productivity and Survivorship (MAPS) program, is a cooperative effort between public and private organizations, that was initiated on the Walla Walla District in 1992 to provide trend data for diurnal land birds, including NTMB. The MAPS surveys provide annual indices of adult population size and post-fledgling productivity, as well as estimates of adult survivorship and recruitment into the adult population. The six MAPS stations on the Forest include; disturbed coniferous forest, successional alder scrub (Buzzard Creek); montane meadow, coniferous forest, riparian willows (Brock Meadow); montane meadow, coniferous forest (Fry Meadow); successional disturbed mixed coniferous forest (Coyote Ridge); montane meadow, dense coniferous forest (Buck Mountain); and riparian willow/alder, dry chaparral, open mixed conifer/oak forest (Phillips Creek). The MAPS stations in the Blue Mountains represent most of the habitats in the Tucannon analysis area. A MAPS station is located several miles south of the analysis area

The following data highlights the last 8 years (1992-1999) data, pooled for all species, and for all six stations on the Forest. The data, taken from the 1999 Annual Report of the Monitoring Avian Productivity and Survivorship Program in Region 6 of the USDA Forest Service (Pyle et al 1999), follows:

- A total of 782 birds were captured and 39 species were recorded during the summer of 1999. Newly banded birds comprised 62 percent of the total captures.
- The greatest number of total captures (296) was recorded at Buck Mountain Meadow and the smallest number of total captures (60) was recorded at Fry Meadow.
- Species richness was greatest at Buck Mountain (27 species) and the lowest at Buzzard Creek (16 species).
- The adult population size has consistently declined since 1992 (1992, 694 to 1999, 393).
- The population size of young birds has substantially declined since 1992 and 1993 (1992, 856; 1993, 272 to 1999, 171).
- The proportion of young in the catch has declined since 1992, but has remained stable since 1994.
- Survivorship estimates are near expected levels, ranging from a low of 0.141 for Ruby-crowned kinglet to a high of 0.633 for Western tanager, with a mean of 0.442.
- Estimates of recapture probabilities were within reason but varied from 0.108 for Yellow-rumped warbler to 0.733 for Wilson's warbler with a mean of 0.391.
- The estimate for the proportion of resident adults in 1999 are as expected, ranging from 0.12 for Wilson's warbler to 1.00 for American robin, Yellow-rumped warbler, and Lincoln's sparrow and averaged 0.66.

Plausible reasons behind the declines identified in the MAPS data include, loss of breeding habitat, land use practices surrounding the station, historic pesticide use in the area, a decrease in the return to breeding sites, and “natural” changes in forest structure and/or composition at the site (Pyle 2000).

In 1994, the Oregon and Washington Chapters of Partners In Flight (PIF) came together to analyze the status of NTMB in Oregon and Washington. That report (Andelman and Stock 1994) identified breeding NTMB in Oregon, habitat relations, and NTMB population trends. The analysis primarily relied on breeding bird surveys conducted across the state between 1968 and 1994. In addition, the Interior Columbia Basin Ecosystem Management Project (ICBEMP), assessed NTMB in the basin (Saab and Terrell. 1997). The ICBEMP assessment took the Oregon and Washington PIF assessment a step further, and assessed NTMB under various management themes. Table 8-13 contains NTMB breeding birds in the Tucannon watershed, identified by Andelman and Stock (1994, Table 4) as species with “significant declining trends,” and noted by Saab and Terrel (1997, Table 6) as “species of high concern to management.” When treatments occur in their habitat, attention should be directed toward maintaining or developing suitable habitat characteristic for these species.

Table 8-13. Neotropical migratory birds that may be of "concern" in the Tucannon watershed.

Species	Primary Habitat for Breeding	"Significant" Declining Trends (Andelman and Stock 1994)	"High Concern to Management" (Saab and Rich 1997)
American kestrel	Coniferous forest, Grassland	X	
Mourning dove	Coniferous forest, Riparian	X	
Vaux's swift	Coniferous forest, Riparian	X	
Rufous hummingbird	Coniferous forest, Riparian	X	
Belted kingfisher	Riparian	X	
Lewis' woodpecker	Coniferous forest, Riparian		X
Williamson's sapsucker	Coniferous forest, Riparian	X	
Olive-sided flycatcher	Coniferous forest	X	X
Western wood-pewee	Coniferous forest, Riparian	X	
Violet-green swallow	Coniferous forest, Riparian	X	
Barn swallow	Riparian	X	
Rock wren	Grassland, Cliff, Rock, Talus	X	
Swainson's thrush	Coniferous forest, Riparian	X	
Varied thrush	Coniferous forest	X	
Orange-crowned warbler	Riparian	X	
Wilson's warbler	Riparian	X	
Western tanager	Coniferous forest, Riparian	X	
Chipping sparrow	Coniferous forest	X	
White-crowned sparrow	Riparian	X	
Dark-eyed junco	Coniferous forest, Riparian	X	
Western meadow lark	Grassland	X	X
Pine siskin	Coniferous forest		X
American goldfinch	Riparian	X	

As noted in Table 8-13, most of these species are dependant on coniferous forests and riparian habitats. While these habitats occur in the analysis area, there are fewer distinct habitat types, an imbalance of structural diversity, and an increasing number of small patches of habitat that are scattered across the landscape that limit habitat suitability. Left unchecked, theses changes could lead to a reduction in habitat quality for many bird species that dependent on a variety of structures, habitat types, and large patches of habitat to function overtime in the landscape.

With the intent to improve land bird habitat in the Tucannon watershed, restoration should focus on increasing vegetative composition and structural diversity. Reference the Habitat Composition and Riparian sections above for restoration activities that could improve or maintain NTMB habitat. Use the Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman, 2000) to address restoration actions beneficial to land birds in the watersheds.

Northern Goshawk

The historic population density and distribution of the goshawk in the watershed is unknown. Based on the assessment of available habitat for 1935, this species would have occurred historically in the Tucannon watershed in sufficient numbers to maintain a population over time. Current population status and distribution of goshawk in the watershed is unknown. To a limited extent, formal inventories for this species has occurred on the District and general observation of occurrence have been reported to the Zone Biologist. Nest sites are not known to occur in the analysis area, although it is very likely some may exist.

Preferred habitat for the goshawk consists of coniferous forests with a variety of structural stages for nesting and foraging. Nesting sites typically consist of a dense cluster of large trees, surrounded by a similar forest type with a more open overstory. The understory is relatively open and the nest site is generally within one-quarter mile of a stream or other water source. The best foraging habitat occurs in a mosaic of structural stages scattered across the landscape (FEIS 1998 and ABI 2000). Goshawk habitat occurs in the mid and upper elevations of the Tucannon analysis area. Essential habitat components for the northern goshawk, identified in this analysis, include primary reproductive habitat for nesting.

The trend in total habitat availability for the goshawk has remained somewhat stable in the analysis area when compared to 1935 (Table 8-11). Available primary habitat has increased, 44 percent since 1935. Conversely, secondary habitat has decreased, from 53 percent in 1935 to 10 percent in 2002. While habitat appears to have increased or remained stable, primary reproductive habitat, the essential habitat component (Table 8-12), has declined 13 percent in the analysis area. The greatest reduction in nesting habitat (essential habitat), in the analysis area occurred in north and central portion of the area.

Based on the 1935 map of Northern Goshawk habitat availability (Map 8-17), primary reproductive and foraging habitat occurred in large blocks that connected well with similar habitat. This habitat was well distributed across the landscape and occurred mostly at mid and low elevations. Primary reproductive habitat (nesting) occurred in large blocks with most of it in the northern and central portion of the analysis area. Secondary habitat occurred in large blocks and scattered patches mostly in the southern and central portion of the analysis area. In 2002, Northern Goshawk habitat availability map (Map 8-18) shows primary reproductive mostly occurring in the southern portion of the area, in moderate to small patches of habitat, somewhat connected. Primary foraging habitat occurs in large blocks, widespread throughout the area and across all elevation in the analysis area. Secondary habitat occurs in small patches, limited in distribution and scattered across the eastern and southern portion of the analysis area. Overall, the habitat quality for the goshawk in the Tucannon analysis area is considered fair-good because primary reproductive habitat is well distributed throughout the area, units occurs in large patches and is well connected to similar habitat. The changes in goshawk primary reproductive habitat (nesting sites) reflect the declines in late and old structure since 1935.

With the intent to improve and maintain goshawk habitat in the Tucannon analysis area, restoration should focus on maintaining the availability and distribution of primary nesting habitat. Replacement stands should be identified and moved toward a more mature or old structural class. Uneven-aged forest management techniques in dry and moist sites can improve northern goshawk habitat in the Tucannon watershed.

Bighorn Sheep

The historic distribution and density of Rocky Mountain bighorn sheep in the watershed is unknown. Generally, sheep were native to most of the mountain and canyon country in northeast Oregon and southeast Washington (Bailey 1936) including the Blue Mountains and Tucannon River. Bailey (1936) reported skull fragment with horns cores, picked up on the Wenaha River, and noted 50 sheep occurred in the Wallowa National Forest in 1933. Bighorn sheep were gone from the region by 1945. The initial reintroduction of Rocky Mountain sheep into the Wenaha-Tucannon Wilderness occurred in 1983 with 15 sheep from Washington (Hall Mountain) and 15 sheep from Oregon (Lostine River). Subsequent stocking occurred in 1984 and 1986. California bighorn sheep were also stocked along the Tucannon River in 1960 (6) and Asotin Creek HMA in 1973 (4). These sheep may have eventually joined the Wenaha-Tucannon herd. The current herd consists of a blend of sheep varieties.

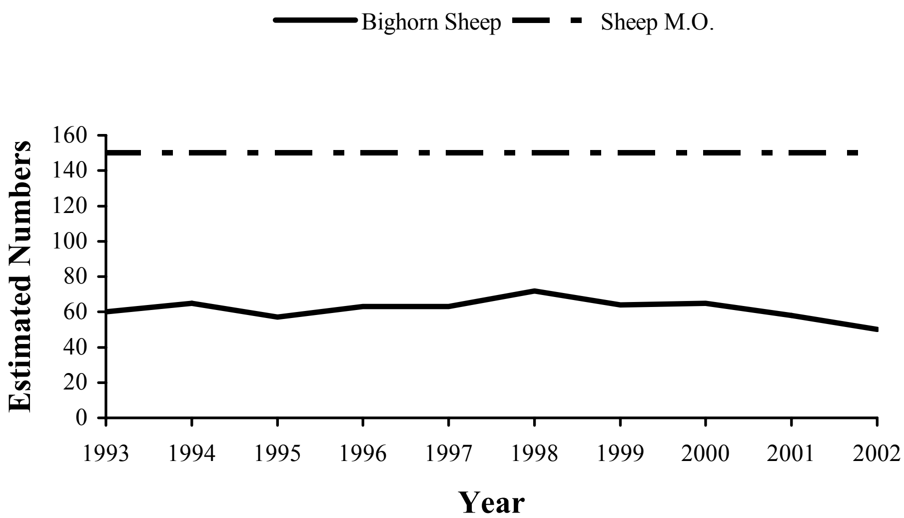


Figure 8-2. Bighorn sheep population trends for the Tucannon Unit.

The Tucannon unit contains two herds, the Tucannon and the Asotin. The Tucannon unit occurs in the southeastern portion of the watershed. This includes the general area, from Hatchery Ridge to approximately, Waterman Canyon and up Cummings Creek to Huckleberry Butte. The herd primarily consists of California subspecies, but a few Rocky Mountain bighorns wonder in from time to time. The long-range goal is to replace the California bighorn sheep with Rocky Mountain bighorn sheep. Primary lambing areas are on the northern portion of Hatchery Ridge and the southeast facing slopes of Cumming Creek. The Tucannon herd is near range capacity and further population increases are unlikely.

Management objective (MOs) for bighorn sheep in the Tucannon unit is 150 animals. The bighorn sheep numbers in Figure 8-2 reflect two herds from 1993 to present. The Tucannon herd has declined from approximately 70 head to 15 over the last 4 years, while the Asotin Creek herd has increased to about 35 head. So numbers reflect a slight declining population, when in fact one herd is at an all time low. The bighorn sheep population in the Tucannon unit (Tucannon and Asotin) is about 60 percent below the management objective. The herd composition has remains low but stable over the last few years. The number of rams per 100 ewes has averaged six rams in the last 3 years while the number of lambs per 100 ewes has averaged about eight lambs.

The Wenaha-Tucannon herd experienced a major *Pasteurella* die-off during the winter and spring of 1995-1996 reducing the population by about 50 percent. Since 1996, the herd has remained low but stable over the last few years (Figure 8-2). The herd will remain low until lamb survival improves in the herd (Vick Coggins, ODFW. Personal com.). Pasteurella pneumonia, scabies, and lungworms continue to threaten the health and survivability of the herd. WDFW biologists constantly monitor the herds for disease and parasite outbreaks.

Preferred habitat for bighorn sheep consists of rugged, open to semi-open areas of coniferous grassland or grass/shrub plant communities that affords high visual contact with their surroundings. The sites should include occasional to frequent expanses of cliffrock, rimrock, and rocky outcroppings, this is especially important for lambing and escape from predators. Typically, sheep avoid forested areas, but it is not unusual to find them seeking thermal cover from conifers, juniper and mountain mahogany when available. Grasses make up the staple forage species, complemented seasonally with forbs and shrubs. Water is an essential requirement for bighorn sheep and in some cases may limit their distribution. Winter range generally consists of low elevation grasses and shrubs. The overall intent of bighorn sheep management is to keep habitat and populations as remote and undeveloped as possible. Habitat in the analysis area occurs primarily east and north of the Tucannon River.

With the intent to maintain bighorn sheep populations and habitat in the Tucannon watershed, restoration should focus on maintaining foraging habitat, minimizing access, and preventing contact with domestic sheep herds. Maintain and/or enhance grassland and shrubland communities in the analysis area and restore areas (grass tree mosaic) to a more desirable historic forage condition and composition. In addition, periodically, burn current and historical grassland habitat to maintain a suitable habitat condition and improve forage quality for sheep. Manage open road densities, in bighorn sheep habitat to less than 2.0 miles per square mile. Bighorn sheep populations are highly susceptible to disease and parasites. Domestic sheep herds often serve as a reservoir of diseases that can be detrimental to bighorn sheep. Therefore, it is essential to separate domestic and wild sheep on the landscape.

Issues and Concerns

Maintain and enhance Late and Old structure (LOS) in the watershed, including old growth.

When compared to 1935, changes in the LOS stage have occurred in the watershed and documented in previous sections of this chapter. The total amount of LOS currently in the analysis area is below “desirable levels” for terrestrial wildlife in the watershed. In addition, patch size and arrangement of old forest stands has changed from historic conditions. The changes in LOS stages are attributed to natural events like insect and disease, drought, wind-throw, and wildfire. However, the majority of change is attributed to harvest and fire suppression since the 1940’s.

To maintain and enhance LOS stage condition in the Tucannon analysis area, restoration should focus on maintaining current LOS levels, expanding the size of old forest patches, and increasing LOS in deficient PAG. Appendix B outlines a management strategy to sustain desirable levels of LOS in the Tucannon watershed. To develop viable habitat for LOS associated species, 35 to 41 percent of the forested vegetation should be at an old forest stage (single stratum and/or multi-strata). Limit further reductions in existing old forest stands in the watershed until the appropriate distribution and patch size is obtained. Opportunities to develop old forest structure should focus on growing forested stands adjacent to existing LOS stands, increase patch size, and replace current LOS stands that could “fall apart” in the short term. In the Tucannon watershed, improvements in LOS could occur in the northeast portion of the analysis area to improve and maintain distribution and connectivity in the watersheds. Maintain the quantity (amount), patch size, and connectivity of LOS stands in the southern portion of the analysis area.

Restore and maintain wetland ad riparian habitats.

The watershed contain a few small wetlands (moist meadows), generally less than 5 acres in size and riparian broadleaf communities are limited to the Tucannon River and the major tributaries. Impacts to riparian, wetland, and aspen communities include elk and livestock utilization, invasive conifers, recreation, and fire suppression in the watershed for the last 60 years.

To restore and maintain wetland and riparian habitats in the Tucannon watershed, focus on increasing the amount of habitat and the broadleaf composition in moist and wet areas along streams and seeps and in wet meadows. Enhance wetland and riparian communities currently in the watershed and prevent further degradation of the community. Regenerate suitable sites adjacent to existing communities to expand and develop wetland communities in the analysis area.

Maintain and enhance deadwood habitat (snags ad downwood).

Snag densities and green replacement trees derived from CVS inventories far exceed Forest Plan standards at the watershed scale. The "high" tree mortality in the in the watersheds can be attributed to past and ongoing insect and disease outbreaks in the area. With the "high" tree mortality in the watershed, there is high likelihood that downwood densities are at or will soon be at adequate levels at the watershed scale. While snag and green-replacement tree densities may appear to be above standards and guidelines across the watershed, densities may be far below standards in many locations and at the project level. Therefore, conduct inventories to assure Forest Plan guidelines for dead standing wood, replacement trees, and downwood met project (treatment) level standards. To maintain and enhance deadwood habitat in the watershed, select large dominate trees for snag development. In stands where downwood densities are below Forest Plan guidelines, jackstraw small and medium diameter trees to develop downwood habitat.

Maintain and enhance big game winter range.

In the Tucannon analysis area, the availability of forage habitat for elk has increased approximately 6 percent when compared to 1935. In the analysis area, the forage component appears to be plentiful in the summer but limited in the winter because of the moderate amount of winter range available in the analysis area. A large patch of "winter range" (grass/shrub or non-forest) appears on the 1935 map adjacent to the Tucannon River, north and east of confluence of Panjab. This patch of habitat is not evident on the 2002 map. In addition, there has been a general reduction of grassland and shrubland in the analysis area as result of encroaching conifers

With the intent to maintain and enhance big game winter range in the Tucannon analysis area, focus on prescribe burning existing winter range habitat. To maintain a suitable habitat condition, perform this action periodically to maintain forage quality, and reduce foraging impacts on private lands. In the long-term, restore grassland and shrubland to their former extent to increase the amount of winter range in the watershed.

Maintain and enhance bighorn sheep habitat.

The overall intent of bighorn sheep management is to keep habitat and populations as remote and undeveloped as possible. Habitat in the analysis area occurs primarily east and north of the Tucannon River. In the Tucannon drainage, habitat capability for bighorn sheep is constrained by the limited amount of escape cover in the analysis area. Foraging habitat is somewhat limited in the winter because of the moderate amount of winter range available in the analysis area. A large patch of "winter range" (grass/shrub or non-forest) appears on the 1935 map adjacent to the Tucannon River, north and east of confluence of Panjab. This patch of habitat is not evident on the 2002 map. In addition, there has been a general reduction of grassland and shrubland in the analysis area as result of encroaching conifers

With the intent to maintain and enhance big game winter range in the Tucannon analysis area, focus on maintaining foraging habitat, minimizing access, and preventing contact with domestic sheep herds. Maintain and/or enhance grassland and shrubland communities in the analysis area and restore areas (grass tree mosaic) to a more desirable historic forage condition and composition. In addition, periodically, burn current and historical grassland habitat to maintain a suitable habitat condition and improve forage quality for sheep. Manage open road densities, in bighorn sheep habitat to less than 2.0 miles per square mile.

Maintain landbird habitat in the watershed.

Most declining landbird species are dependant on coniferous forests and riparian habitats. While these habitats occur in the analysis area, there are fewer distinct habitat types, an imbalance of structural diversity, and an increasing number of small patches of habitat that are scattered across the landscape that limit habitat suitability.

With the intent to maintain landbird habitat the analysis area, focus on increasing vegetative composition and structural diversity across the landscape. Use the Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman, 2000) to address restoration actions beneficial to land birds in the watersheds.

CURRENT AND REFERENCE CONDITIONS FOR HERITAGE RESOURCES

There have been approximately 151 National Historic Preservation Act (NHPA) compliance projects conducted within the 79,776 acre Tucannon analysis area of the Umatilla National Forest. Eighty-seven of these projects have been cultural resource inventories and sixty-four were non-inventory heritage projects including literature/file searches, an architectural evaluation, data recovery projects (2), a damage assessment, monitoring projects, a rehabilitation plan, and five eligibility determinations. Of the 87 inventory projects, 81conform to current Umatilla National Forest inventory standards while six do not as they predate current Forest standards. The inventory design was formulated with the intent to discover all historic properties in a given area. As a result of the inventory projects, roughly 80 percent of the Tucannon analysis area has been surveyed for heritage resources. The majority of the unsurveyed area is within the Wenaha-Tucannon Wilderness area. Additional unsurveyed areas consist of the state and private holdings that parallel the Tucannon River. In this same area on National Forest lands, there are remnants of unsurveyed isolated ridges and drainages that were not covered during earlier inventories, a total of less than 40 acres. The remaining un-surveyed area lies just west of the Wenaha-Tucannon Wilderness.

As a result of the above inventory projects, 173 historic properties have been located for an approximate ratio of one property for every 461 acres. This site ratio is slightly higher than other areas of the northern Blue Mountains with similar diverse topographic conditions. This may be partially attributed to its strategic location within the region. Not only did this area have its own bounty to offer; including fish, game, and fresh water, but it also offered means of access to other parts of the Pacific Northwest. Ninety of the 173 properties cultural resource properties within the Tucannon analysis area are of Native American affiliation and 83 are of Euro-American affiliation. Of these properties, the Tucannon, Godman, and Clearwater Guard Stations (and associated outbuildings), the Oregon Butte Lookout Tower, the Tucannon Campground Picnic Shelter, are considered eligible for the National Register of Historic Places (NRHP). The remaining properties have not been evaluated for NRHP eligibility, but are considered potentially eligible and afforded the same protection. Sixty-six of the properties are isolated artifacts and are not considered eligible for inclusion in the NRHP.

Typically, Native American sites are more common than Euro-American sites in the northern half of the Umatilla National Forest, and generally outnumber other site types by a 20 percent margin (Lucas 1995). In this case, Euro-American sites (52%) are more common than Native American affiliated sites (48%).

Ethnographic Information

The analysis area is within what is known as the Columbia Plateau cultural area. Ethnographic groups of Native Americans who inhabited and/or utilized parts of what is now known as the Umatilla National Forest include the Nez Perce, Umatilla, Cayuse, Palus, and Walla Walla Indians (Steward 1938; Blyth 1938). It is not known if the analysis area itself was restricted to use by only one of these groups, but is considered unlikely due to the fact that boundaries between different culture groups (for example the Columbia Plateau cultural area and the Great

Basin cultural area located immediately to the south) were often times very amorphous with large areas being used by more than one group (Jaenig 1991). According to Anastio (1972:119), cross-utilization of resources was standard and possibly even necessary due to the varied types and quantities of resources available in the diverse natural environment of the Columbia Plateau. Common cultural attributes included (but are not limited to) intermarriage and kinship ties; trading partnerships; riverine settlement patterns; technology to support a diet that included fish, roots, and wild meat; and group interaction based upon shared subsistence areas and resources (Walker 1967:16).

Discerning specific activities conducted within the analysis area by prehistoric Native Americans is problematic due to the paucity of information other than surface examination-derived site reports. However, there is a plethora of archaeological information from the Lower Snake River Region (Leonhardy and Rice 1970), as well as information concerning the Southern Plateau area in general, which can be used to infer a generalized pattern of land use within the analysis area. These activities would be expected to largely conform to the reported seasonal foraging routines in place for the given time periods of southern Plateau prehistory. Generally, adaptations consisted of a mixture of nomadism and sedentism, based upon seasonal rounds for subsistence (Lucas 1996). The lower elevations of the river drainages were utilized during the winter months, camps were established along the drainages and groups mainly subsisted on local game and dried provisions. During the milder months, temporary campsites in the uplands were established near water and food resources that became available on a seasonal basis (Hudson et al. 1978). A wide variety of plant items, such as nuts, berries, bulbs, and roots were used not only as food and/or medicinal items, but as materials manufactured into clothing, tools, etc. (Anastio 1972:119). There are numerous species of plants that are considered culturally significant within the Tucannon analysis area, some of which are considered of great importance to Native Americans. Included, but certainly not limited to, are camas, biscuitroot, and Indian carrot (Minthorn 1994). The same is true of the animals that were hunted (elk, deer, mountain sheep, rabbits, etc.), the meat being eaten and the rest of the animal utilized for other purposes. The majority of these resources would have been found within the analysis area, and were most likely utilized by different groups of the Columbia Plateau and Great Basin, to different degrees.

To access the above mentioned resources must have been relatively easy due to the somewhat easy topography of the surrounding Tucannon River Valley and the valleys of its tributaries, which created natural pathways or transportation routes. Reid describes two major aboriginal travel corridors located near the analysis area:

> One route ran from Wallula near the confluence of the Snake and Columbia Rivers eastward to the Lewiston basin and Clearwater-Snake confluence, approximately following the present course of Highway 12. The Lewis and Clark expedition used this trail on their return journey to avoid the rapids and portages of the “Big Bend” of the lower Snake. For the Nez Perce, Umatilla, and Cayuse, the corridor linked the buffalo plains of Montana with the great southern plateau trade mart at the Dalles.
>
> A second route ran north to south from the westernmost village near Almota to summer camps at Pomeroy and Dayton, thence south across the Grand Ronde basin to the Wallowa River (Chalfant 1974: 117-118). This route brought the lower Nez Perce into shared summer fishing camps with parties of Umatillas, Cayuses, Walla Wallas, and sometimes even Paiutes. These multiethnic summer fishing camps suggest a mechanism for the exchange and northward distribution of southern toolstones such as obsidians and Craig Mountain dacite (Reid et al 1998:4.3).

These routes are only two of what must have been a myriad of trails used by Native Americans, many of them subsequently followed by trappers, traders, and missionaries. Tucker (1940) indicates that trails were often connected across drainages and adjacent ridges. Many of these minor trails, more suited for foot traffic, may have been abandoned after the introduction of the horse (Hudson et al. 1978).

The Tucannon analysis area is within the ceded and traditional use lands of the Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Treaty rights and privileges include:

- the right of taking fish at all the usual and accustomed places and erecting suitable buildings for curing;
- the privilege of hunting, gathering roots and berries;
- the privilege of pasturing horse and cattle;
- the implied reservation of water to effecuate hunting and fishing rights.

Archaeology

Few sites within the northern Umatilla National Forest have been extensively investigated. A total of three sites within the analysis area have been archaeologically excavated and analyzed. Two upland sites within the analysis area have been tested or mitigated by data recovery excavations (Flenniken et al. 1991 and Reid et al. 1998). Both sites were situated along a high (over 6000 feet) ridge and within close proximity to a spring. Archaeological data from these tests indicated that these sites may have been used as transitory stops or camping areas during travel through the area or while accessing local resources. Dates of use for these sites (at least 6000 years ago) was based upon point typology derived from Leonhardy and Rice (1970) classification scheme and/or stratigraphic associations (Mount Mazama eruption).

A third excavated site is situated at a lower elevation (3790), at the confluence of two drainages. Archaeological material recovered indicated that the site functioned primarily as a lithic procurement site (Lucas 1997) as well as a base camp for hunting large mammals. Point types recovered can be placed within the Leonhardy and Rice (1970) sequence for the lower Snake basin, and represent a time range that extends from at least 5000 to 2000 years ago (Reid et al 1998). Radiocarbon samples were submitted and reflect a few of the many site occupations that probably occurred in the last 2500 years (Reid et al 1998).

Historic information

Although European trade goods were introduced much earlier, the arrival of the Lewis & Clark expedition in 1805 was the first introduction of Euro-Americans and Native Americans in the area. The explorers camped in the Tucannon region on their way back from the Pacific coast. Likewise, missionaries Marcus and Narcissa Whitman passed through the Tucannon watershed as they pursued their destination of the Walla Walla valley (Johnson 1996). Fur trappers also came into the region, but by the 1830s many of the interior drainages had been depleted of fur bearing trade animals (Lucas 1996). During the period of 1855-58, Fort Taylor was built at the mouth of the Tucannon River as a supply depot for troops fighting Indian wars. The fort was not designed to protect settlers, and as a result, little settlement occurred until after the wars when the region was proclaimed open to settlement. Access to the region by explorers, trappers, traders, and missionaries was fairly brief until the discovery of gold led to a more sedentary population that in turn created a demand for goods and services (Fulgham 1989). Cattle and sheepman took advantage of the market situation and grazing became more important. The Idaho mining communities were supplied by pack trains that hauled produce from Walla Walla to Lewiston. A stage line was also constructed in 1862 with routes that crossed the Tucannon area in 2 places (Johnson 1995). Steam navigation was utilized along the Columbia and Snake Rivers. These transportation links, as well as the Homestead Act of 1862, helped create the setting for additional immigration to the Tucannon region (Johnson 1995).

Agriculture gained a strong foothold during this time, and by 1875 a warehouse and loading dock had been built at the mouth of the Tucannon. Here, sacked grain was picked up by the Oregon Steam Navigation Company (Johnson 1995).

Mining development in the Tucannon area reached its apex during the years of 1897-98 (Fletcher 1988), and several lode mines were located in the Upper Tucannon and Cummings Creek area (Clifford 1994). However, mining was not very profitable, and most of the mining operations were abandoned by the 1920s.

The establishment of the Wenaha Forest Reserve (1905) was part of the federal response to concerns over the depletion of natural resources and marks the beginnings of the conservation movement. The creation of the Forest Service was intended to help regulate access to forest resources such as water, timber, and range activities. Under the supervision of the Forest Service, the Civilian Conservation Corps (CCC) constructed a number of both recreational as well as administrative structures within the analysis area. The Oregon Butte lookout tower, and the Tucannon, Godman, and Clearwater Guard Stations are examples of administrative structures. CCC-constructed recreational structures can be found at many of the developed campgrounds.

A review of the historic site types within the Tucannon analysis area shows a pattern of land use similar to other areas of Euro-American activity within the northern Blue Mountains. Site types are largely indicative of administrative efforts conducted by the U.S. Forest Service over the past 97 years. Site types such as administrative structures and fire lookout facilities are most common. Range improvements such as spring developments and corrals may also be found in the Tucannon watershed. There is also a small number of early “resort” or private lodges represented. The balance of Euro-American site types within the Tucannon analysis area are generally related to homesteading activity and include cabins and other dwellings.

RECOMMENDATIONS

The 'recommendations' step is the final one in the "ecosystem analysis at the watershed scale" process (REO 1995). Recommendations are designed to respond to issues, concerns and findings identified during the five previous ecosystem analysis steps.

The following overall management strategy was developed by the FWAT and the District IDT and can be considered as an overall guide to the specific recommendations that follow.

Integrate land management activities to maximize watershed health through implementation of a combination of strategies. This includes actions that lead to ecosystem integrity throughout the watershed. Tools and methods that may be used included prescribed fire, commercial and non-commercial treatments to manipulate upland vegetation, riparian and aquatic ecosystem enhancement, transportation management, recreation feasibility assessment, incorporating local and social values, tribal and collaborative partnerships, and existing laws, regulations and policy.

In addition ***restoration emphasis areas*** were selected to emphasize and prioritize resource activities in the watershed follow. The following objective statements provided for each area are intended to guide management actions in the watershed.

- Vegetation: Promote ecosystem integrity, resilience and sustainability by adjusting vegetation (all) structure and composition.
- Riparian/Aquatics/Water Quality: Restore ecosystem structure, function and biophysical components of riparian/aquatics by managing the vegetation and other elements to promote natural processes.
- Recreation: Provide for a diverse array of recreational opportunities to forest users while balancing the competing uses of natural resources.
- Transportation Management: Provide for public access while integrating and protecting other resource considerations in the watershed.

Within the context of the ***restoration emphasis areas***, the overall ***watershed strategy***, and in response to the ***issues and concerns*** outlined in the preceding sections, a broad array of management recommendations were developed for the Tucannon watershed. The recommendations are presented by resource area. Although there is significant overlap among the recommendations by individual resource areas, they were not combined in order to preserve the original intent of each of the specialists reports.

Soils and Geology

1. While stable on a large-scale, the presence of many small, shallow landslide and talus slope source areas requires consideration of their potential effects on developments. Road placement and design in particular should account for these processes. As experienced during the 96/97 flood events, developments at the base of drainages can expect occasional debris flows of (mostly) cobble and stone size material.
2. The Blue Mountains Ecological Unit Inventory should be accelerated in order to reach this area in a suitable timeframe. The detail of mapping and inclusion of potential vegetative communities is important for future planning efforts as land-use pressures

increase. This inventory will help identify the location of the deep, silt loam soils found in this area, which are among the most productive on the Forest. Although they are relatively resilient in response to disturbance, they should be managed carefully to maintain their growth and water processing capacity.

3. Site-specific problems related to soil compaction, displacement, and instability should be identified. The available information indicated that few (if any) areas are affected to the extent that mechanical rehabilitation is warranted. Ongoing detailed field assessments may reveal potential sites.
4. Although erosion is not a widespread problem in the drainage, there are some developed roads and recreation sites that warrant attention. The severity of the problem is highly dependent on specific conditions. The generally low road densities and well-maintained recreation sites help manage erosion problems. Attendance to road maintenance, drainage improvements, and stabilization efforts on the road systems is critical to erosion and sedimentation issues. Continued assessment of road system needs and condition will provide the necessary information for any road removal or obliteration proposals.
5. It would be useful to document areas where long-term soil productivity may have been impacted by logging activities (landing areas or major traffic areas). Due to the resiliency of the soil these areas may be few.
6. Target high productivity sites for optimizing vegetative growth potential. The high productive value of certain of the soils in this watershed is an important consideration when evaluating treatments for a variety of concerns. Soil amendments may be considered in situations where more rapid recovery of productive capacity is desired, for example on a road obliteration project. Also, amendments for growth enhancement have shown favorable response in tree growth trials.
7. Survey old mine sites for safety hazards and environmental effects, and bat habitat or populations.
8. Pursue/encourage the completion of the ecological unit inventory process on the District.

Hydrology

The following recommendations focus on actions to improve hydrologic function and watershed condition in the upper Tucannon and Pataha watersheds. Emphasis is placed on federally managed portions of these watersheds; however, recommendations for coordination with other landowners to meet this goal are also included.

1. Road system upgrades have the potential to improve water quality. Considerable road obliteration has already been implemented in portions of the Upper Tucannon and Pataha watersheds. Future road obliteration should focus on streamside roads and on subwatersheds with high road densities, such as Pataha Creek and Cummings Creek. Practices that disperse rather than concentrate runoff such as surface gravelling, outsloping, drivable dips, waterbars, storm hardening road surfaces, installation of rolling dips over existing culverts, and designing vegetated filter strips along roadways to catch excess sediment, are recommended. Continue to upgrade road/stream crossings to reduce the possibility of severe erosion during high flow events when water overtops the road or re-routes around the culverts into roadside ditches.
2. Riparian restoration with native plants is a high priority, and emphasis should be placed

on perennial or fish bearing streams with streamside roads, recreation developments, or other disturbances. Emphasis should also be placed on coordinating with state agencies and other ownerships to restore riparian and floodplain conditions in the main Tucannon River. Riparian shade should be increased with plantings and streamside grazing exclusion to promote cooler water temperatures, stabilize streambanks, and reduce erosion and sediment delivery.

3. Develop riparian maps and vegetation classifications for existing and potential riparian vegetation to support riparian restoration plans. Use methods developed as part of the Blue Mountains Demonstration Area for mid-scale mapping as a "first approximation" of existing riparian vegetation. Field-based inventory of riparian and stream systems are also needed to validate mapping, identify potential riparian vegetation communities, and design project-specific restoration plans. Coordinate with appropriate State and County groups working on riparian restoration (Washington Department of Fish and Wildlife, Columbia County Conservation District).
4. Include treatment of noxious weeds as part of riparian vegetation management plans; reestablish native plant communities, increase abundance and diversity of riparian species ecologically appropriate to the site, and increase stream shade and deep-rooted streambank vegetation.
5. Reduce the number and concentration of riparian and streamside developments by relocating and modifying developed and dispersed recreation sites, dikes, roads, and trails.
6. Coordinate with the State Department of Ecology in future development of TMDLs and Water Quality Management Plans. Road treatments and riparian enhancements would contribute to improvement in water quality and are consistent with the 2000 Memorandum of Agreement between the FS and DOE. A Water Quality Restoration Plan for federal portions of the watershed contributing to water quality degradation is a requirement in the 303(d) strategy.
7. Continue to evaluate effectiveness of past restoration practices and post-flood stabilization work: evaluate effectiveness of instream structures, riparian revegetation, road stabilization and decommissioning, and road-stream crossing upgrades.
8. Best Management Practices (BMPs) should be applied for all land-disturbing activities, including administrative actions, operations, and mitigation for short-term disturbances. All management plans with potential for ground-disturbance should include site-specific BMPs for water quality protection. BMPs include: riparian buffers, silt fences for erosion control, proper location of skid trails for logging, and timing of in-stream management activities. Projects should be periodically monitored to assure applicable BMPs are properly implemented and are effective in minimizing adverse impacts to water quality.
9. Consider mapping and classifying the existing riparian vegetation.
10. Set up a tracking system to check effectiveness monitoring of ongoing/already accomplished in-stream structures.
11. Look at old campsites we have already moved for potential native plant community revegetation opportunities.

Wildlife

1. Look at opportunities to expand or create large patch sizes of late old structure (or at least 200 acres in size). Also, consider distributing more late old structure across the entire

watershed.

2. Utilize prescribed fire to increase the quality and quantity of winter range for bighorn sheep.
3. Look at secondary forage areas for lynx and see if there might be opportunities to push them back toward primary lodgepole pine forage (especially in the head end of the Tucannon River drainage).
4. Look for opportunities to create additional watering developments (ponds/guzzlers) for cattle, big game and upland birds.
5. Look for opportunities to rehabilitate meadows (both dry and wet) across the watershed. This could include removing conifer encroachment, reestablishing native grasses/forbs/shrubs, or adding soil amendments to dry meadows.
6. Monitor snag and down wood densities and compare to Forest Plan standards. Establish a post activity monitoring protocol.
7. Work with the Washington State DFWS to create co-management prescriptions across the northern end of the analysis area.
8. Look at grass/tree mosaic vegetation types to determine if there has been a reduction in habitat conditions.

Fish and Wildlife

The following Tucannon subbasin near-term fish and wildlife needs are based on the findings and recommendations in the Tucannon River and Pataha Model Watershed Plans, the Tucannon River Watershed Plan-Environmental Assessment and information collected and recommended by WDFW, WDOE, USFS, CTUIR, and the NPT. Projects that address the following needs are directed at satisfying subbasin limiting factors and fish and wildlife management goals, objectives, and strategies.

Fish Habitat

1. Improve or re-establish well developed, mature riparian areas, increased channel stability and sinuosity, and floodplain connectivity on the National Forest.
2. Participate as an active partner in the Tucannon River Model Watershed Plan for restoration, maintenance, or enhancement activities for spawning and rearing habitat within the subbasin.

Assessments

1. Evaluate and implement the removal of exotic fish species such as brook trout.
2. Participate in the re-assessment of the *Tucannon River Model Watershed Plan* in relationship to current ESA recovery plans.
3. Assist in development of spawner / recruit data bases from information collected to determine what are full seeding levels of spring chinook and steelhead for the basin.
4. Conduct on-the-ground assessment of previous plan actions, current habitat conditions, and water quality.
5. Expand monitoring and assessment activities to improve our understanding of bull trout distribution, abundance, life histories and movements.
6. Participate in multi-agency assessments of fish distribution, production, abundance, and habitat quality in the Tucannon Watershed.

Natural Production

1. Participate in an assessment of the efficacy of habitat improvement projects within the basin to alleviate factors limiting the production of native salmonids.
2. Support the goal to increase wild steelhead and spring chinook to sustainable levels through habitat protection and restoration.
3. Review and comment on escapement and harvest management goals for natural production.
4. Assist with deposition of salmonid carcasses and nutrient cycling (enhance ecological productivity).

Enforcement

- Increase efforts to control illegal harvest of ESA listed salmonids in cooperation with other law enforcement agencies.

Manage Grazing Effects

1. Continue to look for opportunities to establish good habitat and water on the upslope to keep grazing cattle out of riparian areas.
2. Tucannon (upper and lower) pastures and Maloney pastures have not been grazed since 1994. Look at opportunities to bring that issue to closure to keep cattle grazing out of the Tucannon River riparian bottoms.

Other

1. Overall incorporate by reference the draft bull trout recovery plan for the Pataha and Tucannon subwatershed as completed by the USFWS in 3/2002.
2. Collaboratively assist (dollars) local model watershed groups with restoration of species in the watershed and across the Forest (i.e. Wyden Amendment).
3. Seek opportunities to cooperatively (i.e. WDFW, NMFS, TU, etc.) education publics and users through implementation of the Respect the River Program.
4. Conduct effectiveness monitoring on past activities (i.e. BMP's) in the watershed.
5. Assess current and past management activities and their effects on recovering fish populations and aquatic habitat.

Upland Forest Vegetation

Table 9-1 summarizes the acres that would qualify for four of the silvicultural treatments discussed in the upland vegetation section of this report. A total of 53,759 acres in the Tucannon analysis area (77% of the forested area) qualify for at least one of the treatment opportunities described in this section. Note that treatment opportunities were calculated using the entire forested area and thus acreages include Forest Plan management allocations that do not allow treatments.

Table 9-1. Acres by silvicultural treatment opportunities for the Tucannon watershed.

Silvicultural Treatment Opportunity	Area (Acres)	Percent of Forested Area
Thinning (reduce tree density for overstocked stands)		
Stands with a predominance of saplings and poles	5,630	8.1
Stands with a predominance of small and medium trees	32,857	47.2
Improvement Cutting (favor remnant ponderosa pine/larch)		
Mixed stands where remnant ponderosa pine is favored	11,437	16.4
Mixed stands where remnant western larch is favored	4,665	6.7
Regeneration Cutting (restore early-seral trees on dry sites)		
In Douglas-fir stands on dry-forest sites	15,355	22.1
In grand fir stands on dry-forest sites	2,105	3.0
Understory Removal (convert multi-layer to single-layer)		
Stands with a predominance of saplings and poles	8,894	12.8
Stands with a predominance of small and medium trees	14,858	21.4

Sources/Notes: Summarized from the 'ExistVeg' database (see Powell 2001c). Areas identified as a 'thinning' opportunity are overstocked forest stands (see Table 5-21). Areas identified as an 'improvement cutting' opportunity are forest stands with a 'mix-PIPO' or 'mix-LAOC' cover type code (see Table 5-11). Areas identified as a 'regeneration cutting' opportunity are forest stands with a 'PSME' or 'mix-PSME' cover type code (Douglas-fir), or an 'ABGR' or 'mix-ABGR' cover type code (grand fir), and occurring on the dry upland forest PVG. Areas identified as an 'understory removal' opportunity are forest stands occurring on the dry upland forest PVG that have more than one forested canopy layer. *Note that treatment opportunities were not adjusted for Forest Plan management allocations; they can occur on any management allocation in the Tucannon watershed, including Wilderness*.

The criteria used to identify forest polygons that qualify for the four treatment opportunities were not mutually exclusive, which means that many polygons qualified for more than one of them. This fact was used to establish a relatively simplistic prioritization rating based on how many treatment opportunities a polygon qualified for, as shown below:

NUMBER OF TREATMENTS	TREATMENT PRIORITY
1	Low
2	Medium
3	High

Map 5-13 (see appendix) shows the geographical distribution of these treatment priorities for the Tucannon watershed.

Other recommendations include the following:

1. Moderate to high levels of forest damage occurred in the Tucannon watershed during the late 1980s and the early 1990s (see Table 5-7) from bark beetles and tussock moth.. Upland forest silvicultural practices that could be used to respond to this issue are salvage of dead trees and tree planting.
2. Fifty-five percent of upland forest in the Tucannon watershed has forest density levels that threaten its future sustainability (see Table 5-21). Upland forest silvicultural practices that could be used to respond to this issue are thinning.
3. Substantial reductions in the area of early-seral species (particularly ponderosa pine) have contributed to declining vegetation diversity in the Tucannon watershed since 1935. Upland forest silvicultural practices that could be used to respond to this issue are improvement cutting (for stands where early-seral species still exist) and forest regeneration (on dry-forest sites where early-seral species no longer exist).
4. Several analysis indicators show that *dry-forest sites* in the Tucannon watershed currently have conditions that are inconsistent with high levels of ecosystem integrity and resilience (e.g., multi-layered rather than single-layer stand structures; late-seral rather than early-seral tree species). Upland forest silvicultural practices that are responsive to this issue include understory removal, pruning, and prescribed fire.
5. Consider salvage cutting for areas with substantial amounts of forest damage; Table 5-7 summarizes forest damage acreages by year. A salvage program should emphasize dry-forest areas because they have experienced the most pronounced changes in both species composition and forest structure over the last 90 years.
6. If salvage treatments are completed in response to forest damages, then the treated areas should be evaluated to determine their suitability for planting. Any reforestation evaluation should consider establishing western larch and ponderosa pine where they are early-seral species; western white pine should also be considered for sites in the moist-forest potential vegetation group. *If forest health is an objective, then planting should attempt to establish a future stand with at least two-thirds of the composition being early-seral species* (Carlson and others 1983). This recommendation is particularly appropriate for areas with high risk of a future outbreak of western spruce budworm or Douglas-fir tussock moth.
7. Evaluate upland-forest sites with apparent overstocking (see Table 5-21) and if high tree densities are actually present, then consider them for thinning. Map 5-4 shows the location and distribution of upland-forest sites that apparently qualify for the thinning treatment opportunity.
8. Improvement cutting should be considered for mixed-species stands that still have a viable component of early-seral trees in their overstory (either ponderosa pine or western larch in this instance). Improvement cutting could be effective at reducing the susceptibility of ‘Young Forest Multi Strata’ stands (YFMS; see Table 5-14) to destructive crown fires. For that scenario, improvement cutting would be used to address ladder fuels by removing Douglas-fir or grand fir mid-stories or understories. First priority for use of improvement cutting to address crown fire susceptibility should be areas identified as potential firebreak or fire-control sites. If possible, treatment should be concentrated in large blocks of stands (minimum of 1,000 acres; see fire discussion on page 15); small treatment areas are not likely to have a positive impact on either crown fire or insect defoliators, both of which operate at a landscape scale. Map 5-4 shows the location and distribution of upland-forest sites that apparently qualify for the improvement cutting treatment opportunity.
9. Consider regeneration cutting as one silvicultural alternative for addressing the

"reduction in early-seral species" and "inconsistent species composition on dry-forest sites" issues. In that context, regeneration cutting would be used in situations where the desired species do not exist currently, or they exist in numbers too low to qualify as a viable seed source. Map 5-4 shows the location and distribution of upland-forest sites that apparently qualify for the forest regeneration treatment opportunity.

10. Consider understory removal for dry-forest sites with multi-layer structural classes (UR, YFMS, OFMS, see Table 5-14) that could be converted to a single-layer structure. This recommendation could be implemented in the following way: in the near term, identify high quality existing stands in the 'Old Forest Multi Strata' class (OFMS) and screen them to remove stands providing critical wildlife habitat. The remaining stands represent the best opportunity to move portions of the watershed toward the OFSS class in the shortest possible time. Within these areas, determine which stands have a viable component of large old ponderosa pine in good condition. Remove the small- to medium-sized trees in these stands to 'instantly' create OFSS structure. Favor retention of early-seral species (primarily ponderosa pine) where possible. Map 5-4 shows the location and distribution of upland-forest sites that apparently qualify for the understory removal treatment opportunity.
11. After conversion to an OFSS structure, treat or remove woody residues (hand pile slash if accumulations are light, or treat heavy accumulations mechanically) and then use prescribed fire to maintain a low density of large trees.
12. In the longer term, manage some of the 'Young Forest Multi Strata' (YFMS) and 'Stem Exclusion Open Canopy' (SEOC) structural classes to develop a large-tree component as quickly as is permitted by site productivity. Stands on dry sites and containing high levels of ponderosa pine should be favored. Although species preference should be given to ponderosa pine on dry sites, primarily as a mitigation measure because historical partial-cutting practices discriminated against this species, other species should always be retained at ecologically appropriate levels to maintain biological diversity.
13. Consider pruning as a future treatment for young stands on dry-forest sites, coordinated with prescribed burning treatments as a way to lower the risk of pole-sized trees being killed by a fire (torching). Also, thinning and pruning could be used in tandem to address the two main components of crown fire risk – initiation and spread. By removing lower branches, pruning has little impact on crown bulk density but effectively reduces initiation potential by raising crown base height.
14. Consider prescribed fire for dry-forest sites that have received an understory removal or thinning treatment, and as a future treatment for any plantations established following regeneration cutting. Prescribed fire will probably not be feasible for at least 30 years after plantation establishment, but it could then be used as a thinning tool to help create and maintain stand structures with low risk of crown fire or forest health problems related to bark beetle or defoliator attacks (Agee 1996, Morris and Mowat 1958, Scott 1998). As in other recommendations, relatively large treatment areas should be identified as a way to allow this disturbance agent to function at a landscape scale. Highest priority for treatment is dry-forest areas that are suitable for treatment now, or could be suitable with minor 'conditioning' (use of a mechanical pretreatment). Logical 'blocks' of forestland that could provide control opportunities for large-scale conflagration fires in the Tucannon watershed should be considered for this treatment.
15. Consider establishing black cottonwood on ecologically appropriate sites in both the upper (cooler) portion of the dry forest PVG and in the warmer portion of the moist forest PVG.

16. Continue to plant rust-resistant sources of white pine on moist-forest sites where it is ecologically well adapted. Map 5-11 (Map Appendix) shows certain sites that apparently have the ecological potential to support western white pine, but they are certainly not the only ones.
17. Consider opportunities to reduce “vegetation encroachment” in historically grass/shrub habitats. Look at area north of Panjab creek and Tucannon River junction.

Managing Wildfire Risk

Managing to restore potential natural vegetation within an ecosystem will require significant human intervention. Decades of fire exclusion have left many acres of dry forest settings with significant loads of live and dead fuels. Restoration of these stands will require continued fire suppression, under thinning, fuel removal, and prescribed fire. Recommendations to manage wildfire have considerable overlap with the upland vegetation section of this report. To maintain, preserve and protect the natural resources in the watersheds, meet the goals of the LMP, and restore the resilience to the ecosystems, the following recommendations are provided:

1. Accelerate the application of prescribed fire to mimic historical fire regimes in terms of frequency and intensity.
2. Create management plans to protect private and federal infrastructure in the Tucannon watershed (i.e. fish hatchery, summer cabins, guard stations, Camp Wooten, etc.). There is also old growth requiring protection just east of Camp Wooten.
3. Develop fuels management plans to consider fuels breaks on ridgetops to facilitate prescribed fire lines, wildfire control points, and possibly incorporation of native plant management objectives.
4. Reduce fuels, focusing on those areas that are in condition class II and III (see Map 6-4, Map Appendix) through under thinning, mechanical fuel removal, hand and mechanical treatments, and the selective use of prescribed fire.
5. Maintain the current state of those areas that fall into condition class I with landscape prescribed fire.

Noxious Weeds

1. Identify opportunities to work cooperatively with all other private; state and federal land manage agencies in the Tucannon to reduce existing and established populations.
2. Place within each site-specific NEPA project an aggressive noxious weed plan to allow for chemical treatment.

Botanical Resources

1. Continue survey efforts to include the Wenaha Tucannon Wilderness and Tucannon River bottom.
2. Identify and map native plant seed sources.
3. Continue opportunities to combine seed orchard infrastructure with native plant propagation.

Heritage Resources

1. Additional efforts should be made to identify and document sites in need of rehabilitation or evaluation. Approximately 30 lithic dominated sites within the Tucannon watershed are in need of evaluation and possibly rehabilitation. Opportunities to conduct archaeological work should be sought as future projects and management opportunities arise.
2. Areas in need of additional survey coverage within the Tucannon analysis area are located along the Tucannon River, within state and private land holdings, and several isolated drainages and ridge-tops (less than 40 acres) in the same area but situated within National Forest lands. The remaining un-surveyed area is within the Wenaha-Tucannon Wilderness area, as well as a portion just to the west of the wilderness area. Information derived from surveys within the wilderness area could contribute important information concerning settlement and subsistence use of upland areas.
3. The Tucannon Guard Station, a National Register eligible site, is in need of rehabilitation. A rehabilitation plan has been written (Lucas 1999) in accordance with the Secretary of the Interior's Standards for Historic Preservation Projects and has been approved by the Washington State Historic Preservation Officer (SHPO). The initial phase of this plan was begun in 2001. Considerable work remains. The Tucannon Guard Station, thought to be the earliest contract-built guard station in the Pacific Northwest, remains an important focal point within the area. Its location lends itself towards a recreational rental, and/or an interpretive center. It is located within walking distance of Camp Wooten (an environmental learning center), and has potential to contribute to environmental learning. The structure sits on approximately five flat acres, with easy accessibility, and within close proximity to fishing, hunting, and hiking areas. The setting may be conducive to campground development and would serve several local communities. A recreation plan that incorporates use of this facility and area would be beneficial.
4. Monitoring activities should continue. Monitoring should be used to accomplish two objectives; one, as a tool to check the survey strategy to ensure that the survey design is adequate and to record any sites that might have been missed by previous surveys, and two, to monitor the condition of those sites potentially eligible to the NRHP. A review of site forms revealed varying site conditions including no disturbance, disturbance from natural erosion and weathering (natural deterioration), to disturbance related to past and current activities such as road construction, logging, and heavy recreational use.
5. On-going consultation should continue with both the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe to identify any concerns, opportunities, or issues related to the Tucannon Watershed.
6. Identify and survey gaps and attempt to complete field surveys for the entire watershed.
7. Identify any site rehabilitation work necessary from the field surveys (i.e. Tucannon guard station).
8. Work with local communities to develop opportunities for heritage/environmental education programs.

Transportation Network

1. Find opportunities to reduce sediment and accelerated flows (which protects channel stability). This would include assuring culvert size is adequate, drainage is functioning properly, cut slope stability and surfacing is appropriate and functional.
2. Find methods to reduce the "conduit effect" of roads and trails for noxious weed spread.
3. Look at opportunities to reduce introduction of noxious weeds in an overall strategy (i.e. washing vehicles, weed free hay) through the NEPA process and consider incorporating spraying known and anticipated infestations.
4. Check all live water crossings (culverts) to make sure they are fish passable.
5. Look at opportunities to reduce any road densities (by subwatershed) if they exceed Forest Plan guidelines of 2.0 miles open road/square mile.
6. For revegetating open/disturbed areas, utilize native seeds/shrubs when possible.
7. Look at opportunities to decommission roads no longer needed for the long-term transportation system.
8. Look at opportunities to look at existing roads for relocation (i.e. roads adjacent to live water, or overly-steep/poorly-located).
9. Pave the Tucannon river road from Camp Wooten to Panjab.

Socio-Cultural/Recreation

1. Look for dispersed recreation opportunities away from riparian areas.
2. Promote environmental education programs (i.e. Respect the River).
3. Promote more recreational education (i.e. additional kiosk's).
4. Re-evaluate existing recreational facilities that were exempt the first go around to determine effects on fish.
5. Look at potential to develop recreational opportunities, reduce summer stream flow temperatures, maintain constant stream flows, initiate local hydropower, develop concessionaire opportunities by creating a concrete reservoir at Columbia center.
6. Assess recreational residences for water quality, permit compliance, and general usage.
7. Assess winter recreational activities and infrastructure that supports that program (snow-parks with connecting trails).
8. Work with local ORV groups to develop long-term trail systems or use areas that facilitate needs, but minimize effects to other resources.
9. Identify whether there are potential opportunities to develop more facilities to accommodate people with disabilities and sight seeing
10. Assess the closure of Tucannon river road from highway use to motorized recreation from Panjab creek to sheep creek.
11. Assess changing entry to Camp Wooten, re-introduce Hixon creek to original stream course and look at any other opportunities to improve floodplain values.

DATA GAPS

Upland Vegetation

1. Pomeroy District should continue its on-going efforts to develop a 'limited vegetation components' or 'species of special concern' GIS layer (and associated databases) to monitor the location and status of these restricted plant communities
2. The Pomeroy Ranger District should continue to acquire updated stand examinations whenever possible.
3. The Pomeroy Ranger District should complete those database revisions prior to using the Tucannon watershed vegetation database for project planning or to meet other local needs.

Hydrology

1. Implement Regional watershed maps and terminology (5^{th} and 6^{th} HUC). Develop common streams databases with Regional Ecosystem Office, Interagency Hydrography Clearinghouse, and NRIS Water team.
2. Continue analysis of the backlog of stream discharge, temperature, and sediment data. Use these findings to adapt management and focus monitoring efforts to address current and future management questions.
3. Incomplete records for stream discharge at the Tucannon at Panjab gage should be examined and a determination made to reactivate or discontinue this gage.
4. Further analysis of stream temperature data may help streamline current monitoring efforts.
5. Results from Tucannon sediment data analysis will help guide future efforts for instream sediment monitoring and aquatic habitat assessment.
6. Analyze, interpret, and report Cummings Creek and Pataha Creek sediment data.
7. Stream channel reference reaches have been useful in evaluating post-flood channel changes and show promise as surrogates for instream sediment monitoring. Resurvey established reference reaches every 5 years or after major flood events.
8. Initiate discussions with state and county agencies, tribes, and universities to develop coordinated monitoring and data sharing. Consider development of "data clearinghouse" with Model Watershed program.
9. Adopt the environmental education program "Respect the River" to increase public awareness and stewardship for riparian/stream ecosystem protection and restoration.

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APPENDIX A: INITIAL ISSUES IDENTIFICATION AND INTEGRATION

Editors note: This section contains the results of meetings between the Forest Watershed Assessment Team (FWAT) and the Pomeroy District Interdisciplinary Team (IDT) to identify key issues and restoration opportunities in the Tucannon watershed. The meeting was held on March 5-6, 2002. All of the material generated during this meeting was incorporated into the watershed report. It was appended to the report to preserve the record of interaction between the FWAT and IDT.

This chapter integrates issues and opportunities from the watershed assessment in order to focus restoration activities in the Tucannon watershed. Referenced as a blueprint of management opportunities, it will serve to guide planning efforts on the District well into the future. A joint meeting between the Forest Watershed Assessment Team (FWAT) and the Pomeroy District Interdisciplinary Team (IDT) resulted in a consolidated list of issues and opportunities for the watershed. With the many opportunities available for all resources in the watershed, the group felt it was important to also provide some focus to restoration in the area. As a result, the group identified four major resource areas to prioritize management in the watershed. Finally, to guide the District toward restoration of the Tucannon watershed, a general management strategy was developed from the issues, opportunities and emphasis areas identified at the meeting in Pomeroy.

ISSUES and CONCERNS

Roads

- Roads continue to contribute sediment and create some channel instability.
- Roads and trails serve as a conduit for noxious weeds.
- Some roads still have crossings that might be barriers to fish passage.
- Are open road densities below 2.0-miles/sq. mi. by subwatershed?

Grazing

- Will be put in hydrology: -number of AUM's and current grazing strategies.

Vegetation

- Are forest products going to be a result of any activities?
- Fifty-five percent of upland forest stands are overstocked, threatening long-term sustainability.
- Encroaching vegetation due to fire suppression has significantly reduced a large grass/shrub component of the watershed.
- Fire suppression has also reduced the ponderosa pine/western larch/lodgepole pine component of the watershed (HRV).
- Fire suppression has also affected the overall structure of stands, i.e. less single story ponderosa pine/western larch, and much more multi-storied structural stands.

- Preserve/protect/increase native plant associations and their habitats. Includes other vegetative species such as forbs, shrubs, grasses, aspen, western white pine, etc.
- Invasive species have taken over native habitats.

Riparian/Stream System

- Riparian ecosystems are not in-sync with historical stream and flood-plane characteristics and past native vegetation. The overall function of the system is being adversely affected.
- The human environment and societal expectations have greatly affected the main stem of the Tucannon and Pataha subwatersheds.

Water Quality

- Current water quality (temperature/sediment) is not at optimum conditions, especially in the lower and parts of the middle main stem.

Wildlife

- Lack of distribution and small patch sizes of late old structure.
- Sustain quality and quantity of big game winter range and bighorn sheep habitat.
- Elk satisfactory cover may be below forest plan standards.
- Sustain threatened and endangered species (i.e. lynx) habitat.
- Strive to reduce a downward trend in sensitive wildlife species of interest present as well.

Noxious Weeds

- Noxious weeds are infesting native plant communities, especially along travel corridors.
- Exotic plant species are also infesting native plant communities, especially along travel corridors.

Heritage Resources

- Protect and preserve significant historic properties.

Geology and Soils

- A large percentage of the watershed has a high erosion hazard rating.
- Management activities could negatively affect high productivity soils.
- Is there a safety or water quality issue with known adits?

Fish

- Strive to recover four T&E listed fish in the Tucannon Watershed.
- Strive to reduce a downward trend in sensitive fish species of interest present as well.

Fuels Management

- Ladder and down woody fuels are increasing the fire hazard and potential catastrophic conditions across the watershed.
- If catastrophic wildfire were to occur, current trends would result in high costs for suppression and high risk to private landowners and current infrastructure.

Recreation

- Conflicting uses between recovery strategies, and developed and dispersed recreation use.

Opportunities for Restoration

The following opportunities for restoration activities were brainstormed during the March 6th meeting in Pomeroy. The opportunities for restoration are a direct response to the issues and concerns identified in the previous section. Resource assessments in the watershed analysis and knowledge of on-the-ground conditions, by District personnel, support the opportunity for implementation in the watersheds.

Roads

- Find opportunities to reduce sediment and accelerated flows (which protects channel stability). This would include assuring culvert size is adequate, drainage is functioning properly, cut slope stability and surfacing is appropriate and functional.
- Find methods to reduce the "conduit effect" of roads and trails for noxious weed spread.
- Look at opportunities to reduce introduction of noxious weeds in an overall strategy (i.e. washing vehicles, weed free hay) through the NEPA process and consider incorporating spraying known and anticipated infestations.
- Check all live water crossings (culverts) to make sure they are fish passable.
- Look at opportunities to reduce any road densities (by subwatershed) if they exceed Forest Plan guidelines of 2.0 miles open road/square mile.
- For revegetating open/disturbed areas, utilize native seeds/shrubs when possible.
- Look at opportunities to decommission roads no longer needed for the long-term transportation system.
- Look at opportunities to look at existing roads for relocation (i.e. roads adjacent to live water, or overly-steep/poorly-located).
- Pave the Tucannon river road from Camp Wooten to Panjab.

Grazing

- Continue to look for opportunities to establish good habitat and water on the upslope to keep grazing cattle out of riparian areas.
- Tucannon (upper and lower) pastures and Maloney pastures have not been grazed since 1994. Look at opportunities to bring that issue to closure to keep cattle grazing out of the Tucannon River riparian bottoms.

Vegetation

- Consider pre-commercial and commercial thinning from below to reduce overstocked stands. This would help stands be more resilient against populations of insect and disease.
- Look at opportunities for "improvement cutting" to take multi-storied old structured stands back to single story old structure stands, especially on drier sites favoring ponderosa pine.
- Understory removal might be used in younger stands, especially on drier sites, to "set them up" to become larger diameter old structure stands. This would help stands be more resilient against populations of insect and disease.
- Consider opportunities to reduce "vegetation encroachment" in historically grass/shrub habitats. Look at area north of Panjab creek and Tucannon River junction.
- Look for opportunities to re-introduce and inventory (GIS layers) native plant associations such as white pine, aspen, grasses, shrubs, etc.
- Consider looking at secondary forage areas for lynx and see if there might be opportunities to push them back toward primary forage (especially in the head end of the Tucannon River drainage).
- Are there opportunities to provide continuous supplies of forest products (posts, poles, firewood, mushrooms, berries, etc.).

Riparian/Stream Systems

- Consider mapping and classifying the existing riparian vegetation.
- The TEUI process is considering the mapping of existing riparian vegetation, but the process in floundering due to lack of and funding. Contracts are already ongoing; the only thing needed is dollars.
- Look at increasing shade and streamside vegetation with appropriate native vegetation to maintain bank stability and create sediment storage capabilities. This would include noxious weed control, increasing the diversity of native vegetation, and other practices.
- Eliminate and/or modify infrastructure in riparian areas (i.e. roads, trails, campgrounds, dikes, etc.).
- Look at old campsites we have already moved for potential native plant community revegetation opportunities.
- Set up a tracking system to check effectiveness monitoring of ongoing/already accomplished in-stream structures.

Water Quality

- Other described actions can improve overall water quality.
- There may be other important recommendations that result from reviewing existing monitoring data and comparing it with past/existing conditions to determine if there are opportunities to further improve water quality monitoring.
- Continue systematic BMP monitoring.

Wildlife

- Look at opportunities to expand or create large patch sizes of late old structure (at least 200 acres in size). Also consider distributing more of it across the entire watershed.
- Utilize prescribed fire to increase the quality and quantity of winter range for bighorn sheep.
- For lynx, look at opportunities to expand primary lodgepole pine foraging habitat.
- Look for opportunities to create additional watering developments (ponds/guzzlers) for cattle, big game and upland birds.
- Monitor snag and down wood densities and compare to Forest Plan standards. Establish a post activity monitoring protocol.
- Work with the Washington State DFWS to create co-management prescriptions across the northern end of the analysis area.
- Look at grass/tree mosaic vegetation types to determine if there has been a reduction in habitat conditions.

Noxious Weeds

- Identify opportunities to work cooperatively with all other private; state and federal land manage agencies in the Tucannon to reduce existing and established populations.
- Place within each site-specific NEPA project an aggressive noxious weed plan to allow for chemical treatment.

Heritage Resources

- Identify and survey gaps and attempt to complete field surveys for the entire watershed.
- Identify any site rehabilitation work necessary from the field surveys (i.e. Tucannon guard station).
- Work with local communities to develop opportunities for heritage/environmental education programs.

Geology and Soils

- Pursue/encourage the completion of the TEUI inventory process on the District.
- Identify potential site-specific problem areas that may be currently compacted, displaced, unstable or eroding.
- Look for opportunities to rehabilitate meadows (both dry and wet) across the watershed. This would include removing conifer encroachment, reseeding with native grasses/forbs/shrubs, or adding soil building materials to dry scab meadows.
- Target high productivity site areas for optimizing vegetative growth potentials.
- Survey old mine sites for safety hazards and/or bats.

Fisheries

- Overall incorporate by reference the draft bull trout recovery plan for the Pataha and Tucannon subwatershed as completed by the USFWS in 3/2002.
- Collaboratively assist (dollars) local model watershed groups with restoration of species in the watershed and across the Forest (i.e. Wyden Amendment).

- Seek opportunities to cooperatively (i.e. WDFW, NMFS, TU, etc.) education publics and users.
- Conduct effectiveness monitoring on past activities (i.e. BMP's) in the watershed.
- Assess current and past management activities and their effects on recovering fish populations and aquatic habitat.

Fuels Management

- Tie to vegetation section in looking at ladder fuels reduction and thinning opportunities.
- Consider reintroduction of historical fire cycles through prescribed fire.
- Create management plans to protect private and federal infrastructure in the Tucannon watershed (i.e. fish hatchery, summer cabins, guard stations, Camp Wooten, etc.). Goes both ways as we have old growth values needing protection just east of Camp Wooten.
- Develop fuels management plans to consider fuels breaks on ridgetops to facilitate prescribed fire lines, wildfire control points and possible incorporation of native plant management objectives.

Recreation

- Look for dispersed recreation opportunities away from riparian areas.
- Promote environmental education programs (i.e. Respect the River).
- Promote more recreational education (i.e. additional kiosk's).
- Re-evaluate existing recreational facilities that were exempt the first go around to determine effects on fish.
- Look at potential to develop recreational opportunities, reduce summer stream flow temperatures, maintain constant stream flows, initiate local hydropower, develop concessionaire opportunities by creating a concrete reservoir at Columbia center.
- Assess recreational residences for water quality, permit compliance, and general usage.
- Assess winter recreational activities and infrastructure that supports that program (snow-parks with connecting trails).
- Work with local ORV groups to develop long-term trail systems or use areas that facilitate needs, but minimize effects to other resources.
- Are their potential opportunities to actually develop more facilities to accommodate people with disabilities and sight seeing?
- Assess the closure of Tucannon river road from highway use to motorized recreation from Panjab creek to sheep creek.
- Assess changing entry to Camp Wooten, re-introduce Hixon creek to original stream course and look at any other opportunities to improve floodplain values.

Botany

- Continue survey efforts to include the Wenaha Tucannon Wilderness and Tucannon River bottom.
- Identify and map native plant seed sources.
- Continue opportunities to combine seed orchard infrastructure with native plant propagation.

Restoration Emphasis Areas

Four resource areas selected to emphasize and prioritize resource activities in the watershed follow. In addition, objective statements provided for each area will help guide management actions in the watershed.

Vegetation

- Promote ecosystem integrity, resilience and sustainability by adjusting vegetation (all) structure and composition.

Riparian/Aquatics/Water Quality

- Restore ecosystem structure, function and biophysical components of riparian/aquatics by managing the vegetation and other elements to promote natural processes.

Recreation

- Provide for a diverse array of recreational opportunities to forest users while balancing the competing uses of natural resources.

Transportation Management

- Provide for public access while integrating and protecting other resource considerations in the watershed.

Tucannon Watershed Management Strategy

The following management strategy was developed by the FWAT and the District IDT to guide management actions in the Tucannon watershed.

> Integrate land management activities to maximize watershed health through implementation of a combination of strategies. This includes actions that lead to ecosystem integrity throughout the watershed. Tools and methods that may be used included prescribed fire, commercial and non-commercial treatments to manipulate upland vegetation, riparian and aquatic ecosystem enhancement, transportation management, recreation feasibility assessment, incorporating local and social values, tribal and collaborative partnerships, and existing laws, regulations and policy.

APPENDIX B: CONSIDERATIONS FOR SUSTAINING LATE/OLD FOREST STRUCTURAL STAGES AT THE LANDSCAPE SCALE.

Management Direction for LOS

In the Land and Resource Management Plan (Umatilla National Forest 1990), old growth tree habitat is managed through dedicated forested units, managed lodgepole stands, riparian areas, and unroaded areas distributed throughout the Forest. The dedicated old growth units are in mixed conifer and ponderosa pine types that have been identified and mapped as Management Area C1. Lodgepole pine habitat units are identified and managed according to the specifications listed in Management Area C2. In addition, the Forest Plan protects existing old growth/mature habitat in Management Areas A1, A2, A7, A8, C3A, C7, C8, D2, F2, and F4 (roadless, riparian, and other suitable areas outside wilderness). The old growth/mature habitat on the Forest is managed for those species with a strong affinity for that habitat condition (i.e. pileated woodpecker, marten, three-toed woodpecker, etc.). The size of old growth stands varies by management indicator species (MIS): pileated woodpecker, 300 acres; pine marten, 160 acres; and northern three-toed woodpecker, 75 acres. The distribution of stands differs for dedicated and managed stands, but average spacing is every 5 miles across the Forest. Units did not need to meet old growth/mature conditions at the time of selection. Forest-wide standards for old growth include the following: maintain habitat within suitable and/or capable conditions for the MIS, maintain the distribution of units throughout the Forest, and maintain sufficient amounts for (other) wildlife species. Essential to the management of old growth is field verification and tracking of units, stands, and surrounding areas.

The Regional Forester's Forest Plan Amendment #2 (Forest Service 1995) also provides direction for managing late and old structure. The direction, referred to as the "Eastside Screens," requires the Forest to analyze the Historical Range of Variability (HRV) at the watershed scale. This analysis characterizes the difference in percent composition of the structural stages between HRV and current conditions for each biophysical environment. The HRV condition determines potential treatment areas.

When LOS stages fall below HRV for a particular biophysical group within a watershed, then there should be not net loss of LOS from that group. Timber harvest can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS for the biophysical group. Harvest activities are allowed outside of LOS, with the intent to maintain and/or enhance LOS components in stands, provided the follow standards are met: 1) Maintain all remnant late and old seral and structural live trees >21" dbh currently within the stand. 2) Manipulate vegetative structure in a manner to move it toward a condition to meet HRV. 3) Maintain open park-like stands conditions, where they occurred historically. Maintain connectivity and reduce fragmentation of LOS stand by adhering to the following standards. Maintain or enhance the current level of connectivity between LOS stands and between Forest Plan "old growth" management areas, by maintaining stands between them to serve the purpose of connectivity. LOS stands and designated "old growth" stands need to be connected with each other inside the watershed and outside the watershed, in a contiguous network pattern by at least two different directions. Connectivity corridor-stands are those where medium diameter or larger trees are common, and canopy closures are within the top one-third of site potential. Stand widths should be at least 400 feet wide at their narrowest point. The length of the connectivity corridor depends on the distance between LOS/"old growth" stands. The Eastside Screens (Regional Forester's Amendment #2) provides additional standards and guidance for managing LOS stages for other HRV scenarios.

Current LOS Situation

A variety of wildlife species on the Forest appear to demonstrate a high level of use and dependence on mature and old growth tree habitat. Past harvest activities have removed much of the suitable old growth tree habitat once found on the Forest. Based on historic records and current habitat assessments, the size and arrangement of late/old forest has declined greatly since 1936. Historic late/old forests typically occurred in large patches, contained a large amount of interior habitat, connected to similar habitats, and generally occupied more than 50 percent of the forested area. Current late/old forests generally occur in small patches, contain little interior habitat, are widely scattered patches, seldom connect to similar habitats, and occupy less than 20 percent of the forested area. The remaining stands of LOS are not uniformly or evenly distributed across the landscape.

The management of old growth habitat for wildlife species and other values continues to be an issue of controversy. Various public interests are divided on the amount of old growth habitat to retain on the Forest. A number of individuals have expressed concern about reductions of old growth/mature tree habitat. Based on this controversy and the current condition of old forest stands, one of the driving objective of forest management is to restore late/old forest conditions at the landscape scale and across the Forest.

Proposed LOS Strategy

Overall, the goal is to manage for a late and old forest condition well within the Historic Range of Variability (HRV) of the watershed. The following objectives lead to the restoration of the Late and/or Old Structural component in the watershed.

- Maintain existing LOS units/stands.
- Expand the LOS component in the watershed.
- Increase the patch size of LOS stands.
- Utilize existing LOS direction to implement the strategy.

Implementation

The purpose of this strategy is to increase the amount of late and old structure in the watershed as soon as possible and to restore this component firmly within the HRV. In order to have a significant and lasting affect on the watershed, the structural composition needs to be enough (acreage) to make a difference in the watershed and provide habitat for viable populations. By obtaining a moderate level of LOS stage restoration, a reasonable stockpile of LOS would be available to buffer the erosion of LOS stages in the watershed due to natural disturbance (insect, disease, fire, etc.), harvest, and normal stand dynamics. Once stands have developed, structural diversity in the watershed would resemble a more "desirable" condition. With a more diverse structural component, the watershed would be more receptive to an array of cultural treatments increasing management options throughout the watershed. Targeting a moderate level of restoration also provides a firm foundation for the re-establishment of old growth habitat and wildlife species associated with LOS in the watershed and across the Forest. Maintaining the LOS component at a moderate level puts the District in a better position to manage the LOS component, once "optimal" levels are established (at some point in time). In addition, maintaining a moderate level of LOS stage hedges the likelihood of going back and increasing the amount of LOS in the future if restoration were to occur at a lower level. Managing LOS at lower level essentially maintains the status quo in the watershed limiting management's flexibility, and potentially impeding the recovery of ecosystem processes and function.

Table B-1 identifies the amount of LOS to restore in the Tucannon watershed. The HRV Mid-point in the Table is simply a rounded value derived from the mean of the two extreme values of the historic range for the two structural stages. The HRV Mid-point value is the restoration objective for maintaining LOS stages at the moderate level. The Restoration Objective is the targeted acres to move and maintain the LOS stage in the watershed. If possible, a restoration objective less than 150 acres, for any PAG, should be joined with a similar potential vegetation groups (PVG (i.e. Cold Forest, Moist Forest, Dry Forest, etc.)) in order to reduce the number of fragmented stands, increase interior habitat, and to approximate historic patch size.

Table B-1. Restoration objectives for LOS stages in the Tucannon watershed.

		Old Forest Multi Strata			Old Forest Single Stratum		
Potential Vegetation Group	Plant Association Group	Historic Range of Variability	HRV Mid-point	Tucannon Restoration Objective (acres)	Historic Range of Variability	HRV Mid-point	Tucannon Restoration Objective (acres)
Cold	Cold, Moist	20-60 %	25%	636	0-5 %	4%	102
	Cold, Dry	10-40 %			0-5 %		
	Cool, Dry	1-20 %			1-10 %		
Moist	Cool, Wet	30-60 %	29%	10,996	0-5 %	3%	1,137
	Cool, Very Moist	20-40 %			0-5 %		
	Cool, Moist	10-30 %			0-5 %		
	Warm, Very Moist	20-40 %			0-5 %		
	Warm, Moist	10-30 %			0-5 %		
Dry	Warm, Dry	5-20 %	12%	3,497	15-55 %	40%	11,656
	Hot, Dry	5-15 %			20-70 %		
Total		N/A	N/A	15,129	N/A	N/A	12,807

Implementing objectives are address anytime a project proposal develops in the watershed. At that time, stands will be selected/identified, in order to fully attain, the restoration objective for the watershed (Table B-1). Efforts would then focus on maintaining the existing LOS condition and/or moving stands toward an LOS condition as soon as possible.

Initially, all existing old forest patches or stands (old forest single strata or old forest multi stratum) are selected and conserved from anthropogenic disturbances such as timber harvest so they can serve as a corner stone for future networks. Then existing stands/patches can be used as stepping-stones to increase the quantity and improve the quality of LOS in the watershed. Forest Plan old growth units (C1 or C2) can be included if their existing condition is near an old forest condition.

To expand the LOS component in the watershed identify "new" stands or building off existing stands to meet the restoration objective identified in Table B-1. Mid-to late-seral patches (understory reinitiation and young forest multi strata stands), in close proximity to existing old forest patches can be selected as potential replacements. The mid-to late-seral patches should be examined on the ground to determine which old forest attributes they currently have, and to determine if cultural activities (thinning, etc.) could promote missing attributes more quickly than would occur by doing nothing. The distribution of desired future patch should be identified and determined if young-seral stands (stand initiation and stem exclusion), located on a desirable spacing could be cultured (thinned, etc.) to produce old forest attributes more quickly than would occur by less aggressive treatments. When identifying candidates for future old forest multi strata, stands should be selected that have the highest potential to survive to the old forest stage – namely areas on north facing aspects and at high elevations, particularly if they occur within valley bottoms and drainage headwalls. The predicted location of semi-stable environmental setting could be modeled using criteria described by Camp and others (1997).

In order to maximize interior habitat and mimic historic patch sizes large LOS patches/stands need to be developed. The intent is to create old forest patches/stands at least 300 acres in size, with their length not be more than 1.5 times their width. Where feasible, the focus should be on increasing the LOS component adjacent to LOS stands in order to obtain a larger patch size.

Apply the existing standards and guidelines in the Forest Plan and "Eastside Screens" to implement this strategy and manage LOS and old growth stands identified or selected in the watershed. LOS stands and old growth habitat needs to be connected with each other inside the watershed as well as to like stands in adjacent watersheds in a continuous network pattern by at least two different directions. Connective habitat consists of stands where medium (>10" DBH) or large (>20" DBH) diameter trees are common, and canopy closure is within the top one-third of the site potential. Connective stands should be at least 400 feet wide at their narrowest point, but a more desirable width of 800 to 1,200 feet is preferred.

Monitoring

All stands identified as LOS stands or targeted for LOS development will be verified by ground-truthing to determine current and potential condition. Current LOS stands and stands selected for development to a LOS condition will be identified in the stand database as such. The stand condition will be updated and tracked periodically in the database. Stands should be reviewed after cultural treatments and 3-5 years after treatments to evaluate the effects of treatment on the stand. A map showing existing and potential LOS stages and habitat connectivity in the watershed will be developed. The map should be available as needed and particularly during the development phase of the project.

APPENDIX C: PLANT TAXA WITHIN THE ANALYSIS AREA

The following table identifies the present taxa known from the analysis area. Species are organized alphabetically by life forms: F=forbs; G=grasses; G-L=grass-likes; S= shrubs; and T=trees.

Native status is indicated last with N=native to North America, and I=introduced from off continent.

Table C-1: List of 708 plant taxa found within the Tucannon analysis area to date

Scientific Name	Common name	Life form	Native status
Achillea millefolium	common yarrow	F	N
Aconitum columbianum	Columbia monkshood	F	N
Aconitum columbianum s. columbianum	Columbia monkshood	F	N
Actaea rubra	wild red baneberry	F	N
Adenocaulon bicolor	trail plant	F	N
Adiantum aleuticum	maidenhair fern	F	N
Agastache urticifolia	nettleleaf horsemint	F	N
Agoseris aurantiaca	orange agoseris	F	N
Agoseris glauca	pale agoseris	F	N
Agoseris grandiflora	large-flower agoseris	F	N
Agoseris heterophylla	annual agoseris	F	N
Allium douglasii	Douglas' onion	F	N
Allium fibrillum	fringed onion	F	N
Allium macrum	rock onion	F	N
Allium madidum	Blue Mountain swamp onion	F	N
Allium tolmiei tolmiei	Tolmie's onion	F	N
Alyssum alyssoides	pale alyssum	F	I
Amaranthus albus	white tumbleweed	F	I
Anaphalis margaritacea	common pearlyeverlasting	F	N
Anemone piperi	windflower	F	N
Angelica arguta	sharptooth angelica	F	N
Antennaria anaphaloides	tall pussytoes	F	N
Antennaria dimorpha	low pussytoes	F	N
Antennaria howellii s. howellii	field pussytoes	F	N
Antennaria luzuloides	woodrush pussytoes	F	N
Antennaria racemosa	raceme pussytoes	F	N
Antennaria rosea	rosy pussytoes	F	N
Antennaria stenophylla	narrow-leaf pussytoes	F	N
Antennaria umbrinella	umber pussytoes	F	N
Anthemis cotula	mayweed chamomile	F	I
Apocynum androsaemifolium	spreading dogbane	F	N
Apocynum cannabinum	hemp dogbane	F	N
Aquilegia formosa	Sitka columbine	F	N
Arabis divaricarpa	spreadingpod rockcress	F	N
Arabis glabra	tower mustard	F	N
Arabis hirsuta	hairy rockcress	F	N
Arabis holboellii	Holboell's rockcress	F	N

Scientific Name	Common name	Life form	Native status
Arabis lemmonii	Lemmon's rockcress	F	N
Arabis microphylla	littleleaf rockcress	F	N
Arabis sparsiflora	sicklepod rockcress	F	N
Arceuthobium campylopodum	western dwarf mistletoe	F	N
Arceuthobium douglasii	Douglas dwarf mistletoe	F	N
Arctium minus	common burdock	F	I
Arenaria aculeata	prickly sandwort	F	N
Arenaria capillaris	mountain sandwort	F	N
Arenaria congesta	ballhead sandwort	F	N
Arenaria congesta cephaloidea	ballhead sandwort	F	N
Arenaria congesta congesta	ballhead sandwort	F	N
Arenaria serpyllifolia	thyme-leaf sandwort	F	I
Arnica amplexicaulis	streambank arnica	F	N
Arnica cordifolia	heartleaf arnica	F	N
Arnica fulgens	orange arnica	F	N
Arnica latifolia	mountain arnica	F	N
Arnica mollis	hairy arnica	F	N
Arnica sororia	twin arnica	F	N
Artemisia douglasiana	Douglas' sagebrush	F	N
Artemisia ludoviciana	prairie sage	F	N
Artemisia ludoviciana s. ludoviciana	prairie sagebrush	F	N
Asarum caudatum	wild ginger	F	N
Aspidotis densa	pod fern	F	N
Astragalus canadensis	Canada milkvetch	F	N
Astragalus reventus	Blue Mountain milkvetch	F	N
Astragalus whitneyi	balloon pod milkvetch	F	N
Astragalus whitneyi sonneanus	balloon pod milkvetch	F	N
Athyrium filix-femina	lady fern	F	N
Athysanus pusillus	sandweed	F	N
Balsamorhiza careyana	Carey's balsamroot	F	N
Balsamorhiza incana	woolly balsamroot	F	N
Balsamorhiza sagittata	arrowleaf balsamroot	F	N
Balsamorhiza serrata	serrated balsamroot	F	N
Barbarea orthoceras	American wintercress	F	N
Besseya rubra	red kittentail	F	N
Blepharipappus scaber	blepharipappus	F	N
Buglossoides arvensis	corn gromwell	F	I
Calochortus elegans	northwestern Mariposa	F	N
Calochortus eurycarpus	bigpod Mariposa	F	N
Calochortus nitidus	broadfruit Mariposa lily	F	N
Calypso bulbosa	calypso orchid	F	N
Camassia quamash	common camas	F	N
Camelina microcarpa	littlepod falseflax	F	I
Campanula rotundifolia	Scotch bluebells	F	N
Capsella bursa-pastoris	shepherd's purse	F	I
Cardamine cordifolia lyallii	large mountain bittercress	F	N
Cardamine oligosperma	little western bittercress	F	N
Castilleja cusickii	Cusick's paintbrush	F	N
Castilleja hispida	harsh paintbrush	F	N
Castilleja miniata	scarlet paintbrush	F	N
Castilleja tenuis	hairy owl clover	F	N
Centaurea biebersteinii	spotted knapweed	F	I

Scientific Name	Common name	Life form	Native status
Centaurea cyanus	bachelor's button	F	I
Centaurea diffusa	diffuse knapweed	F	I
Centaurea solstitialis	yellow star thistle	F	I
Cerastium arvense	starry cerastium	F	N
Cerastium fontanum s. vulgare	mouse-ear chickweed	F	I
Cerastium glomeratum	sticky cerastium	F	N
Cerastium nutans	nodding chickweed	F	N
Chaenactis douglasii douglasii	hoary chaenactis	F	N
Chamerion angustifolium s. circumvagum	fireweed	F	N
Cheilanthes gracillima	lace lip-fern	F	N
Cichorium intybus	chicory	F	I
Cicuta douglasii	Douglas' waterhemlock	F	N
Circaea alpina	enchanter's nightshade	F	N
Cirsium arvense	Canada thistle	F	I
Cirsium vulgare	bull thistle	F	I
Clarkia pulchella	deerhorn	F	N
Clarkia rhomboidea	common clarkia	F	N
Claytonia cordifolia	heart-leaved minerslettuce	F	N
Claytonia lanceolata lanceolata	western springbeauty	F	N
Claytonia perfoliata s. perfoliata v. perfoliata	minerslettuce	F	N
Claytonia sibirica sibirica	Siberian minerslettuce	F	N
Clematis hirsutissima	sugarbowls	F	N
Clintonia uniflora	queen's cup beadlily	F	N
Collinsia parviflora	small-flowered blue-eyed Mary	F	N
Collomia grandiflora	large-flowered collomia	F	N
Collomia linearis	narrow-leaf collomia	F	N
Comandra umbellata	common comandra	F	N
Corallorrhiza maculata	spotted coral root	F	N
Corallorrhiza striata	striped coral root	F	N
Corallorrhiza trifida	yellow coral root	F	N
Cornus canadensis	bunchberry	F	N
Crepis acuminata	long-leaved hawksbeard	F	N
Crepis atribarba	slender hawksbeard	F	N
Crepis atribarba ssp. originalis	slender hawksbeard	F	N
Crepis occidentalis	western hawksbeard	F	N
Cryptantha flaccida	beaked cryptantha	F	N
Cryptantha intermedia	common cryptantha	F	N
Cryptantha pterocarya	winged cryptantha	F	N
Cryptantha torreyana	Torrey's cryptantha	F	N
Cryptantha watsonii	Watson's cryptantha	F	N
Cynoglossum officinale	common houndstongue	F	I
Cypripedium fasciculatum	clustered lady slipper	F	N
Cypripedium montanum	mountain lady slipper	F	N
Cystopteris fragilis	brittle bladderfern	F	N
Daucus carota	Queen Anne's lace	F	I
Delphinium burkei	Burke's larkspur	F	N
Delphinium depauperatum	slim larkspur	F	N
Delphinium nuttallianum	upland larkspur	F	N
Delphinium occidentale	western larkspur	F	N
Descurainia incana	mountain tansymustard	F	N
Descurainia pinnata	pinnate tansymustard	F	N

Scientific Name	Common name	Life form	Native status
Descurainia sophia	flixweed tansymustard	F	N
Dianthus armeria	Deptford pink	F	I
Dicentra cucullaria	dutchman's breeches	F	N
Dicentra uniflora	steer's head	F	N
Dipsacus fullonum	teasel	F	I
Disporum hookeri	Hooker's fairybell	F	N
Disporum trachycarpum	wartberry fairybell	F	N
Dodecatheon conjugens	slimpod shootingstar	F	N
Dodecatheon jeffreyi	tall mountain shooting star	F	N
Dodecatheon pulchellum s. cusickii	Cusick's shootingstar	F	N
Draba praealta	tall draba	F	N
Draba verna	spring whitlow-grass	F	N
Dryopteris expansa	spreading woodfern	F	N
Dryopteris filix-mas	male fern	F	N
Epilobium anagallidifolium	alpine willow-herb	F	N
Epilobium brachycarpum	tall annual willow-herb	F	N
Epilobium ciliatum s. glandulosum	common willow-herb	F	N
Epilobium ciliatum s. watsonii	Watson's willow-herb	F	N
Epilobium glaberrimum	smooth willow-herb	F	N
Epilobium lactiflorum	alpine willow-herb	F	N
Epilobium minutum	small-flowered willow-herb	F	N
Epilobium palustre	swamp willow-herb	F	N
Equisetum arvense	common horsetail	F	N
Equisetum hyemale	common scouringrush	F	N
Equisetum laevigatum	smooth horsetail	F	N
Equisetum telmateia braunii	giant horsetail	F	N
Equisetum variegatum	northern scouringrush	F	N
Erigeron bloomeri	scabland fleabane	F	N
Erigeron bloomeri bloomeri	scabland fleabane	F	N
Erigeron chrysopsidis	dwarf yellow fleabane	F	N
Erigeron disparipilus	Snake River daisy	F	N
Erigeron eatonii	Eaton's daisy	F	N
Erigeron filifolius	threadleaf fleabane	F	N
Erigeron linearis	lineleaf fleabane	F	N
Erigeron peregrinus s. callianthemus	subalpine daisy	F	N
Erigeron pumilus	low fleabane	F	N
Eriogonum douglasii	Douglas buckwheat	F	N
Eriogonum flavum	yellow buckwheat	F	N
Eriogonum heracleoides	Wyeth's creamy buckwheat	F	N
Eriogonum ovalifolium	cushion buckwheat	F	N
Eriogonum strictum	strict buckwheat	F	N
Eriogonum umbellatum	sulphur buckwheat	F	N
Eriogonum umbellatum ellipticum	sulphur buckwheat	F	N
Eriogonum vimineum	broom buckwheat	F	N
Erodium cicutarium	stork's bill	F	I
Erysimum capitatum capitatum	plains erysimum	F	N
Erysimum occidentale	pale wallflower	F	N
Erythronium grandiflorum	fawnlily	F	N
Floerkea proserpinacoides	false mermaid	F	N
Fragaria vesca	woods strawberry	F	N
Fragaria virginiana	blueleaf strawberry	F	N
Frasera fastigiata	clustered frasera	F	N

Scientific Name	Common name	Life form	Native status
Fritillaria atropurpurea	checker lily	F	N
Fritillaria pudica	yellow bell	F	N
Gaillardia aristata	blanketflower	F	N
Galium aparine	catchweed bedstraw	F	N
Galium bifolium	thinleaf bedstraw	F	N
Galium boreale	northern bedstraw	F	N
Galium mexicanum s. asperulum	rough bedstraw	F	N
Galium multiflorum	shrubby bedstraw	F	N
Galium triflorum	sweetscented bedstraw	F	N
Gayophytum racemosum	racemed groundsmoke	F	N
Gentianella amarella s. acuta	northern gentian	F	N
Geranium bicknellii	Bicknell's geranium	F	N
Geranium molle	dovefoot geranium	F	I
Geranium pusillum	small-flowered crane's bill	F	I
Geum macrophyllum	largeleaf avens	F	N
Geum triflorum ciliatum	red avens	F	N
Gilia capillaris	smoothleaved gilia	F	N
Gnaphalium palustre	lowland cudweed	F	N
Goodyera oblongifolia	rattlesnake-plantain	F	N
Grindelia nana	low gumweed	F	N
Gymnocarpium disjunctum	oak fern	F	N
Hackelia diffusa	diffuse stickseed	F	N
Hackelia hispida hispida	rough stickseed	F	N
Hackelia micrantha	blue stickseed	F	N
Helianthella uniflora	oneflower helianthella	F	N
Heracleum maximum	common cowparsnip	F	N
Hesperochiron pumilus	centaur flower	F	N
Heterocodon rariflorum	heterocodon	F	N
Heuchera cylindrica	roundleaf lava alumroot	F	N
Heuchera micrantha	smallflower alumroot	F	N
Hieracium albiflorum	white hawkweed	F	N
Hieracium cynoglossoides	houndstongue hawkweed	F	N
Hieracium gracile	slender hawkweed	F	N
Hieracium scouleri	woolly weed	F	N
Holosteum umbellatum	jagged chickweed	F	I
Horkelia fusca	tawny horkelia	F	N
Hydrophyllum capitatum	ballhead waterleaf	F	N
Hydrophyllum fendleri	Fendler's waterleaf	F	N
Hypericum perforatum	Klamathweed	F	I
Idahoa scapigera	scalepod	F	N
Iliamna rivularis	streambank globemallow	F	N
Impatiens aurella	jewelweed	F	I
Ipomopsis aggregata s. aggregata	skyrocket gilia	F	N
Iris missouriensis	western blue flag	F	N
Ivesia gordonii	Gordon's ivesia	F	N
Lactuca serriola	prickly lettuce	F	I
Lagophylla ramosissima	slender rabbitleaf	F	N
Lathyrus lanszwertii	thickleaf peavine	F	N
Lathyrus nevadensis	Sierra peavine	F	N
Lemna minor	duckweed	F	N
Leucanthemum vulgare	oxeye daisy	F	I
Lewisia pygmaea	dwarf lewisia	F	N

Scientific Name	Common name	Life form	Native status
Lewisia triphylla	three leaf lewisia	F	N
Ligusticum canbyi	Canby licoriceroot	F	N
Linanthus harknessii	Harkness' linanthus	F	N
Linaria dalmatica	bastard toadflax	F	I
Linum lewisii lewisii	blue flax	F	N
Listera caurina	western twayblade	F	N
Listera convallarioides	broadlipped twayblade	F	N
Listera cordata	heartleaf twayblade	F	N
Lithophragma glabrum	bulbiferous fringecup	F	N
Lithophragma parviflorum	small-flowered fringecup	F	N
Lithospermum ruderale	wayside gromwell	F	N
Lomatium ambiguum	Wyeth biscuitroot	F	N
Lomatium bicolor leptocarpum	slenderfruit lomatium	F	N
Lomatium cous	cous biscuitroot	F	N
Lomatium dissectum	fernleaved desert parsley	F	N
Lomatium gormanii	Gorman's bicuitroot	F	N
Lomatium grayi	Gray's desert parsley	F	N
Lomatium macrocarpum	big seed biscuitroot	F	N
Lomatium minus	John Day Valley desert parsley	F	N
Lomatium triternatum	nineleaf desert parsley	F	N
Lotus unifoliolatus unifoliolatus	Spanish clover	F	N
Lupinus argenteus	silvery lupine	F	N
Lupinus aridus s. aridus	prairie lupine	F	N
Lupinus burkei s. burkei	Burke's lupine	F	N
Lupinus caudatus	tailcup lupine	F	N
Lupinus garfieldensis	Asotin lupine	F	N
Lupinus lepidus	prairie lupine	F	N
Lupinus leucophyllus	velvet lupine	F	N
Lupinus sericeus	silky lupine	F	N
Lupinus sulphureus	sulphur lupine	F	N
Madia citriodora	lemon tarweed	F	N
Madia glomerata	cluster tarweed	F	N
Madia gracilis	common tarweed	F	N
Madia minima	small-head tarweed	F	N
Maianthemum racemosum	feather Solomonplume	F	N
Maianthemum stellatum	starry false Solomon's seal	F	N
Matricaria discoidea	pineapple weed	F	N
Medicago lupulina	black medic	F	I
Medicago sativa	alfalfa	F	I
Medicago sativa s. falcata	yellow lucerne	F	I
Melilotus officinalis	white sweetclover	F	I
Mentha arvensis	field mint	F	N
Mentzelia albicaulis	whitestem mentzelia	F	N
Mentzelia dispersa	bushy mentzelia	F	N
Mertensia ciliata	broad-leaf bluebells	F	N
Mertensia longiflora	small bluebells	F	N
Mertensia oblongifolia	oblongleaf bluebells	F	N
Mertensia paniculata	tall bluebells	F	N
Microseris nutans	nodding microseris	F	N
Mimulus breviflorus	short-flowered mimulus	F	N
Mimulus breweri	Brewer's monkeyflower	F	N
Mimulus floribundus	purple-stem monkeyflower	F	N

Scientific Name	Common name	Life form	Native status
Mimulus guttatus	common monkeyflower	F	N
Mimulus moschatus	musk monkeyflower	F	N
Mimulus nanus	dwarf monkeyflower	F	N
Mimulus primuloides	primrose monkeyflower	F	N
Minuartia rubella	reddish sandwort	F	N
Mitella breweri	Brewer mitrewort	F	N
Mitella caulescens	leafy mitrewort	F	N
Mitella pentandra	five stamen mitrewort	F	N
Mitella stauropetala	side-flowered mitrewort	F	N
Moehringia macrophylla	bigleaf sandwort	F	N
Monardella odoratissima	Pacific monardella	F	N
Moneses uniflora s. uniflora	woodnymph	F	N
Monotropa hypopithys	pinesap	F	N
Monotropa uniflora	Indian pipe	F	N
Montia linearis	lineleaf Indianlettuce	F	N
Myosotis discolor	yellow and blue forget-me-not	F	N
Myosotis scorpioides	common forget-me-not	F	I
Myosotis stricta	blue scorpion-grass	F	N
Navarretia intertexta	needleleaf navarretia	F	N
Navarretia intertexta s. intertexta	needleleaf navarretia	F	N
Navarretia intertexta s. propinqua	needle-leaf navarretia	F	N
Nemophila breviflora	Great Basin nemophila	F	N
Nemophila parviflora	smallflower nemophila	F	N
Nothocalais troximoides	false agoseris	F	N
Olsynium douglasii inflatum	grass widow	F	N
Onopordum acanthium	cottonthistle	F	I
Orobanche pinorum	pine broomrape	F	N
Orobanche uniflora	oneflowered broomrape	F	N
Orogenia linearifolia	linear-leaved orogenia	F	N
Orthilia secunda	sidebells pyrola	F	N
Orthocarpus tenuifolius	owl clover	F	N
Osmorhiza berteroi	mountain sweet-cicely	F	N
Osmorhiza depauperata	bluntfruited sweet-cicely	F	N
Osmorhiza occidentalis	western sweet-cicely	F	N
Paeonia brownii	Brown's paeony	F	N
Parietaria pensylvanica	pellitory	F	N
Pedicularis bracteosa pachyrhiza	bracted lousewort	F	N
Pedicularis contorta	coiled parrot's beak	F	N
Pedicularis contorta contorta	coiled pedicularis	F	N
Pedicularis racemosa	leafy/sickletop lousewort	F	N
Pedicularis racemosa s. alba	leafy/sickletop lousewort	F	N
Penstemon attenuatus	sulphur penstemon	F	N
Penstemon davidsonii	Davidson's penstemon	F	N
Penstemon deustus	hot rock penstemon	F	N
Penstemon fruticosus	shrub penstemon	F	N
Penstemon gairdneri	Gairdner's penstemon	F	N
Penstemon pennellianus	Pennell's penstemon	F	N
Penstemon procerus	littleflower penstemon	F	N
Penstemon rydbergii	Rydberg's penstemon	F	N
Penstemon venustus	Blue Mountain penstemon	F	N
Perideridia bolanderi	Bolander's yampah	F	N
Perideridia gairdneri	Gairdner's yampah	F	N

Scientific Name	Common name	Life form	Native status
Petasites frigidus	sweet coltsfoot	F	N
Petasites frigidus palmatus	sweet coltsfoot	F	N
Phacelia hastata	whiteleaf phacelia	F	N
Phacelia hastata hastata	alpine scorpionweed	F	N
Phacelia heterophylla	varileaf phacelia	F	N
Phacelia linearis	threadleaf phacelia	F	N
Phlox caespitosa	tufted phlox	F	N
Phlox gracilis s. gracilis	pink microsteris	F	N
Phlox longifolia	long-leaved phlox	F	N
Phlox viscida	sticky phlox	F	N
Phoenicaulis cheiranthoides	daggerpod	F	N
Piperia elegans	California hillside habenaria	F	N
Piperia unalascensis	Alaska rein orchid	F	N
Plagiobothrys scouleri	Scouler's popcornflower	F	N
Plantago lanceolata	buckhorn plantain	F	I
Plantago major	nippleseed plantain	F	I
Plantago patagonica	Patagonia Indianwheat	F	N
Platanthera dilatata dilatata	white bog orchid	F	N
Platanthera stricta	slender bog orchid	F	N
Plectritis macrocera	longhorn plectritis	F	N
Polemonium micranthum	littlebells polemonium	F	N
Polemonium pulcherrimum	showy polemomium	F	N
Polygonum aviculare	prostrate knotweed	F	N
Polygonum bistortoides	American bistort	F	N
Polygonum douglasii	Douglas' knotweed	F	N
Polygonum douglasii s. majus	wiry knotweed	F	N
Polygonum douglasii s. spergulariiforme	fall knotweed	F	N
Polygonum minimum	leafy dwarf knotweed	F	N
Polygonum polygaloides	polygala knotweed	F	N
Polygonum polygaloides s. kelloggii	Kellogg's knotweed	F	N
Polystichum andersonii	Anderson's swordfern	F	N
Polystichum lonchitis	mountain hollyfern	F	N
Polystichum munitum	common swordfern	F	N
Poplygonum polygaloides s. confertiflorum	closeflowered knotweed	F	N
Potentilla glandulosa s. glandulosa	gland cinquefoil	F	N
Potentilla glandulosa s. pseudorupestris	sticky/gland cinquefoil	F	N
Potentilla gracilis	northwest cinquefoil	F	N
Potentilla gracilis fastigiata	Nuttall cinquefoil	F	N
Potentilla gracilis flabelliformis	slender cinquefoil	F	N
Potentilla pectinisecta	Elmer's cinquefoil	F	N
Potentilla recta	erect cinquefoil	F	I
Prunella vulgaris	common selfheal	F	N
Prunella vulgaris s. lanceolata	selfheal	F	N
Pseudognaphalium stramineum	cotton-batting plant	F	N
Pteridium aquilinum	bracken fern	F	N
Pterospora andromedea	woodland pinedrops	F	N
Pteryxia terebinthina foeniculacea	turpentine cymopterus	F	N
Pyrola asarifolia	common wintergreen	F	N
Pyrola chlorantha	green pyrola	F	N
Pyrola minor	snowline pyrola	F	N
Pyrola picta	leafless pyrola	F	N
Pyrrocoma carthamoides carthamoides	large-flowered goldenweed	F	N

Scientific Name	Common name	Life form	Native status
Pyrrocoma hirta hirta	sticky goldenweed	F	N
Ranunculus acris	meadow buttercup	F	I
Ranunculus aquatilis	white water buttercup	F	N
Ranunculus glaberrimus	sagebrush buttercup	F	N
Ranunculus glaberrimus ellipticus	sagebrush buttercup	F	N
Ranunculus occidentalis	western buttercup	F	N
Ranunculus orthorhynchus	straightbeak buttercup	F	N
Ranunculus uncinatus	wood buttercup	F	N
Ranunculus uncinatus parviflorus	woodland buttercup	F	N
Ranunculus uncinatus uncinatus	wood buttercup	F	N
Rorippa nasturtium-aquaticum	watercress	F	N
Rudbeckia occidentalis	blackhead	F	N
Rumex acetosa	garden sorrel	F	I
Rumex acetosella	sheep sorrel	F	I
Rumex aquaticus fenestratus	western dock	F	N
Rumex crispus	curly dock	F	I
Rumex obtusifolius	broad-leaved dock	F	I
Rumex salicifolius	willow dock	F	N
Sagina saginoides	alpine pearlwort	F	N
Sanguisorba minor	garden burnet	F	I
Sanguisorba occidentalis	annual burnet	F	N
Saxifraga integrifolia	swamp saxifrage	F	N
Saxifraga mertensiana	Merten's saxifrage	F	N
Saxifraga nidifica nidifica	swamp saxifrage	F	N
Saxifraga odontoloma	brook saxifrage	F	N
Scleranthus annuus	knotgrass	F	I
Scrophularia lanceolata	lanceleaf figwort	F	N
Scutellaria angustifolia	narrowleaved skullcap	F	N
Scutellaria antirrhinoides	snapdragon skullcap	F	N
Sedum lanceolatum	lanceleaf stonecrop	F	N
Sedum stenopetalum	wormleaf stonecrop	F	N
Selaginella densa	compact selaginella	F	N
Senecio canus	woolly groundsel	F	N
Senecio crassulus	thickleaf groundsel	F	N
Senecio hydrophiloides	sweetmarsh butterweed	F	N
Senecio integerrimus	western groundsel	F	N
Senecio jacobaea	tansy ragwort	F	I
Senecio serra	butterweed groundsel	F	N
Senecio triangularis	arrowleaf groundsel	F	N
Sidalcea oregana s. oregana v. procera	Oregon checkermallow	F	N
Silene douglasii douglasii	Douglas' silene	F	N
Silene menziesii	Menzies' silene	F	N
Silene oregana	Oregon catchfly	F	N
Sisymbrium altissimum	tumblemustard	F	I
Sisymbrium loeselii	Loesel tumblemustard	F	I
Solidago canadensis	meadow goldenrod	F	N
Solidago gigantea	smooth goldenrod	F	N
Spergularia rubra	red sandspurry	F	I
Stellaria borealis s. sitchana	Bongard's starwort	F	N
Stellaria crispa	crisped starwort	F	N
Stellaria longifolia	longleaved starwort	F	N
Stellaria longipes	longstalk starwort	F	N

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Stellaria media	chickweed	F	I
Stellaria nitens	shining chickweed	F	N
Stellaria obtusa	bluntsepaled starwort	F	N
Stenanthium occidentale	western stenanthium	F	N
Stenotus lanuginosus lanuginosus	woolly goldenweed	F	N
Stephanomeria tenuifolia tenuifolia	bush wirelettuce	F	N
Streptopus amplexifolius	claspleaf twistedstalk	F	N
Synthyris missurica	blue kittentails	F	N
Synthyris missurica s. missurica	blue kittentails	F	N
Tanacetum vulgare	common tansy	F	I
Taraxacum laevigatum	smooth dandelion	F	I
Taraxacum officinale	common dandelion	F	I
Thalictrum fendleri	Fendler's meadowrue	F	N
Thalictrum occidentale	western meadowrue	F	N
Thermopsis rhombifolia montana	mountain thermopsis	F	N
Thlaspi arvense	field pennycress	F	I
Thlaspi montanum montanum	blue pennycress	F	N
Thysanocarpus curvipes	fringe pod	F	N
Tiarella trifoliata	coolwort foamflower	F	N
Tiarella trifoliata unifoliata	coolwort foamflower	F	N
Tragopogon dubius	yellow salsify	F	I
Tragopogon pratensis	meadow salsify	F	I
Trautvetteria caroliniensis	false bugbane	F	N
Trifolium aureum	yellow clover	F	I
Trifolium cyathiferum	cup clover	F	N
Trifolium dubium	suckling clover	F	I
Trifolium eriocephalum	woollyhead clover	F	N
Trifolium hybridum	alsike clover	F	I
Trifolium latifolium	twin clover	F	N
Trifolium longipes	longstalk clover	F	N
Trifolium macrocephalum	bighead clover	F	N
Trifolium pratense	red clover	F	I
Trifolium repens	white clover	F	I
Trillium ovatum	white trillium	F	N
Trillium petiolatum	purple trillium	F	N
Triteleia grandiflora	Douglas' brodiaea	F	N
Typha latifolia	common cattail	F	N
Urtica dioica	stinging nettle	F	N
Urtica dioica s. gracilis	stinging nettle	F	N
Valeriana scouleri	Scouler's valerian	F	N
Valeriana sitchensis	Sitka valerian	F	N
Valerianella locusta	European corn salad	F	I
Veratrum californicum	California falsehellebore	F	N
Veratrum viride	green falsehellebore	F	N
Verbascum blattaria	moth mullein	F	I
Verbascum thapsus	flannel mullein	F	I
Veronica americana	American speedwell	F	N
Veronica anagallis-aquatica	water speedwell	F	I
Veronica arvensis	common speedwell	F	I
Veronica peregrina s. xalapensis	purslane speedwell	F	N
Veronica serpyllifolia	thyme-leaved speedwell	F	N
Veronica serpyllifolia s. humifusa	thymeleaf speedwell	F	N

Scientific Name	Common name	Life form	Native status
Vicia americana	American vetch	F	N
Vicia americana s. americana	American vetch	F	N
Viola adunca	early blue violet	F	N
Viola glabella	stream violet	F	N
Viola orbiculata	darkwoods violet	F	N
Woodsia oregana	Oregon woodsia	F	N
Woodsia scopulina	Rocky Mountain woodsia	F	N
Wyethia amplexicaulis	mule's ears	F	N
Zigadenus paniculatus	panicled death camas	F	N
Zigadenus venenosus	meadow death camas	F	N
Zigadenus venenosus gramineus	meadow death camas	F	N
Achnatherum lemmonii lemmonii	Lemmon's needlegrass	G	N
Achnatherum occidentale s. occidentale	western needlegrass	G	N
Agrostis exarata	spike bentgrass	G	N
Agrostis gigantea	redtop	G	I
Agrostis scabra	winter bentgrass	G	N
Agrostis stolonifera	redtop	G	I
Agrostis thurberiana	Thurber bentgrass	G	N
Alopecurus aequalis	shortawn foxtail	G	N
Alopecurus pratensis	meadow foxtail	G	I
Arrhenatherum elatius	tall oatgrass	G	I
Bromus briziformis	rattlesnake brome	G	I
Bromus carinatus	mountain brome	G	N
Bromus commutatus	hairy brome	G	I
Bromus hordeaceus s. hordeaceus	soft brome	G	I
Bromus inermis	smooth brome	G	I
Bromus inermis s. inermis	smooth brome	G	I
Bromus japonicus	Japanese brome	G	I
Bromus tectorum	cheatgrass brome	G	I
Bromus vulgaris	Columbia brome	G	N
Calamagrostis rubescens	pinegrass	G	N
Cinna latifolia	drooping woodreed	G	N
Dactylis glomerata	orchard grass	G	I
Danthonia intermedia	timber oatgrass	G	N
Danthonia unispicata	onespike oatgrass	G	N
Deschampsia danthonioides	annual hairgrass	G	N
Deschampsia elongata	slender hairgrass	G	N
Elymus elymoides	bottlebrush squirreltail	G	N
Elymus glaucus	blue wildrye	G	N
Elymus glaucus s. glaucus	blue wildrye	G	N
Elymus glaucus s. jepsonii	blue wildrye	G	N
Elymus lanceolatus s. lanceolatus	thickspike wheatgrass	G	N
Elymus trachycaulus s. trachycaulus	fairway crested wheatgrass	G	N
Elytrigia intermedia	pubescent wheatgrass	G	I
Eragrostis cilianensis	stinkgrass	G	I
Festuca campestris	rough fescue	G	N
Festuca idahoensis	Idaho fescue	G	N
Festuca occidentalis	western fescue	G	N
Festuca ovina	sheep fescue	G	N
Festuca rubra	red fescue	G	N
Festuca subulata	bearded fescue	G	N
Festuca viridula	green fescue	G	N

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Glyceria elata	tall mannagrass	G	N
Glyceria grandis	American mannagrass	G	N
Glyceria striata	fowl mannagrass	G	N
Koeleria macrantha	prairie junegrass	G	N
Lolium arundinaceum	tall fescue	G	I
Lolium perenne	perennial ryegrass	G	I
Melica bulbosa	oniongrass	G	N
Melica spectabilis	showy oniongrass	G	N
Melica subulata	Alaska oniongrass	G	N
Phleum pratense	common timothy	G	I
Poa annua	annual bluegrass	G	I
Poa bulbosa	bulbous bluegrass	G	I
Poa compressa	Canada bluegrass	G	I
Poa leibergii	Leiberg's bluegrass	G	N
Poa leptocoma	bog bluegrass	G	N
Poa palustris	fowl bluegrass	G	I
Poa pratensis	Kentucky bluegrass	G	I
Poa secunda	slender bluegrass	G	N
Poa trivialis	roughstalk bluegrass	G	I
Poa wheeleri	Wheeler's bluegrass	G	N
Pseudoroegneria spicata s. inermis	beardless bluebunch wheatgrass	G	I
Pseudoroegneria spicata s. spicata	bluebunch wheatgrass	G	N
Torreyochloa pallida pauciflora	weak alkaligrass	G	N
Trisetum spicatum	downy oatgrass	G	N
Ventenata dubia	ventenata	G	I
Vulpia bromoides	six-week fescue	G	I
Vulpia microstachys microstachys	small fescue	G	I
Vulpia myuros	rattail fescue	G	N
Carex amplifolia	big leaved sedge	G-L	N
Carex aquatilis	water sedge	G-L	N
Carex athrostachya	slender-beaked sedge	G-L	N
Carex backii	Back's sedge	G-L	N
Carex concinnoides	northwest sedge	G-L	N
Carex deweyana	Dewey's sedge	G-L	N
Carex disperma	soft-leaved sedge	G-L	N
Carex filifolia	threadleaf sedge	G-L	N
Carex geyeri	elk sedge	G-L	N
Carex hoodii	Hood's sedge	G-L	N
Carex laeviculmis	smooth-stemmed sedge	G-L	N
Carex lenticularis	densely tufted sedge	G-L	N
Carex lenticularis lenticularis	densely tufted sedge	G-L	N
Carex microptera	small-winged sedge	G-L	N
Carex multicostata	many ribbed sedge	G-L	N
Carex pachystachya	thick-headed sedge	G-L	N
Carex petasata	Liddon's sedge	G-L	N
Carex raynoldsii	Raynold's sedge	G-L	N
Carex rossii	Ross sedge	G-L	N
Carex stipata	sawbeak sedge	G-L	N
Carex vulpinoidea	fox sedge	G-L	N
Eleocharis acicularis	needle spike-rush	G-L	N
Juncus balticus	Baltic rush	G-L	N
Juncus bufonius bufonius	toad rush	G-L	N

Scientific Name	Common name	Life form	Native status
Juncus effusus var. conglomeratus	bog rush	G-L	N
Juncus ensifolius	swordleaf rush	G-L	N
Juncus longistylis	long-styled rush	G-L	N
Juncus orthophyllus	straight-leaved rush	G-L	N
Juncus parryi	Parry rush	G-L	N
Juncus tenuis	slender rush	G-L	N
Luzula campestris	field woodrush	G-L	N
Luzula parviflora	small-flowered woodrush	G-L	N
Luzula spicata	spike woodrush	G-L	N
Scirpus microcarpus	panicled bulrush	G-L	N
Alnus incana	mountain alder	S	N
Alnus viridis s. sinuata	Sitka alder	S	N
Amelanchier alnifolia	western serviceberry	S	N
Amelanchier alnifolia alnifolia	Saskatoon serviceberry	S	N
Arctostaphylos nevadensis	pinemat manzanita	S	N
Arctostaphylos uva-ursi	bearberry	S	N
Artemisia rigida	stiff sagebrush	S	N
Artemisia tridentata	big sagebrush	S	N
Artemisia tridentata s. vaseyana	mountain big sagebrush	S	N
Ceanothus integerrimus	deerbrush ceanothus	S	N
Ceanothus sanguineus	redstem ceanothus	S	N
Ceanothus velutinus	snowbrush ceanothus	S	N
Cercocarpus ledifolius	curlleaf mountain mahogany	S	N
Chimaphila menziesii	little prince's pine	S	N
Chimaphila umbellata	common prince's pine	S	N
Chrysothamnus viscidiflorus	green rabbitbrush	S	N
Clematis columbiana	Columbia virgin's bower	S	N
Clematis ligusticifolia	western virginsbower	S	N
Cornus sericea s. sericea	red osier dogwood	S	N
Crataegus douglasii	black hawthorn	S	N
Ericameria nauseosa s. nauseosa v. nana	gray rabbitbrush	S	N
Gaultheria humifusa	western wintergreen	S	N
Holodiscus discolor	creambush oceanspray	S	N
Linnaea borealis	American twinflower	S	N
Lonicera ciliosa	western trumpet honeysuckle	S	N
Lonicera involucrata	bearberry honeysuckle	S	N
Lonicera utahensis	Utah honeysuckle	S	N
Mahonia repens	low Oregongrape	S	N
Menziesia ferruginea	fool's huckleberry	S	N
Oplopanax horridus	devil's club	S	N
Paxistima myrsinites	Oregon boxwood	S	N
Philadelphus lewisii	Lewis mockorange	S	N
Physocarpus capitatus	Pacific ninebark	S	N
Physocarpus malvaceus	mallow ninebark	S	N
Prunus emarginata	bittercherry	S	N
Prunus virginiana	common chokecherry	S	N
Rhamnus alnifolia	alder-leaved buckthorn	S	N
Ribes cereum cereum	wax currant	S	N
Ribes hudsonianum	stinking currant	S	N
Ribes lacustre	prickly currant	S	N
Ribes oxyacanthoides s. cognatum	Umatilla gooseberry	S	N
Ribes oxyacanthoides s. irriguum	Idaho gooseberry	S	N

Scientific Name	Common name	Life form	Native status
Ribes viscosissimum	sticky currant	S	N
Ribes wolfii	Wenaha currant	S	N
Rosa eglanteria	sweetbriar	S	I
Rosa gymnocarpa	baldhip rose	S	N
Rosa nutkana	Nootka rose	S	N
Rosa woodsii	Wood's rose	S	N
Rubus discolor	Himalayan blackberry	S	I
Rubus idaeus	red raspberry	S	N
Rubus laciniatus	evergreen blackberry	S	I
Rubus leucodermis	whitebark raspberry	S	N
Rubus parviflorus	western thimbleberry	S	N
Rubus ursinus	Pacific blackberry	S	N
Salix amygdaloides	peachleaf willow	S	N
Salix commutata	undergreen willow	S	N
Salix exigua	coyote willow	S	N
Salix lucida s. caudata	whiplash willow	S	N
Salix lucida s. lasiandra	Pacific willow	S	N
Salix scouleriana	Scouler willow	S	N
Salix sitchensis	Sitka willow	S	N
Sambucus nigra s. cerulea	blueberry elder	S	N
Sambucus racemosa	black elderberry	S	N
Sorbus scopulina	Cascade mountain ash	S	N
Spiraea betulifolia	birch spiraea	S	N
Symphoricarpos albus	common snowberry	S	N
Symphoricarpos oreophilus	mountain snowberry	S	N
Syringa vulgaris	lilac	S	I
Vaccinium membranaceum	big huckleberry	S	N
Vaccinium myrtillus	dwarf whortleberry	S	N
Vaccinium scoparium	grouse huckleberry	S	N
Abies grandis	grand fir	T	N
Abies lasiocarpa	subalpine fir	T	N
Acer glabrum douglasii	Rocky Mountain maple	T	N
Alnus rhombifolia	white alder	T	N
Alnus rubra	red alder	T	N
Betula occidentalis	red birch	T	N
Frangula purshiana	cascara	T	N
Juniperus occidentalis	western juniper	T	N
Larix occidentalis	western larch	T	N
Picea engelmannii	Engelmann spruce	T	N
Pinus contorta	lodgepole pine	T	N
Pinus monticola	western white pine	T	N
Pinus ponderosa	ponderosa pine	T	N
Populus balsamifera s. trichocarpa	black cottonwood	T	N
Populus tremuloides	quaking aspen	T	N
Pseudotsuga menziesii	Douglas fir	T	N
Robinia pseudoacacia	black locust	T	I
Taxus brevifolia	Pacific yew	T	N
Ulmus americana	American elm	T	N