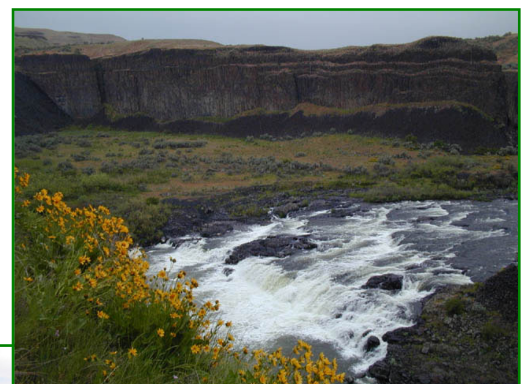
Palouse Subbasin Management Plan

FINAL DRAFT ~ May 2004



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i. Introduction

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i. Introduction

The Palouse subbasin management plan was developed as part of the rolling provincial review process developed by the Northwest Power and Conservation Council (NWPCC) for each of the 62 subbasins in the Columbia River Basin. Subbasin plans will be reviewed and adopted into the NWPCC's Columbia Fish and Wildlife Program to help direct Bonneville Power Administration (BPA) funding of projects aimed at protection, mitigation and enhancement of fish and wildlife habitats adversely impacted by the development and operation of the Columbia River hydropower system. The NWPCC, BPA, and the US Fish and Wildlife Service (USFWS) intend to use subbasin plans to help meet the requirements of the 2000 Federal Columbia River Power System Biological Opinion. The subbasin plan is also intended to provide a resource for use by USFWS as a part of threatened and endangered species recovery planning.

Initial planning began with the designation of Palouse-Rock Lake Conservation District (PRLCD) as the lead entity. In June 2003, the PRLCD was awarded a budget of $29,635 to develop the Palouse subbasin management plan.

The lead entity's responsibility, serving as a contractor to the NWPCC, was to initiate the planning process. The manager of PRLCD, Trevor Cook, served as the subbasin coordinator. The subbasin coordinator provided leadership throughout the process, served as a contact point, and coordinated communication between various stakeholders and interested parties. PRLCD subcontracted with Resource Planning Unlimited, Inc. (RPU) in June 2003 to facilitate the planning process, write and edit management plan components.

To enable a coordinated ecosystem-based approach to fish and wildlife habitat protection and restoration efforts, the PRLCD convened the Palouse subbasin Technical Team (Technical Team). The Technical Team is comprised of fish and wildlife agency representatives with jurisdictional authority within the Palouse subbasin. These team members assisted in developing all sections of the plan, including the assessment; inventory; and management. A Palouse subbasin Working Group (Working Group) was developed by PRLCD. The Working Group was comprised of representatives from fish and wildlife habitat interests throughout the Palouse subbasin. (Technical Team and Working Group members listed in Appendix E.)

Two methods of plan development were used to craft the Palouse subbasin management plan and accompanying components; group meetings and individual meetings. Beginning in October 2003, draft documents were sent via electronic mail to Technical Team and Working Group members on three occasions, providing an opportunity to assist and comment in developing an inventory of past and ongoing projects, defining critical issues, recommending guiding principles, and identified alternative solutions. Along with the draft document distributions were accompanying meetings which were held to review and contribute to plan development. Meetings were held on three occasions throughout the planning process with all meetings open to the public. Agency and public participation in group meetings and document review was limited; however, in addition to Technical Committee meetings, individual meetings were held between Technical Team members, subbasin coordinator and the contractor to review and revise the plan. The individual contacts, in addition to the group sessions, were effective for revising draft documents for submittal, review and comments.

The Palouse subbasin management plan is comprised of three parts; the Assessment, Inventory, and Management Plan. The three components are interdependent, while each plays a unique role in understanding the characteristics, management history, and visions for the future of the Palouse subbasin. The Palouse subbasin management plan's components include:

- Assessment: The assessment characterizes historic and current biophysical conditions in the Palouse subbasin. It represents an interdisciplinary effort by multiple agencies to provide necessary technical information to guide actions to restore and conserve fish and wildlife habitat within the Palouse subbasin. The assessment provides the analysis and background information to support the recommendations made in the Palouse subbasin management plan.

- Inventory: The inventory includes information on existing fish and wildlife protection, restoration, artificial production activities, and management plans within the subbasin. The inventory provides an overview of the management context, including existing resources for protection and restoration in the subbasin.

- Management Plan: The management plan includes a vision for the future of the Palouse subbasin, objectives and strategies for reaching management goals. Research, monitoring and evaluation needs are also addressed in this section.

Palouse Subbasin Management Plan

1. Assessment

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1. Assessment

1.1 The Palouse Subbasin Of The Past

Forces deep within buckled the earth's crust. Upward shifting of giant slabs of granite were forced even higher. This was the beginning to the geological uplift, volcanic activity, erosion and flooding that created the Palouse region.

Remnants of this massive uplift are still visible in the mountains and buttes of the eastern portion of the basin. Following the mountain uplift, volcanoes erupted about 10-30 million years ago. Early lava flows filled the valleys and subsequently covered most of the high hills and eventually formed a near solid sea of basalt. A few hills protruded through the basalt around the edges of the lava field.

Then the dust storms started. Widespread wind erosion occurred in eastern Washington and Oregon. Wild blown soils covered the lava fields with deposits as thick as 200 feet. Prevailing southwest winds left loess deposits in dune-like shapes. These hills have gentle south and west facing slopes, and many north and east slopes were left with steep and short slopes. All but the highest buttes and mountains of the eastern subbasin were buried by these deposits. This was the Palouse of over 100,000 years ago.

The southbound movement and melting of glaciers and ice fields in southern British Columbia created ice dams in the valleys, forming massive lakes. When ice dams burst, the released water swept away the loess material and soil was scoured down to the lava field floor. This "floor" of basalt, a dense crystalline lava, covers more than 100,000 square miles in parts of Washington, Idaho and Oregon.

Figure 1. Rolling Palouse hills.

The number of catastrophic floods were estimated to range from 10 to the 100s. One such catastrophic flood, the Spokane Flood, left its mark along a course of more than 550 miles, extending from western Montana to the Pacific Ocean. Ice dams impounded water in Glacial Lake Missoula, which covered an area of more than 3,000 square miles. As the ice dams failed, the lake drained at a rate unmatched by any flood known, and the water had only one place to go—south and southward across the Rathdrum Prairie and down the Spokane Valley. Estimated to flow at a rate of 45 miles per hour, a series of floods reached the lava field. The water turbulence provided the erosional energy to sweep away much of the loess and expose the jointed basalt underneath. The most spectacular flood feature was the resulting Channeled Scablands. The part of the lava field that underlies the Scablands in eastern Washington is a saucer-shaped area of about 15,000 square miles almost completely surrounded by mountains and nearly encircled by three rivers—the Columbia, the Spokane, and the Snake Rivers.

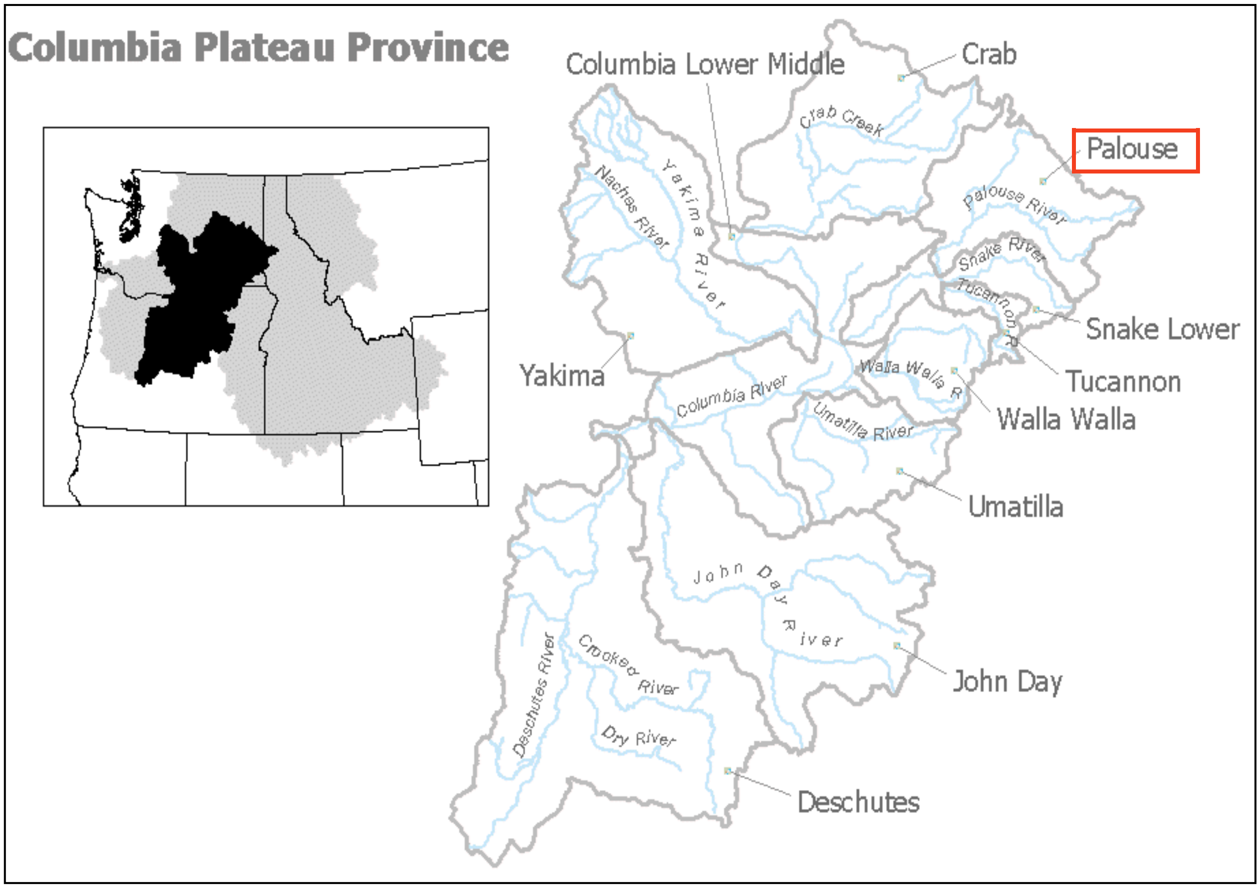
1.2 The Present Day Palouse Subbasin

1.2.1 General Description

The Palouse subbasin is located within the Columbia Plateau Province. Within the subbasin, the Palouse River and its tributaries drain an area encompassing over 2 million acres. Of the overall 2,114,000 acres, approximately 17% of the Palouse subbasin lies in Idaho, primarily within Latah County. In Washington, the majority of the subbasin lies in Whitman County with lesser amounts (approximately 25%) occurring in Adams County to the west, and Spokane County to the north.

The Palouse River originates in the Palouse Mountain Range within the St. Joe National Forest northeast of Moscow, Idaho and flows in a westerly direction into eastern Washington, south of Spokane. The Palouse River then winds through the rolling farm ground of Latah and Whitman Counties before it enters the Snake River at the Whitman/Franklin County line.

Figure 2. Palouse Subbasin within the Columbia Plateau Province



High, massive mountains and deep intermountain valleys characterize the eastern portion of the subbasin that lies in the Northern Rocky Mountains of Idaho. The topography is rugged with heavily timbered, steep sided ridges and rounded peaks. Precambrian metasedimentary and metamorphic rocks underlie the mountainous portions, and intrusions of granitic deposits also exist.

Major valleys in the eastern part of the subbasin are filled with alluvial deposits, while the majority of the rest of the subbasin is composed primarily of basalt covered by a thick layer of wind blown loess. The hills are characterized by gently sloping south and west facing slopes, and short steep north and east slopes.

The most western portion of the basin contains the Channeled Scablands. These lands were formed when large ice dams in Montana broke releasing massive torrents of water that crossed the Palouse Region approximately 150,000 years ago (Spokane Flood). These huge flood events scoured the soil from the land, leaving behind channelized exposed basalt with islands of loess soil not swept away by the floods.

The northern portion of the watershed consist primarily of the Cheney/Palouse Flood Tract of the Channeled Scablands. It is characterized by relatively flat topography, shallow soils and exposed basalt, and numerous shallow depressions and channels containing wetlands and small tributary streams. The Turnbull National Wildlife Refuge is located there.

Elevations in the forested headwaters reign over 5,300 feet above sea level. One of the watershed's unique features is the climate. There is an approximate 7-inch increase in mean annual precipitation with each 1,000 foot rise in elevation. As much as 50 inches of mean annual precipitation occurs in the forestlands near the eastern boundary, and as low as 10 inches near the western border. Snow normally comprises 60-70% of the total annual precipitation at higher elevations and 40% of the annual precipitation at the lower forestland elevations in the headwaters and middle reaches of the watershed. Annual precipitation decreases with decreasing elevation as the stream travels in a west, southwest direction. Precipitation is light during summer and increases in fall, reaching a peak in winter months.

1.2.2 Land Use and Land Ownership

According to Ashley and Stovall (2003b), major land uses in the Palouse subbasin include agriculture, livestock grazing, and suburban development. Livestock grazing occurs largely in the channeled scablands in the western portion of the subbasin.

Private lands followed by state, federal, county, and city ownership dominate land ownership. There are two cities with populations over 10,000 (Moscow, Idaho and Pullman, Washington), one city with a population over 3,000 (Colfax), 10 towns with populations over 200, and more than a dozen smaller communities.

1.2.3 Jurisdictional Authorities

1.2.3.1 Indian Tribes

Indian tribal areas of interest are displayed in the Upper Columbia River Basin Draft Environmental Impact Statement (1997). That document defines the following three tribes as having an area of interest within portions of the Palouse subbasin: Coeur d'Alene Tribe, Nez Perce Tribe, and Spokane Tribe.

1.2.3.2 Whitman County Ordinances

A Washington state law was passed by the legislature in 1990 and amended in 1991 that addresses the negative consequences of unprecedented population growth and suburban sprawl in Washington. The Growth Management Act requires all cities and counties in the state to do planning and has more extensive requirements for the largest and fastest-growing counties and cities in the state. Its requirements include guaranteeing the consistency of transportation and capital facilities plans with land use plans.

Several county ordinances affect land use in Whitman County, including:

- Zoning
- Subdivision
- State Environmental Policy Act
- Shorelines Management Act
- Flood Hazard Areas
- Wetlands
- Fish and Wildlife Habitat Conservation Areas
- Critical Aquifer Recharge Area Designation and Protection

In addition, towns and other public water suppliers implement Well-Head Protection Areas that extends the influence of the Aquifer Protection Ordinance. With the Growth Management Act's requirement to prove adequate and potable water before issuance of a building permit or approval of a subdivision, there are some areas in Whitman County that may not be able to be developed, such as any area of granite bedrock (Bordsen 1998).

Zoning Ordinance: Whitman County Zoning Ordinance is based upon a 1978 Comprehensive Plan that encourages most development to occur within cities, towns, or designated unincorporated communities. A major reason for this ordinance is to prevent encroachment of land uses incompatible with agriculture (Bordsen 1998). Generally, the land use that is most incompatible with agriculture (and with the other use districts) is the non-farm rural residence. Both the Subdivision and Zoning Ordinances and State law combine to limit the division of the land and the construction of residences in the Agricultural District. For example, for residences, a maximum of only three lots are allowed to be created from a parent parcel. State law prohibits another land division from this subdivided area for five years from the date of the last subdivision. The minimum size of the rural residential parcel is based on County Environmental Health requirements for on-site water and sewer, usually two acres. The Zoning Ordinance allows land division and building permits on the land that has not been in commercial agricultural production for the last three years. (An exception exists for farmers who can build a residence for someone making 50% of their income from farming, but they must commit not to sell or lease this house to a non-farmer for 10 years.)

The Zoning Ordinance does allow certain kinds of development in Heavy and Light Industrial, and Heavy Commercial Districts. These tend to be, compared with the total county area, small in size. In general, when an area is zoned from agricultural to something else, the only method for setting conditions, for example, storm-water run-off, is to use the authority within the State Environmental Policy Act (SEPA) to set conditions administratively. This has been done historically when zone changes have been approved. The Conditional Use process is different from Zone Changes in that the Board of Adjustment can set conditions, such as controlling erosion and stormwater run-off, without changing the zone designation.

Subdivision Ordinance: The proposed Planned Residential Development (PRD) concept, while allowing some uses that are not now possible, could add significant control of impacts to the environment if adopted as currently proposed. The ordinance would most likely impact areas surrounding Pullman as opposed to Colfax, Palouse or Garfield.

State Environmental Policy Act: This State law requires an environmental review of almost all projects and on-project actions primarily relating to development. If a project has no significant negative impact on the environment, an administrative Determination of Non-Significance (DNS) is issued. If a project could have a significant negative impact that can be resolved through certain condition, a Mitigated Determination of Non-Significance (MDNS) is issued. If there are negative impacts that cannot be mitigated, an Environmental Impact Statement (EIS) is required. An important feature of the SEPA is that it allows opportunity for the public awareness of projects and for public input, both as comment on the administrative decision, and as a possible appeal of the administrative decision.
Shorelines Management Act

Shoreline Management Act: Each local government with "Shorelines of the State" has been required to adopt a Shorelines Management Act (SMA) ordinance. The effect of this ordinance is to restrict development within 200 feet of the ordinary high water mark of designated shoreline. The SMA applies to all marine waters, streams with a mean annual flow greater than 20 cubic feet per second, and/or lakes 20 acres or larger.

Flood Hazard Areas: The Zoning Ordinance has had a Flood Management Overlay chapter since 1984. The Federal Insurance Rate Maps (FIRM) were published in 1984. While development within a floodplain is possible, the intent of this ordinance is to discourage development in these areas (Bordsen 1998).

Wetlands Ordinance: Wetlands are protected by this ordinance. Any proposed development within 200 feet of a wetland requires that a wetland specialist evaluate the wetland. Wetlands may be one of four categories, and required buffers from wetlands range from 25 to 200 feet. It is possible to encroach into or fill a wetland, but mitigation is required. Since this ordinance was passed in 1994, it has had the effect of encouraging development to be located away from wetlands (Bordsen 1998).

Fish and Wildlife Habitat Conservation Areas: Applications for development undergo a review by sending the location to the Washington Department of Fish and Wildlife (WDFW) office, which responds by sending information from their mapped database. In this way, the county is informed if a development could impact significant habitat. As necessary, conditions can be set to protect habitat. Since Whitman County has so much land in intensive agricultural operation, habitat is usually found on steep or rocky ground, and along riparian areas and drainages (Bordsen 1998).

Critical Aquifer Recharge Area Designation and Protection: To the extent that a hydrogeologic study would find that certain areas along drainages, creeks and rivers may be critical aquifer recharge areas, this ordinance would set conditions for development that may affect those areas.

1.2.3.3 City of Pullman Growth Management Manual

The City of Pullman, Washington follows the Growth Management Manual for the City of Pullman. Chapters 3.4 addresses the classification, designation, regulation and mitigation of fish, wildlife, and plant habitat conservation areas within the city limits. Chapter 3.6 addresses the classification, designation and regulation of wetlands within the city limits.

1.2.3.4 Latah County Ordinances

The Latah County Planning and Zoning Commission oversees development in Latah County. The Palouse subbasin encompasses the majority of Latah County. Latah County has adopted land use ordinances pursuant to the authority granted in Title 67, Chapter 65, of the Idaho Code and Article 12, Section 2, of the Idaho Constitution. Land use ordinances are adopted and implemented to achieve the following goals: 1) promote the health, safety, and general welfare of the people of the respective county; 2) insure that the goals and purpose of the Idaho Local Planning Act are accomplished and facilitated; 3) fulfill the statutory mandate of Idaho Code 67-6503; and 4) control construction and uses of land which may do irreparable harm to existing buildings, uses of land, and the economic and social stability of the county.

Latah County also has a floodplain ordinance that regulates the lowest allowable elevation for construction within the floodplain. Latah County is revising the land use ordinance and if adopted as drafted will provide for setbacks from intermittent and perennial streams for winter animal feeding areas and a riparian area protection zone that will prohibit construction within 100 feet of a stream.

1.2.3.5 City of Moscow Ordinance

The City of Moscow, Idaho follows Moscow City Code. Included within the code are two water quality provisions: the Erosion and Sediment Control provisions of the Uniform Building Code (Title 7, Chapter 1); and the stormwater runoff control ordinance (Title 5, Chapter 15). Both of these provisions address nonpoint source water pollution.

1.2.3.6 Construction General Permits

The US Environmental Protection Agency (EPA) has reissued the general permit that authorizes the discharge of pollutants in stormwater discharges associated with construction activity (also known as the "construction general permit" or CGP). The CGP covers stormwater discharges associated with both small and large construction activity. Small construction activity is added in response to the Phase II Storm Water Regulations promulgated on December 8, 1999 (64 FR 68722). Specifically, the Phase II regulations add permitting requirements for stormwater discharges from construction activities that disturb from one to five acres.

1.2.4 Water Resources

1.2.4.1 Rivers and Streams

The Palouse River flows through a unique landscape originating in the Moscow Mountains of west-central Idaho's panhandle. The Palouse River and its tributaries flow freely with no major man-made impoundments existing from the headwaters to the mouth within the subbasin. The river flows southwesterly toward a deep canyon of basalt and plunges over Palouse Falls near the confluence of the Palouse and Snake Rivers. The basalt cliff occurs 6 miles from the stream's confluence with the Snake River. This unique feature to the basin is 182 feet tall.

Figure 3. Palouse River Falls

Over 398 miles of stream are included within the Palouse River drainage. The major tributaries and their representative percentage of the overall subbasin include:

- Cow Creek (20%)
- Palouse River Mainstem (15%)
- North Fork Palouse River (15%)
- Rock Creek (13%)
- Union Flat Creek (10%)
- Pine Creek (9%)
- South Fork Palouse River (9%)
- Cottonwood Creek (5%)
- Rebel Flat Creek (2%)
- Thorn Creek (2%)

Several permanent stream gauging stations within the subbasin provide current and historic records of the Palouse River and some of its major tributaries. A USGS (United States Geological Survey) gauging station indicates the North Fork Palouse River[1] (mainstem Palouse

[1] USGS gauging station (number 13345000) on North Fork Palouse River is located at latitude 46° 54'55", longitude 116° 57'00", Latah County, Hydrologic Unit 17060108, river mile 132.2.

River in Idaho) flow usually peaks during the month of March with an average stream flow of 740 cubic feet per second (cfs). This gauging station is located west of Potlatch, Idaho near the stateline and represents a drainage area of 317 square miles. Low flows of less than 15 cfs occur from August through October. However, rain and rain-on-snow events can cause large swings in stream flow, with most precipitation occurring December through June. The period of record for this gauging station includes October 1914 to September 1919, and December 1966 to present. Extremes for the period of record include a maximum discharge, 14,600 cfs on February 9, 1996, and a minimum daily discharge of 0.09 cfs on September 24, 1973.

The South Fork of the Palouse River's highest mean monthly discharge as measured at the USGS gauging station in Pullman, Washington[2] (representing a drainage area of 132 square miles) occurs in February. An average of approximately 130 cfs is historically recorded at this station, with discharges mostly less than 5 cfs from July through October. Period of record includes February 1934 through September 1942, January 1960 through September 1981, and May 2001 to present.

The long-term USGS gauging station located near the mouth of the Palouse River is located at Hooper, Washington.[3] This station reports average stream flows of approximately 1,300 cfs in March to 300 cfs in August. This gauging station captures total discharge from most of the basin (representing a drainage area of 2,500 square miles), with the exception of Cow Creek (Washington) which enters a few hundred yards downstream. Period of record includes October 1898 through March 1916, October 1951 through September 1985, October 1987 through September 1990, and October 1991 through present.

Agricultural use of water from the Palouse River and its tributaries is limited to a few sprinkler systems on land adjoining these streams, principally for supplemental irrigation of hay, pasture, and some small grains.

1.2.4.2 Lakes

The subbasin has 42 lakes that contain water throughout the year. In addition, there are numerous seasonal lakes and potholes that dry up during summer months. Most lakes are in the Rock Creek and Cow Creek watersheds. They were formed by flooding, carving and gouging of the landscape during the early ice age and glaciation periods. Many of the lakes have no outlets and are large water filled depressions with basalt bottoms. Surface areas of the lakes range from less than 20 acres to the 2,147 acres of Rock Lake. Total water surface of lakes in the subbasin is estimated at more than 8,500 acres (13 square miles).

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[2] USGS gauging station (number 13348000) on South Fork Palouse River at Pullman, Washington is located at latitude 46° 43'57", longitude 117° 10'48", Whitman County, Hydrologic Unit 17060108.
[3] USGS gauging station (number 13351000) on Palouse River at Hooper, Washington is located at latitude 46° 45'31", longitude 118° 08'52", Whitman County, Hydrologic Unit 17060108.

1.2.4.3 Ground Water

Ground water in the Palouse subbasin is pumped from two basalt aquifer systems. The basalt units are part of the Columbia River Basalt Group, which consists of thousands of feet of lava flows that cover most of eastern Washington. The primary municipal drinking water source is the deep Grande Ronde aquifer. The shallower Wanapum (Priest Rapids) aquifer is the primary water supply for rural residents of Latah County within the basin limits and in some areas of Whitman County and southern Spokane County. There are significant differences in the geology from east to west across the subbasin. The Sediments of Bovill, and Vantage interbed (sedimentary unit) become thin west of Moscow. Sedimentary interbeds within the basalt aquifers are much more abundant beneath Moscow than beneath Pullman. The Grand Ronde aquifer is deeper beneath Pullman.

1.2.5 Water Quality

Interstate waters like the Palouse River and its tributaries are required by the federal Clean Water Act to meet the receiving state's water quality standards at the state line. Both Idaho and Washington have similar standards for water quality. The Washington Department of Ecology (Ecology), and the Idaho Department of Environmental Quality (DEQ) are the respective state agencies who have adopted water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity.

Ecology and DEQ are required by Section 303(d) of the Clean Water Act to list waterbodies that do not meet surface water quality standards. Data collected by agency staff as well as data from tribal, state, local governments, and industries are used to determine whether or not a waterbody should be listed on the §303(d) list. Both DEQ and Ecology update the §303(d) list periodically for surface waters that do not meet state surface water quality standards.

Total Maximum Daily Loads (TMDLs) must be completed on §303(d) listed streams and lakes for each parameter that exceeds state water quality standards. The purpose of the TMDL is to determine the amount of pollution a waterbody can receive and still remain healthy for its intended uses, such as industrial, agriculture, drinking, recreation, and fish and aquatic habitat. Many TMDLs are required to be completed on the Palouse River and its tributaries.

In Washington, the 1998 §303(d) is the most current list, and includes streams within the Watershed Resource Inventory Area number 34 (WRIA 34) illustrated by the following list:

Stream Name	Limiting Parameters
Medical Lake	Total phosphorus
Missouri Flat Creek	Dissolved oxygen, fecal coliform bacteria
Palouse River	pH, temperature, dissolved oxygen, fecal coliform bacteria, ammonia-N dieldrin, 4,4'-DDE, PCB-1260, chromium, heptachlor epoxide
South Fork Palouse River	Temperature, pH, fecal coliform bacteria, dissolved oxygen
Paradise Creek	Fecal coliform bacteria, ammonia-N, dissolved oxygen, temperature
Pine Creek	Temperature, pH, dissolved oxygen
Rebel Flat Creek	Fecal coliform bacteria, dissolved oxygen
Rock Creek	pH, temperature
Union Flat Creek	Temperature

A TMDL for ammonia was completed on the South Fork Palouse River in 1994. The only other TMDL near completion within Washington §303(d) listed streams is the North Fork Palouse River TMDL for fecal coliform bacteria (draft 2004).

In Washington, waterbodies are assigned water quality standards to protect the stream or lake's characteristic uses. The current classification system (AA, A, B, C, and Lake Class) assigns characteristic uses to each class, with lower classes supporting fewer uses. All lakes and their feeder streams within the state are classified as Lake Class and Class AA respectively (unless otherwise specifically classified). Class AA and Class A streams in Washington State need to meet or exceed the characteristic uses of water supply; stock watering; rearing, harvesting and other fish spawning (fresh water); salmonid and other fish migration; wildlife; recreation (primary contact recreation, sport fishing, boating and aesthetic enjoyment); commerce and navigation. Class B streams need to meet or exceed the characteristic uses of water supply; stock watering; rearing, harvesting and other fish spawning (fresh water); salmonid and other fish migration; wildlife; recreation (secondary contact recreation, sport fishing, boating and aesthetic enjoyment); commerce and navigation.

Ecology is currently proposing changes to several numeric surface water quality standards as well as the classification system. The revised standards will be applied so that they support the same uses covered under the current classification structure. Current Washington state classifications[4] are displayed in the following list:

Stream Name	Washington State General Classification
Medical Lake	Lake Class
Missouri Flat Creek	Class A
Palouse River	Class B (Palouse River from mouth to South Fork Palouse River confluence at Colfax, river mile 89.6)
Palouse River	Class A
South Fork Palouse River	Class A
Paradise Creek	Class A
Pine Creek	Class A
Rebel Flat Creek	Class A
Rock Creek	Class AA (above Rock Lake), Class A (below Rock Lake)
Union Flat Creek	Class A

In Idaho, the most current §303(d) list includes the following list:

Stream Name	Limiting Parameters
Deep Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
Flannigan Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
West Fork Rock Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
Gold Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
Hatter Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
Big Creek	Bacteria, flow alteration, habitat alteration, nutrients, sediment, temperature
South Fork Palouse River	Habitat alterations, nutrients, temperature, bacteria, sediment
Cow Creek	Habitat alterations, nutrients, temperature

[4] Water Quality Standards for Surface Water of the State of Washington. Chapter 173-201A WAC (1997 version).

Big Creek, Deep Creek, Flannigan Creek, Gold Greek, Hatter Creek, and West Fork Rock Creek are on the Idaho §303(d) list with a TMDL scheduled for completion in 2004 (draft completed September 2003, Henderson 2003). Cow Creek (Idaho) and the South Fork Palouse River (Idaho portion) are on the §303(d) list with a TMDL scheduled for completion in 2004. Paradise Creek, a major tributary to the South Fork Palouse River, is the only Idaho stream in the subbasin where a TMDL implementation plan has been developed. The water quality standards violated for each of these streams includes sediment, nutrients, water temperature, and bacteria. The mainstem of the Palouse River is not listed.

Idaho DEQ defines water quality standards for a waterbody by designating the use or uses for the water body, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions. DEQ may assign or designate beneficial uses for particular Idaho waterbodies to support. These beneficial uses are identified in the Idaho water quality standards and include: aquatic life support–cold water, seasonal cold water, warm water, salmonid spawning, and modified; contact recreation–primary (swimming) and secondary (wading); water supply–domestic, agricultural, and industrial; wildlife habitats; and aesthetics. If a waterbody has not been classified, then cold water aquatic life and secondary contact recreation are used as the default designated use when waterbodies are assessed.

Designated uses include:

Water Body	Designated Uses[5]
Big Creek	Cold Water Aquatic Life, Salmonid Spawning, Secondary Contact Recreation
Deep Creek	Cold Water Aquatic Life, Secondary Contact Recreation
Flannigan Creek	Cold Water Aquatic Life, Secondary Contact Recreation
Gold Creek	Upper: Cold Water Aquatic Life, Salmonid Spawning, Secondary Contact Recreation Lower: Cold Water Aquatic Life, Secondary Contact Recreation
Hatter Creek	Cold Water Aquatic Life, Secondary Contact Recreation
Rock Creek (Idaho)	Cold Water Aquatic Life, Secondary Contact Recreation
Cow Creek	Cold Water Aquatic Life, Secondary Contact Recreation
South Fork Palouse River	Cold Water Aquatic Life, Salmonid Spawning, Secondary Contact Recreation

1.2.5.1 Point Source Contributors

The primary sources of point source pollution in the Palouse subbasin are wastewater treatment plants (WWTP). All facilities that discharge effluent into surface waters are required to operate under National Pollutant Discharge Elimination System (NPDES), a permit issued by the United States Environmental Protection Agency (EPA) or their delegates which authorizes effluent discharge and activities. Ecology is delegated by the EPA as the state water pollution control agency, responsible for implementing all federal and state water pollution control laws and regulations. Both NPDES and state permits are issued and administered by Ecology. In Idaho, the permits are issued and administered by EPA.

[5] Cold Water Aquatic Life—water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species; Salmonid Spawning—waters which provide or could provide a habitat for active self-propagating populations of salmonid fishes; Secondary Contact Recreation—water quality appropriate for recreational uses on or about the water and which are not included in the primary contact category, these activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur.

NPDES permit holders in the Washington portion of the Palouse subbasin include:

Facility Name	Permit Type	County
Albion Sewage Treatment Plant	Minor	Whitman
Colfax Sewage Treatment Plant	Minor	Whitman
Colton Sewage Treatment Plant	Minor	Whitman
Endicott Sewage Treatment Plant	Minor	Whitman
Farmington Sewage Treatment Plant	State To Ground[6]	Whitman
Garfield Sewage Treatment Plant	Minor	Whitman
Lacrosse Sewage Treatment Plant	State To Ground	Whitman
Oakesdale Sewage Treatment Plant	Minor	Whitman
Palouse Sewage Treatment Plant	Minor	Whitman
Pullman Wastewater Treatment Plant	Major[7]	Whitman
Rosalia Sewage Treatment Plant	Minor	Whitman
Sprague Sewage Treatment Plant	State To Ground	Lincoln
St John Wastewater Treatment Plant	Minor	Whitman
Steptoe Sewer District #1	State To Ground	Whitman
Sunset Mobile Home Park	State To Ground	Whitman
Uniontown Sewage Treatment Plant	State To Ground	Whitman
Wawawai/Riverview RV Park	State To Ground	Whitman
WSU Environmental Health Service	State To POTW[8]	Whitman
WSU Medical Waste Incinerator	State To POTW	Whitman

NPDES permit holders in the Idaho portion of the Palouse subbasin include:

Facility Name	County
Potlatch Wastewater Treatment Plant	Latah
Bennett Forest Industries	Latah
Genesee Wastewater Treatment Plant	Latah
Moscow Wastewater Treatment Plant	Latah
UI Aquaculture Research Facility	Latah

[6] State to Ground is any facility that has a state waste discharge permit and discharges to land or any kind of impoundment, lined or not.

[7] Major Facility is any NPDES facility or activity classified as such by the Ecology Regional Administrator, or in the case of approved state programs, the Regional Administrator in conjunction with the State Director. Major municipal dischargers include all facilities with design flows of greater than one million gallons per day and facilities with EPA/State approved industrial pretreatment programs. Major industrial facilities are determined based on specific ratings criteria developed by EPA/State.

[8] State to POTW is any facility that has a state waste discharge permit and discharges to a municipal wastewater treatment plant.

1.3 Anthropogenic Disturbances

Human activities that have affected natural resources within the Palouse subbasin include agriculture, timber harvest, mining and urban development. Land use activities toward the end of the 19^{th} century began to transform the Palouse subbasin. This transformation from grasslands and forestlands to a resource-extractive region of farming, ranching, timber harvest and mining was documented by a comprehensive study over 25 years ago, the Palouse Cooperative River Basin Study (USDA SCS 1978).

Nearly all productive land in the Palouse River subbasin was settled from 1870 through 1885. The first major influx of immigration to the area was in the early 1880s. The completion of railroad lines from the Pacific Northwest to the Pacific Ocean ended the isolation of the region, made immigration easier and cheaper, and vastly improved the marketing of agricultural products. The population of the Washington Territory (ratified in 1853) increased fivefold in the 1880s.

Soil erosion became a significant problem by the early 1890s. When crawler tractors replaced the horse, some areas previously used for pasture were converted to grain. Greater power moved equipment faster, worked the soil even more and caused more downslope movement of the soil. By this time, farmers were able to go up and down hills instead of working on the contours, as in the days of horse-drawn equipment. Fewer pastures were needed for horses, fences and fence rows were removed, along with many early timber plantings. Habitat for wildlife gradually disappeared. During World War II, many grasslands were plowed out and planted to grain or peas as part of the "Food for Freedom" program. Introduction of field peas for areas of high precipitation made annual cropping possible, reducing the need for summer fallow, which lessened the erosion hazard. Then the newer horse-drawn combine created the problem of excess straw after harvest. A commonly used crop residue management tool for the farmer was to set fire to the stubble after harvest. Nearly all the residue went up in smoke and nothing was returned to the soil as organic matter or retained to protect the soil surface from water-induced erosion.

Though not considered the major industry in the subbasin today, lumber mills were among the first businesses to operate in the area. The first sawmill in Whitman County was built in 1870s, and before the turn of the decade, the water-powered mills were common sights in towns through the region. The north and northeastern parts of Latah County were economically shaped by logging and timber claims. Many immigrants filed homestead claims in the timbered areas hoping to win title to their land and then sell to a lumber company for a handsome profit. However, with the newly created Forest Service and a national interest in creating forest reserves, the government denied these timber homestead claims. The Potlatch Lumber Company owned the majority of land in Latah County at the beginning of the 1900s. The town of Potlatch, built by the company in 1905 and operated by it until the 1950's, is one of the few true examples of a company town in the west. The influence the company had in this area is also reflected in the towns of Deary and Harvard and the depots that once stood along the route of the Washington, Idaho, and Montana railway. The Potlatch company built this railroad to move logs to its large mill at Potlatch which operated until 1981. Logging had a significant effect on this part of the county which contained the largest stand of white pine in the nation. Historic logging activities negatively affected fish habitat, disrupted wildlife habitat, negatively affected the hydrograph and water quality.

Hydropower development on the Snake River provided water to limited irrigated cropland acres within the Palouse subbasin. This allowed conversion of grasslands and shrub-steppe habitat to cropland. Barge navigation along the Lower Snake River, from the confluence of the Clearwater River to the confluence of the Snake River and the Columbia, provides major, year-round water transportation route for irrigated and nonirrigated agricultural and timber industry product transport. This transportation mechanism for grain shipment to reach export markets has promoted a steady increase in land conversion into cropland acres.

In the mid-1850s, several gold strikes were made in the upper Palouse River watershed and many placer mines operated near the headwaters. Most of the mining activities in the Palouse subbasin occurred in Gold and Crane Creeks. In Latah County, at least nine mining districts were created, although none are active today. There was a decline in mining activity by the end of the 1880s, with some placer mining continuing through the 1950s in the upper Palouse River area. Historic mining activities negatively affected fish habitat, and negatively affected the hydrograph and water quality. Recreational dredge mining may currently occur in limited areas in the subbasin, however no commercial mining activities are occurring.

1.4 Wildlife and Fish Resources

1.4.1 Historic Habitats

Historical perspectives increase our understanding of the dynamic nature of landscapes and provide a frame of reference for assessing modern patterns and processes (Weddell 2001). Weddell (2001) cites that the accounts written by nineteen century explores and botanists in the Palouse region were influenced by their values and biases, particularly their interest in development, soil, water, forage plants, minerals and trees.

Weddell (2001) reports that references to a barren landscape indicate that these observers saw little of interest or value in the canyons they pass through. The seasonal distribution of moisture characteristic of the Inland Northwest produced a type of grassland that was unfamiliar to Euroamericans. In addition to the canyons, the higher-elevation grasslands of the Palouse region were described as, “bordered by spacious, open grassy woods of large, widely spaced ponderosa pines in elegant natural parks and dotted with seasonally wet spongy meadows or camas prairies. The economic value of the Palouse grasslands were recognized in exploration and survey reports in the mid 1800s. Many accounts described these bunchgrass lands; “A most beautiful prairie country, the whole of it adapted to agriculture,” and “Very fertile and rolling country, exceedingly well adapted to grazing” were among a few accounts.

According to USGS LUHNA (2003), based on early settlers' descriptions of vegetation and wildlife habitats and more recent botanical assessments of prairie remnants, we know that prior to settlement by European-Americans, bunchgrasses dominated the Palouse region. Most of the original perennial grass prairie, though, was gone by 1900.

Prior to 1900 (Cook 2001), the native grasslands occurred in three types. The more mesic zone, on the wetter, eastern edge of the region, was dominated by two perennial grass species, Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoregneria spicata*). Climax shrub communities, particularly bluebunch wheatgrass-snowberry *(Symphoricarpos* spp.) but also black hawthorn (*Crataegus douglasii*) and rose (*Rosa* spp.), grew on the northern sides of many of the loess hills. Quaking aspen (*Populus tremuloides*) and cow parsnip (*Heracleum lanatum*) communities were common in riparian areas. The western portion was drier, though also dominated by bluebunch wheatgrass. A third distinctive Palouse vegetation community occurred in the Snake River and Clearwater River canyons. These areas, occurring outside of the Palouse subbasin, were far hotter and drier than the prairies and supported a sparser bunchgrass/shrub community. Draws and water seeps in the canyons supported a rich variety of tree species, including hawthorn and mock orange (*Philadelphus lewisii*).

Forest communities occupied the higher elevation mountains and ridges. On warmer sites, ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) grew with a rich shrub understory dominated by oceanspray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), serviceberry (*Amelanchier alnifolia*), snowberry, and wild rose. Cooler north- and west-facing canyons supported some western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), and western larch (*Larix occidentalis*). The upper portions of the channeled scablands are at least fifty percent forested by pure stands of ponderosa pine (Rule 2004).

According to PBI (2004b), the draws and seeps in many of the canyons historically supported a diverse tree flora; riparian areas supported a narrow gallery forest of cottonwood, quaking aspen, mountain maple, and red alder. Wetlands were scattered across the subbasin with the most wetlands occurring in the northwestern portion of the subbasin (where Turnbull National Wildlife Refuge now sits). Wetland vegetation was diverse and typically dominated by camas, a mixture of forbs, sedges, rushes, and many grasses.

A recent study, "Wetlands of the Palouse Prairie: Historical Extent and Plant Composition" (Servheen et al. 2002), described the extent and plant community composition of pre-settlement wetlands in the Palouse Prairie Bioregion, which comprises the eastern portion of the Columbia Plateau in eastern Washington and adjacent northern Idaho. The study concentrated on topographic depressions with deep, well drained or moderately well drained soils; also referenced as seasonally moist or wet meadows. Vernal pools and ponds were not addressed in this study. It was determined that between 12 and 13% of the study area (South Fork of the Palouse River north to Missouri Flat Creek) was once covered in wetlands.

1.4.2 Current Habitat Types

1.4.2.1 Palouse Prairie

Grasslands of the Pacific Northwest constitute one of the major vegetation types or biomes in North America (Lichthardt and Moseley 1997). These grasslands are often called Palouse Prairie, even though they extend far beyond the Palouse region of eastern Washington and adjacent Idaho. Lichthardt and Moseley (1997) differentiate the Palouse Grasslands from other grasslands (Canyon Grasslands for example), by defining them as native steppe vegetation occurring on the gently rolling basalt plateaus and adjacent mountain foothills that are covered with wind-deposited loess.

The Palouse subbasin is home to the unique Palouse Prairie. The Palouse Prairie is a inimitable combination of habitat types (McNab and Avers 1994). Grasslands and meadow-steppe vegetation dominated by grasses are the prototypical vegetation of the Palouse Prairie. Woodlands and forests occur in the northern and eastern portion of the area on hills and low mountains. The relatively arid western portion is dominated by grassland, where bluebunch wheatgrass and Idaho fescue are the most prominent. Meadow-steppe vegetation characterized by Idaho fescue and common snowberry dominates areas with more precipitation, but still too dry to support forest vegetation on deep loamy soils. Most of this meadow-steppe as well as the grassland to the west, has been converted to croplands. Ponderosa pine woodlands and forests form the lower timberline in the eastern portion of the area on hills and low mountains. The transition zone between forest and meadow-steppe consists of a complex interfingering between these two vegetation types. Douglas-fir series forests dominate at higher elevations in the mountains. Isolated fragments of the western red cedar series and grand fir series occur on sheltered north slopes in the mountains.

The Palouse Prairie fauna includes birds typical of grasslands with intermittent riparian systems and pine hills. Grassland species, among others, include American kestrel, ring-necked pheasant, upland sandpiper, western kingbird, horned lark, black-billed magpie, western meadowlark, and savanna sparrow. Riparian system species include Lewis' woodpecker, gray catbird, western bluebird, orange-crowned warbler, northern oriole, black-headed grosbeak, and lazuli bunting. Birds which reach or nearly reach the extent of their range include mountain quail, barn owl, white-headed woodpecker, eastern kingbird, and American redstart. The bald eagle also occurs around larger water bodies. Representative herbivores and carnivores include white-tail deer, mule deer, and weasels. Smaller common herbivores include the black-tail jackrabbit and Washington ground squirrel. Rare species include the whitetail jackrabbit, and possibly the pygmy rabbit. Herpetofauna include the bullfrog, painted turtle, western fence lizard, and skinks. A complete list of wildlife species occurring in the Palouse subbasin is found in section 1.4.6.6 Wildlife Species (Table 2).

The widespread conversion to agricultural croplands throughout the last decade has dramatically diminished this unique ecosystem. Noss et al. (1995) referred to the Palouse Prairie as endangered as a result of native vegetation and wetland losses in the region. Lichthardt and Moseley (1997) cite as a consequence of human alteration (agricultural conversion, grazing and urbanization), the Palouse grasslands are considered one of the most endangered ecosystems in the United States, estimating that less than 1% of the grasslands remain in a natural state.

1.4.2.2 Wildlife Habitat Types within the Southeast Washington Subbasin Planning Ecoregion

WDFW compiled wildlife assessment, inventory, and management information for the Palouse, Lower Snake, Tucannon, Asotin, Walla Walla subbasins (Ashley and Stovall 2004). These contiguous subbasins occupy the southeast corner of Washington state and extend into Idaho and

Oregon. WDFW grouped the Palouse, Lower Snake, Tucannon, Asotin, and Walla Walla subbasins into an area referred to as the Southeast Washington Subbasin Planning Ecoregion.

Southeast Washington Subbasin Planning Ecoregion subbasins share similar habitats, soils, wildlife populations, limiting factors, land uses, and physiographic/hydrologic features. Water from streams within the Southeast Washington Subbasin Planning Ecoregion eventually converge with the Snake River, further tying the subbasins together at the landscape level.

WDFW Southeast Washington Subbasin Planning Ecoregion level planners (Ashley and Stovall 2004) created an approach to subbasin planning at two scales: the ecoregional scale emphasized focal macro-habitats, wherein the subbasin scale highlighted species guilds, individual focal species, important micro habitats, and habitat linkages.

The WDFW Southeast Washington Subbasin Planning Ecoregion approach compared the current availability of the habitat against its historic availability. This coarse filter habitat assessment was used to quickly evaluate the relative status of a given habitat and its suite of obligate species. The coarse filter habitat analysis was combined the with a single species, or fine filter, analysis of one or more obligate species to further ensure that species viability for the suite of species is maintained.

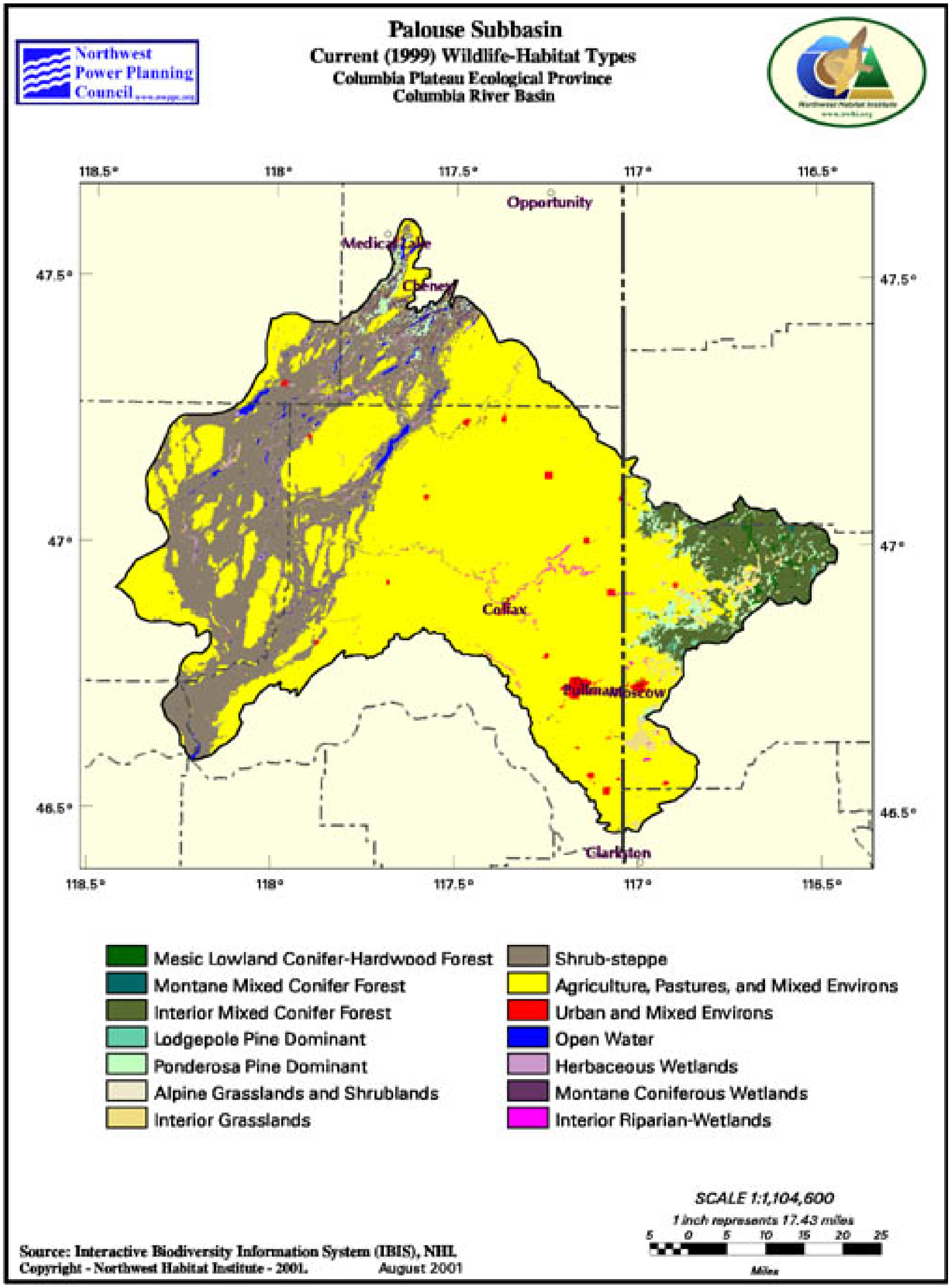
WDFW Southeast Washington Subbasin Planning Ecoregion level planners determined that sixteen wildlife habitat types that occur and include:

- Montane Mixed Conifer Forest
- Eastside (Interior) Mixed Conifer Forest
- Lodgepole Pine Forest and Woodlands
- Ponderosa Pine and Interior White Oak Forest and Woodland
- Upland Aspen Forest
- Subalpine Parkland
- Alpine Grasslands and Shrubland
- Interior Canyon Shrubland
- Eastside (Interior) Grasslands
- Shrub-steppe
- Agriculture, Pasture, and Mixed Environs
- Urban and Mixed Environs
- Lakes, Rivers, Ponds, and Reservoirs
- Herbaceous Wetlands
- Montane Coniferous Wetlands
- Eastside (Interior) Riparian Wetlands

Southeast Washington Subbasin Planning Ecoregion planners determined that fourteen of the sixteen listed wildlife habitat types occur within the Palouse subbasin (Ashley and Stovall 2003b). Of the five subbasins in the Southeast Washington Subbasin Planning Ecoregion, the Palouse subbasin is the largest, comprising 44% of the entire Southeast Washington Subbasin Planning Ecoregion. The fourteen habitat types determined to occur within the Palouse subbasin include:

- Montane Mixed Conifer Forest
- Eastside (Interior) Mixed Conifer Forest
- Lodgepole Pine Forest and Woodlands
- Ponderosa Pine and Interior White Oak Forest and Woodland
- Mesic Lowlands Conifer
- Alpine Grasslands and Shrubland
- Shrub-steppe
- Eastside (Interior) Grasslands
- Agriculture, Pasture, and Mixed Environs
- Urban and Mixed Environs
- Lakes, Rivers, Ponds, and Reservoirs
- Herbaceous Wetlands
- Montane Coniferous Wetlands
- Eastside (Interior) Riparian Wetlands

Figure 4. Palouse Subbasin Wildlife Habitat Types Defined Within the Southeast Washington Subbasin Planning Ecoregion



1.4.2.3 Habitat Types within the Palouse Subbasin

For the purpose of Palouse subbasin management planning, the Palouse Subbasin Technical Advisory Committee (TAC), developed a grouping of six habitat types that currently occur across the Palouse subbasin. These six habitat types were derived from reviewing the characteristics of the Palouse Prairie and discussing the fourteen wildlife habitat types determined to exist across the Palouse subbasin of the Southeast Washington Subbasin Planning Ecoregion (Ashley and Stovall 2004).

The following decision making process was used to guide the selection and grouping of habitat types within the Palouse subbasin:

- WDFW (Ashley and Stovall 2004 and 2003b), at the Southeast Washington Subbasin Planning Ecoregion level, identified sixteen wildlife habitats across the Southeast Washington Subbasin Planning Ecoregion, with fourteen of those wildlife habitats occurring across the Palouse subbasin.
- The habitat groupings performed by the Southeast Washington Subbasin Planning Ecoregion planners were reviewed at the subbasin level.
- At the Palouse subbasin level, wildlife and land managers within Washington and Idaho refined the habitat groupings, determining six habitat types within the Palouse subbasin that support the majority of the wildlife habitat within the subbasin.
- Plant and wildlife focal species were selected to represent habitat types, and infer and/or measure response to changing habitat conditions at the Palouse subbasin level.
- Habitat types were selected to assist Palouse subbasin planning in identifying and prioritizing habitat protection and restoration needs; developing strategies to protect and enhance wildlife populations within the Palouse subbasin and transcending areas across the Southeast Washington Subbasin Planning Ecoregion.

Habitat types that support the majority of the wildlife habitat within the Palouse subbasin include (listed in order of abundance):

- Agriculture
- Shrub-steppe
- Ponderosa Pine Forest
- Grassland
- Mixed Conifer Forest
- Wetlands

An estimated breakdown of acres of habitat type across the Palouse subbasin is included in Table 1. Geographic information system (GIS) mapping resources were not available during this planning effort. Therefore, a map was not developed displaying the Palouse subbasin habitat types. The habitat acreages displayed in Table 1 were estimated combining the figures determined to exist in WDFW subbasin planning work (Ashley and Stovall 2003b), the Palouse Subbasin Summary (Cook 2001), and Palouse Cooperative River Basin Study (USDA SCS 1978).

Table 1. Acres of Habitat Types within the Palouse Subbasin

Habitat Types	Acres	% of Palouse Subbasin
Agriculture	1,349,500	64%
Shrub-steppe	480,800	23%
Ponderosa Pine Forest	62,000	3%
Grassland	37,000	2%
Mixed Conifer Forest	115,400	5%
Riparian and Wetland	7,900	<1%
Other lands (water, urban build up, roadways, other vegetative habitat types)	61,400	3%
Total	2,114,000 Acres	

Resources were not available to utilize geographic information system mapping tools to refine these estimated acres, nor was a map produced to display these values.

1.4.2.4 Agriculture Habitat Type

Agricultural areas have been created; converting native habitat types into cropland, pastureland, and rangeland areas. This widely distributed created habitat is the dominant land use across the Palouse subbasin. Agricultural areas have assumed a permanent characteristic of the Palouse subbasin landscape. Agricultural areas range from annual precipitation zones of 12 to 26 inches. The habitat is found on relatively flat floodplain areas along the Palouse River system, gently rolling loess covered hills, and steep cut-over timbered ground. Edges are mostly abrupt along the habitat borders within agricultural habitat and with other adjacent habitats. The habitat is structurally diverse and includes a wide spectrum of cover types ranging from perennial grasses, to annual crops, to bare soil associated with summer fallow operations.

As reported in the North Fork Palouse River Watershed Characterization (RPU 2002), some early settlers raised livestock and cultivated only enough bottomland to produce gardens and grain for family needs. By the late 1870s, wheat and flax were grown in enough quantities to be shipped out of the area. The Palouse grassland-livestock era ended with railroad construction in the early 1880's. In a very short time, horse powered cultivation of the Palouse hills changed grasslands to cropland. Major crops in those first years of dryland farming were grains, sugar beets and thousands of acres of orchards.

Croplands in the subbasin produce yields comparable to irrigated methods without irrigation, making this area unique. Therefore, farming practices within the majority of the subbasin wear the label “dryland agriculture.” Some irrigated cropland exists on the far western edge of the subbasin.

Today, the predominant cropping sequence consists of annual crops. The major crops in the watershed include soft white winter wheat, hard and soft spring wheat, spring barley, spring peas and lentils. Some of the minor crops grown include winter peas, garbanzo beans, spring and fall canola, oats, grass for grass seed production, and hay. A typical rotation consists of a winter wheat/lentil rotation, winter wheat/spring cereal grain rotation, or winter wheat/spring cereal grain/pea or lentil rotation. Historically, clean cultivated summer fallow was often a part of the cropping rotation. Today, when fallow operations are used, chemical fallow instead of mechanical fallow is implemented to reduce erosion potential. Bluegrass is minimally used as a perennial crop, staying in production between 5 and 15 years.

Determining a typical field operation for each major crop is difficult because of the diversity in equipment availability, field slope and aspect, field location within the subbasin and crop rotations. No-till farming is becoming widely utilized in the watershed. No-till farming includes using specialized equipment to place the fertilizer and seed directly into the previous year's crop residue without performing prior tillage operations. At least in one leg of the rotation, it is common to see a no-till operation replace conventional practices. For example, winter wheat is often no-tilled into lentil, pea, or spring grain stubble, where the fertilizer is applied during the same operation as seeding. A few producers are implementing no-till operations for every leg of the rotation, which is referred to as direct seed. This evolution of crop residue management throughout the subbasin has increased the over-winter crop stubble throughout the agricultural areas. This over-winter crop stubble provides additional food and cover to upland game birds where this farming technique is used.

According to Vander Haegen et al. (date unavailable) agricultural development has converted over 50% of the land originally in shrub-steppe within Washington. The addition of new, human-created habitats (agricultural and rural development) has elevated the food base for some predators (such as magpies) and likely their populations as well, with unknown impacts on shrub-steppe wildlife. The addition of cattle feedlots and pastures to the landscape has enhanced the suitability of the area for brown-headed cowbirds, a nest parasite that lays its eggs in the nests of other birds and thereby depresses the host bird's reproductive success.

Farm fields enrolled in the federal Conservation Reserve Program (CRP) can have considerable value to grassland and shrub-steppe wildlife. Included in this agricultural habitat type are fields enrolled in the CRP and CCRP (Continuous Conservation Reserve Program). These acres are included in this habitat type rather than the grassland or shrub-steppe habitat types because the conversion from annually cropped fields to perennial vegetation has a finite duration. The acres are not guaranteed to stay in permanent vegetative cover and therefore included in this habitat type description rather than in grassland or shrub-steppe habitat types.

These once annually cropped agricultural fields have been converted to long-term vegetation under the premise of conserving soil. Side benefits include wildlife habitat attributes and improvements in water quality. Since the early 1970s, some annually cropped farm land with highly erodable soils were removed from crop production and planted to permanent vegetative cover. In the late 1990s, annually cropped farm land was also converted to wildlife habitat by planting grasses, shrubs and trees. CRP is scattered throughout both the Washington and Idaho grassland habitat type. Vegetative cover ranges from full fields of introduced grasses (crested wheatgrass in the drier western portions to orchard grass and timothy in the most eastern portions) to plantings of native grasses. In more recent years, native grass plantings have increased in popularity and have also included introduction of forbs (e.g. yarrow) and shrubs and trees (e.g. rose, ponderosa pine).

1.4.2.5 Shrub-Steppe Habitat Type

This habitat type borders the Palouse subbasin's northwestern edge. The most mesic sites are dominated by Idaho fescue (*Festuca idahoensis*) with lesser amounts of bluebunch wheatgrass (*Pseudoroegneria spicatum*), threadleaf sedge (*Carex filifolia),* Sandberg bluegrass *(Poa secunda*), and needle and thread grass (*Stipa comata*). On the drier end of the spectrum, bluebunch wheatgrass and Sandberg bluegrass tend to be the dominants, though Idaho fescue usually remains in significant amounts. Forbs are diverse and include many perennials common to other meadow steppe types. The shrub cover ranges from near 0% to greater than 30%. Shrub-dominated areas are limited to ravines and draws.

Areas characteristic of undisturbed shrub-steppe vegetation include a continuous herbaceous layer with a taller, discontinuous layer of three-tip sage (*Artemisia tripartita*). Three-tip sage looks very much like big sagebrush (*A. tridentata*) but is about half as tall, so the sagebrush component of this type is less visually imposing than in types where big sagebrush is the dominant shrub. In a smaller portion of this type where the annual precipitation is approximately 12 inches, Idaho fescue joins bluebunch wheatgrass as a co-dominant bunchgrass area with a cryptogamic crust of mosses and lichens that covers the ground between the vascular plants. Big sagebrush is confined to disturbed sites.

The pattern of agricultural conversion within the shrub-steppe of eastern Washington has resulted in a highly fragmented landscape (Vander Haegen et al.). Where once native grasslands and shrub lands stretched unbroken for thousands of square miles, there exists now only fragments of native habitats in a matrix of agricultural lands. This breakup of formerly contiguous habitats has had detrimental effects on both plant and wildlife species occurrence.

The Wildlife Assessment and Inventory for the Palouse Subbasin by Ashley and Stovall (2003b) provide a review of historical and current condition within the shrub-steppe habitat type. Historically, the sage-dominated shrublands occurred in the western portion of the Palouse subbasin and along the Snake River. Dominant shrubs were sagebrush of several species and subspecies: Basin, Wyoming, and Mountain big sagebrush; low sagebrush; and early, rigid, and three-tip. Bitterbrush also was important in many shrub-steppe communities. Bunchgrasses were largely dominated by four species: bluebunch wheatgrass, Idaho fescue, needle and thread grass, and Sandberg's bluegrass. Many shrublands that were located in areas of deep soil have largely been converted to agriculture leaving shrublands intact on shallow lithosols soil. Floristic quality, however, has generally been impacted by decades of heavy grazing, introduced vegetation, wild fires, and other anthropogenic disturbances.

Today, two shrub-steppe vegetation types occur in the Palouse subbasin. The three-tip sagebrush steppe vegetation type occupies an estimated 7,225 acres of the Palouse subbasin (Ashley and Stovall 2003b). The average shrub cover is about 12% and ranges from near 0% to greater than 30%. In recent years, diffuse knapweed (*Centaurea diffusa)* has spread and threatens to replace other exotics as the chief increaser after grazing. The big sagebrush/fescue steppe vegetation type occupies a small western portion of the Palouse subbasin. Most of the native bunchgrasses and forbs are poorly adapted to heavy grazing by livestock. Grazing tends to lead to increasing dominance by cheatgrass. Several exotic knapweed species have become more common in recent years. Over 75% of the big sagebrush/fescue steppe vegetation is now in agricultural production.

Ashley and Stovall's work (2004) cited that changes in land use over the past century have resulted in the loss of over half of Washington's shrub-steppe habitat. Shrub-steppe communities support a wide diversity of wildlife and the loss of once extensive shrub-steppe communities has reduced substantially the habitat available to a wide range of shrub-steppe associated wildlife, including several birds found only in this community type. More than 100 bird species forage and nest in sagebrush communities, and at least four of them (sage grouse, sage thrasher, sage sparrow, and Brewer's sparrow) are obligates, or almost entirely dependent upon sagebrush. According to Knick et al. (2003), shrub land and grassland birds are declining faster than any other group of species in North America due to loss of habitat.

Knick et al. (2003) cite that accurate range-wide estimates of total area degraded, fragmented, converted to agriculture, or invaded by exotic weeds are needed to grasp fully the magnitude of changes and their impact on birds in the shrub-steppe habitat type. For some pervasive land uses, such as livestock grazing, empirical data to test the effects on bird populations are limited. Experiments are need that have a strong statistical design which includes treatments and controls at spatial and temporal scales relevant to the impacts to vegetation and soils and the dynamics of recovery.

Knick et al. (2003) recommend establishing a coordinated network of study sites across a gradient of habitat conditions at which demographic information, such as reproductive success, adult and juvenile survival, adult return rates, and patterns of juvenile dispersal, can be obtained. An intensive program to mark birds as such sites could yield valuable insight into population dynamics but will require a long-term commitment to maintain. Long-term studies involving marked individuals also could assess the potential for birds' site fidelity to delay population response to habitat changes, a possible cause of confounded bird-habitat models. Ultimately, development of population models based on life-stage information collected from such a net work of sites could yield significant insights into critical life stages, survival during breeding, migration and wintering periods, and the influence of habitat on population dynamics.

Knick et al. (2003) believes that long-term studies incorporating a wide-spread system of exclosures and ability to control treatment levels are necessary to determine effects of land use on habitat and birds. The treatment projects planned by management agencies and the large number of areas to be treated represent a opportunity to design a sound experimental approach. In addition, a commitment to monitoring at appropriate scales would provide feedback to evaluate treatment effects and provide a basis for adaptive management strategies.

1.4.2.6 Ponderosa Pine Forest Habitat Type

The ponderosa pine forest habitat type currently occurs in the most north central area of the subbasin near the Turnbull National Wildlife Refuge, and is scattered throughout the most eastern portion of the subbasin in Idaho. Several small remnants also occur within the North and South Forks of the Palouse River drainage and Moscow Mountain range.

Ponderosa pine forms climax stands that border grasslands and is also a common member in many other forested communities. Ponderosa pine *(Pinus ponderosa)* is a drought tolerant tree that usually occupies the transition zone between grassland and forest. Climax stands are characteristically warm and dry, and occupy lower elevations throughout their range. In the Palouse subbasin, ponderosa pine associations can be separated into three shrub-dominated and one grass-dominated habitat types: *Physocarpus malvaceus* (ninebark; limited to northeast to northwest aspects); *Symphoricarpos albus* (common snowberry, sporadic from Coeur d'Alene south along western forest edge in northern Idaho); and *Stipa comata* (needlegrass).

Annual precipitation in ponderosa pine habitat type is between 14 and 30 inches. Wide seasonal and diurnal temperature fluctuations are normal, and the habitat type generally lies between 2,000 and 5,000 feet. Its occurrence at any particular location is strongly influenced by aspect and soil type.

Historical information was presented in the Southeast Washington Subbasin Planning Ecoregion assessment (Ashley and Stovall 2004) and reports that prior to 1850, this habitat was mostly open and park like with relatively few undergrowth trees. The ponderosa pine ecosystem has been heavily altered by past forest management. Specifically, the removal of overstory ponderosa pine since the early 1900s and nearly a century of fire suppression have led to the replacement of most old-growth ponderosa pine forests by younger forests with a greater proportion of Douglas fir (*Pseudotsuga menziesii*) than ponderosa pine (Habeck 1990). Fire scar evidence in the northern Rocky Mountains indicates that ponderosa pine forests burned approximately every 1-30 years prior to fire suppression, preventing contiguous understory development and, thus, maintaining relatively open ponderosa pine stands. The 1930s-era timber inventory data suggests large diameter ponderosa pine-dominated stands occurred in very large stands, encompassing large landscapes. Such large stands were fairly homogeneous at the landscape scale (i.e. large trees, open stands), but were relatively heterogeneous at the acre scale, with patchy tree spacing, and multi-age trees. Clear cut logging and subsequent reforestation have converted many older stands of ponderosa pine/Douglas-fir forest to young structurally simple ponderosa pine stands.

Forest management and fire suppression have led to the replacement of old-growth ponderosa pine forests by younger forests with a greater proportion of Douglas fir than ponderosa pine. Clear cut logging and subsequent reforestation have converted many older stands of ponderosa pine/Douglas-fir forest to young structurally simple ponderosa pine stands (Ashley and Stovall 2003b). Currently, much of this habitat has a younger tree cohort of more shade-tolerant species that gives the habitat a more closed, multi-layered canopy. For example, this habitat includes previously natural fire-maintained stands in which grand fir can eventually become the canopy dominant. Large late-seral ponderosa pine, Douglas-fir, and grand fir are harvested in much of this habitat. Under most present-day management regimes, typical tree size decreases and tree density increases in this habitat. Bark beetles, primarily of the genus *Dendroctonus* and *Ips*, kill thousands of pines annually and are the major mortality factor in commercial saw timber stands.

According to the Southeast Washington Subbasin Planning Ecoregion assessment (Ashley and Stovall 2004), declines of ponderosa pine forest are among the most widespread and strongest declines among habitat types in an analysis of source habitats for terrestrial vertebrates in the Interior Columbia Basin. In addition to the overall loss of this forest type, two features, snags and old-forest conditions, have been diminished appreciably and resulted in declines of bird species highly associated with these conditions or features. The extensive loss and degradation of ponderosa pine forests characteristic, and the fact that several highly associated bird species have declining populations, support the importance of habitat type focus on protection and enhancement.

1.4.2.7 Grassland Habitat Type

The Southeast Washington Subbasin Planning Ecoregion Assessment (Ashley and Stovall 2004) identified a reduction in grassland habitats by 97% because of conversion to other uses in the past 100 years. Of the once continuous native prairie dominated by mid-length perennial grasses, only approximately 1% of the Palouse grasslands remain. It is one of the most endangered ecosystems in the United States and all other remaining parcels of native prairie are subject to weed invasions and occasional drifts of aerially applied agricultural chemicals. This habitat decline has significantly impacted grassland dependent species such as sharp-tailed grouse.

In historical accounts collected and recited by Weddell (2001), loss of the Palouse grasslands was being noticed by the 1890s. The report describes land use changes; “Sheep and cattle are rapidly destroying the native plants and by the time private explorations reach these regions the flora will have been totally exterminated,” and “rapidly disappearing vegetation of this region had largely been broken up for the growing of wheat, only isolated tracts of the best developed prairies remained intact.” By the early 1900s published reports mention numerous non-native annual grasses and other plant species that had become established and were increasing.

The Wildlife Assessment and Inventory for the Palouse subbasin by Ashley and Stovall (2003b) provides a review of historical and current condition within the grassland habitat type. Historically, bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass were the dominant native perennial grasses within the interior grassland habitat type, and specific grass dominance changed based on plant association type.

Most grassland habitat occurs mainly on the plateau landscapes within the subbasin, with a minor amount occurring as canyon grasslands. The plateaus are composed of gentle slopes with deep silty loess soils in an expansive rolling dune-like landscape. Grasslands may occur in a patchwork with shallow soil scablands or within biscuit scablands or mounded topography. Naturally occurring grasslands do not occur within the range of bitterbrush and sagebrush species. While not existing originally, grassland habitats exists today in the shrub-steppe landscape where grasslands have been created by brush removal, agricultural impact, or by fire.

Agricultural uses and introduced perennial plants on abandoned or planted fields are common throughout the current distribution of grassland areas.

The annual precipitation within this type is 17 to 21 inches. Climax native vegetation is lush herbaceous growth punctuated with shrub thickets. The distribution of shrub thickets, grassy stands, and sedge stands appears to be related to the depth of the soil layers.

This habitat is dominated by short to medium-tall grasses. Total herbaceous cover can be closed to only sparsely vegetated. In general, this habitat is an open and irregular arrangement of grass clumps rather than a continuous sod cover. These medium-tall grasslands often have scattered and diverse patches of low shrubs, but few or no medium-tall. Native forbs may contribute significant cover or they may be absent. Grasslands in canyons are dominated by bunchgrasses growing in lower densities than on deep-soil prairie sites. The soil surface between perennial plants can be covered with a diverse cryptogamic or microbiotic layer of mosses, lichens, and various soil bacteria and algae. Moister environments can support a dense sod of rhizomatous perennial grasses. Annual plants are a common spring and early summer feature of this habitat.

Grouped within this habitat type are microphyllous (shrub dominated) draws, often connecting various habitat types. Shrub dominated areas, such as hillside eyebrows, are also found within a mix of habitat types (including agriculture). These areas, depending on the moisture regime, can support stands of small to medium shrubs such as hawthorn, alder, serviceberry, snowberry, rose, etc.

Dominant grasses are Idaho fescue, bluebunch wheatgrass, Junegrass (*Koeleria cristata*), and big bluegrass (*Poa ampla*). The forb flora is especially diverse. The forbs with the greatest mean percent cover are balsamroot (*Balsamorhiza sagittata*), old man's beard (*Geum trifiorum*), and northwest cinquefoil (*Potentilla gracilis*), with numerous others. The dominant shrub is snowberry (*Symphoricarpos albus*), with nutkana rose (*Rosa nutkana*), woods rose (*Rosa woodsii*), and common chokecherry (*Prunus virginiana*).

The Palouse, like most of the steppe types, has been susceptible to invasion by exotic plants. Grazing, in particular, leads to replacement of the native flora by a variety of exotic species. Eventual domination by Kentucky bluegrass is common on deep soil sites. With fire suppression and fragmentation, most of the deep soil Palouse Prairie is being replaced by deciduous shrubs and Kentucky bluegrass (Gamon 2004). Throughout much of the subbasin, native interior grasslands have been replaced by agricultural crops or severely reduced as a result of competition from introduced weed species such as cheatgrass. On the shallower soils and drier parts of the Palouse vegetation type, cheatgrass is usually the eventual dominant. In recent decades another introduced annual, yellow starthistle, has been replacing cheatgrass as the dominant species in disturbed areas.

1.4.2.8 Mixed Conifer Forest Habitat Type

The mixed conifer forest habitat type is a combination of habitats from mid-montane to montane in areas ranging from 2,000 to 7,000 feet, predominately in the eastern portions of the subbasin. Canopy stand structure is diverse with tree layers varying from closed forests to open-canopies.

Douglas fir is the most common tree species in this habitat. In drier sites, Douglas fir and ponderosa pine dominate the over stories, whereas in more moist sites, grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), and/or western larch (*Larix occidentalis*) are dominant or co-dominant with Douglas fir. Western white pine (*Pinus monticola*), Englemann spruce (*Picea englemannii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*) are common on colder sites.

Undergrowth vegetation varies from open to nearly closed shrub thickets from one to many layers. Tall deciduous shrubs include Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier alnifolia*), oceanspray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), willows (*Salix scouleriana*), huckleberry (*Vaccinium membranaceum*), rose varieties (*Rosa spp.*), spirea (*Spiraea betulifolia*), and snowberry (*Symphoricarpos albus*). Herbaceous plants generally include wild ginger (*Asarum caudatum*), queen's cup (*Clintonia uniflora*), false bugbane (*Trautvetteria caroliniensis*), false solomonseal (*Maianthemum stellata*), heartleaf arnica (*Arnica cordifolia*), several lupines (*Lupinus ssp.*), and twinflower (*Linnaea borealis*). Graminoids are common in this forest habitat including brome grasses (*Bromus spp.*), oniongrass (*Melica bulbosa*), sedges (*Carex spp.*), rushes (*Juncus spp.*), fescues (*Festuca spp.*), and bluebunch wheatgrasses (*Pseudoroegneria spicata*).

Fires were probably of moderate frequency (30-100 years)in mixed conifer communities in pre-settlement times. Many sites dominated by Douglas-fir and ponderosa pine, which were formerly maintained by wildfire, may now be dominated by grand fir due to fire suppression. Generally, early seral forests of shade-intolerant trees (western larch, western white pine, ponderosa pine, Douglas-fir) or tolerant trees (grand fir, western red cedar, western hemlock) develop some 50 years following disturbance. This stage is preceded by forb- or shrub-dominated communities. Early seral forest develops into mid-seral habitat of large trees during the next 50-100 years. Forest management practices, such as clearcutting and plantations, have resulted in less diverse tree canopies and an unnatural percentage of mid-seral forest conditions. This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on large shade-intolerant species in mid- and late-seral forests, leaving shade-tolerant species. Fire suppression enforces those logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently more abundant than in historical, native systems. Late-seral forests of shade-intolerant species are now essentially absent. Early-seral forest abundance is similar to that found historically but lacks snags and other legacy features. Even though this habitat is more extensive than pre-1900, natural processes and functions have been modified enough to alter its natural status as functional habitat for many species.

1.4.2.9 Riparian and Wetland Habitat Type

The study, "Wetlands of the Palouse Prairie: Historical Extent and Plant Composition" (Servheen et al. 2002), determined the extent and composition of pre-settlement wetlands in the Palouse Prairie Bioregion, which comprises the eastern portion of the Columbia Plateau in eastern Washington and adjacent northern Idaho. The study concentrated on topographic

depressions with deep, well drained or moderately well drained soils; also referenced as seasonally moist or wet meadows. Vernal pools and ponds were not addressed in this study.
It was determined that the loss of wetlands within the Palouse Prairie Bioregion occurred when the land was converted to grazing and agricultural lands. Many of the historical wetlands were turned into hay meadows, to be harvested for hay, or grazed by livestock. Servheen et al. (2002) conclude that prior to widespread grazing and cultivation, the predominately native vegetation was meadow steppe in which perennial caespitose grasses (growing in dense tufts) were accompanied by herbaceous dicots and low shrubs. Through investigation of late 19th century land surveys, early botanical reports and herbarium species, as well as soil cores taken from two different sites, it was determined that the vegetation of theses sites was characterized by several graminoids, such as sedges, and tufted hairgrass and other species of grasses. Forbs that were found within the wetlands came from the families of lily, iris, smartweed, parsley, and buttercup.

The extent of wetlands of the historical Palouse Prairie Bioregion was determined by creating a model of the flow of water throughout the region using terrain analysis, compared to a model of current information, such as topography and water flow. Soil cores taken from two separate sites were also examined for hydric soil characteristics, and wetland vegetation. It was determined that between 12 and 13% of the study area (South Fork of the Palouse River north to Missouri Flat Creek) was once covered in wetlands (Servheen et al. 2002).

Riparian areas, vernal pools, herbaceous, scrub-shrub and forested wetlands are found within this habitat type. Natural, or undisturbed climax, riparian areas include alder-willow riparian shrublands in higher elevations, and willow and cottonwood in other riparian shrublands at lower elevations. Quaking aspen is also commonly found in these riparian areas. Most riparian areas within the subbasin are void of woody vegetation because of land use disturbance and are dominated by grasses and invasive weeds.

The Washington Natural Heritage Program (WNHP) has recognized the vernal pool ecosystem as an important component of Washington's Natural Area System. WNHP has given low elevation saline and alkali vernal pools their highest priority ranking for preservation. Vernal pool ecosystems are formed in the eastern Washington portion of the subbasin, filling with fall and winter rains and retaining water until the late spring or early summer when reduced precipitation and increased evapotranspiration rates lead to complete desiccation. The wetlands hold water long enough throughout the year to allow some strictly aquatic organisms to flourish, but not long enough for the development of a typical pond or marsh environment. Vernal pools are characterized as amphibious ecosystems, exhibiting winter-wet and summer-dry conditions. Typically in these systems, annual species dominate.

The herbaceous wetland habitat is a mix of emergent herbaceous plants with a grass-like life form. These meadows often occur with deep or shallow water habitats with floating or rooting aquatic forbs and are commonly associated with areas of open water. Herbaceous cover is open to dense. The habitat can be comprised of cattail dominant marshes or sedge/grass meadows. Various grasses or grass-like plants dominate or co-dominate these habitats. Cattails (*Typha latifolia*) occur widely, sometimes adjacent to open water with aquatic bed plants. Several bulrush species (*Scirpus* spp.) occur in nearly pure stands or in mosaics with cattails, grasses, or sedges (*Carex* spp.). A variety of sedges characterize this habitat. Some sedges (*Carex aquatilis,*

C. lasiocarpa, C. scopulorum, C. simulata, C. utriculata, C. vesicaria) tend to occur in cold to cool environments. Other sedges (*C. aquatilis var. dives, C. angustata, C. interior, C. microptera, C. nebrascensis*) tend to be at lower elevations in milder or warmer environments. Introduced species that increase and can dominate with disturbance in this wetland habitat includes reed canary grass (*Phalaris arundinacea*) and Canada thistle (*Cirsium arvense*).
Aquatic beds are part of this habitat and support a number of rooted aquatic plants. Emergent herbaceous broadleaf plants grow in permanent and semi-permanent standing water. Shrubs or trees are not a common part of this herbaceous habitat although willow or other woody plants occasionally occur along margins, in patches or along streams running through these meadows.

Sylvan pools, including abandoned channels and river oxbows, occur throughout the mainstem of the Palouse River and include perennial emergent vegetation. Forested wetlands also occur along stream courses or as patches, typically small, within a matrix of mixed conifer forests lands. Forested wetlands can occur adjacent to other wetland habitats. The forest or woodland (>30% tree canopy cover) dominated by evergreen conifer trees typifies this wetland type. Deciduous broadleaf trees are occasionally co-dominant. The understory is dominated by shrubs (most often deciduous and relatively tall), forbs, or graminoids. The forb layer is usually well developed even where a shrub layer is dominant. Canopy structure includes single-storied canopies and complex multi-layered ones. Typical tree sizes range from small to very large. Large woody debris is often a prominent feature, although it can be lacking on less productive sites.

Indicator tree species for the forested wetland habitat areas, any of which can be dominant or co-dominant, are quaking aspen (*Populus tremuloides*), cottonwood (*Populus* spp.), and willow (*Salix* spp.). Dominant or co-dominant shrubs include red-osier dogwood (*Cornus sericea*), Douglas' spirea (*Spiraea douglasii*), and alder (*Alnus* spp.). Graminoids that may dominate the understory include sedges and grasses. Some common forbs include ferns, field horsetail (*Equisetum arvense*), arrowleaf groundsel (*Senecio triangularis*), and skunk-cabbage (*Lysichiton americanus*).

Historically, riparian wetland habitat was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly or in some combination by grass-forbs, shrub thickets, and mature forests with tall deciduous trees (Ashley and Stovall 2003b). Beaver activity and natural flooding are two ecological processes that affected the quality and distribution of riparian areas and associated wetlands.

Today, agricultural conversion and altered stream channel morphology have played significant roles in changing the character of streams, associated riparian areas and wetlands. Woody vegetation has been extensively suppressed by removal and maintained tilling, grazing in some areas, many of which continue to be grazed. Healthy riparian vegetation is limited in the Palouse subbasin due to intensive land use practices including agriculture and livestock grazing. Remaining riparian habitat is of poor quality and fragmented. The importance of healthy riparian habitat to fish and wildlife cannot be ignored.

Ashley and Stovall's work in the Southeast Washington Subbasin Planning Ecoregion Assessment (2004) determined riparian areas and associated wetlands are imperative for protection and enhancement because their protection, compared to other habitat types, may yield the greatest gains for fish and wildlife while involving the least amount of area. Riparian areas and associated wetlands cover a relatively small area, yet support a higher diversity and abundance of fish and wildlife than any other habitat; provides important fish and wildlife breeding habitat, seasonal ranges, and movement corridors; are highly vulnerable to alteration; and have important social values, including water purification, flood control, recreation, and aesthetics.

1.4.3 Wildlife Resources

1.4.3.1 Threatened and Endangered Wildlife Species

The Fish and Wildlife Service in the Department of the Interior (USFWS) and the NOAA Fisheries Service in the Department of Commerce (NOAA Fisheries) share responsibility for administration of the Endangered Species Act (ESA).

Canada Lynx, listed as federally endangered have been documented in the Idaho portion of the subbasin, with the last known sighting of lynx in 1994. No other information on their population status exists. Lynx need early successional forests for foraging, and mature forests for denning.

Bald eagles, listed as federally threatened, winter along the Palouse River, but the number is not known. There has been no documented nesting on national forest system lands in the Idaho portion of the subbasin.

Gray wolf, listed as federally endangered north of Highway I-90, and listed as experimental south of Highway I-90 The gray wolf has not been recently documented in the Idaho portion of the subbasin, but is known to occur to the south in the adjacent Clearwater River subbasin (Ecovista 2003) and just north in the Marble Creek drainage. It is possible wolves currently, or with growing numbers, will soon realize portions of the subbasin (Hennekey 2004).

1.4.3.2 Listed Plant Species

Two plants found within the Palouse subbasin have ESA listings. Water howellia and Spalding's silene are listed as federally threatened.

Water howellia (*Howellia aquatilis*), an aquatic macrophyte, occurs in seasonal ponds that generally dry out each year (Gamon 2004 and Lichtardt and Moseley 2000). Most ponds are isolated and not connected to any surface drainage course. A majority of the habitat in eastern Washington was created by the Spokane (Bretz) flood events. A single known location of the species in Idaho on the Palouse River floodplain differs from the typical habitat in that the ponds were formed by on-going, fluvial processes, rather than the more catastrophic flood events.

As an annual plant, water howellia's life cycle is tied to the hydrology of the ephemeral ponds. Populations are found almost exclusively in ponds with a bottom surface of firm, consolidated clay and organic sediments. Lichtardt and Moseley (2000) report that the water howellia is found in generally shallow ponds occupied by emergent and aquatic plants, ringed by shrubs on the immediate margin, large deciduous tree species are usually present, with zonal vegetation surrounding the habitat ranging from grassland to coniferous forest.

Spalding's silene, often referred to as Spalding's catchfly (*Silene spaldingii*), is a perennial herb that occurs primarily within open grasslands with a minor shrub component. Within these grasslands, according to Gamon (2004), it is more frequently found on north-facing slopes ,where the dominant vegetation is Idaho fescue. Spalding's catchfly can also be found in areas around the periphery of the Palouse grasslands where there is a mosaic of vegetation corresponding with soil depth. Within such areas, Spalding's catchfly is limited to the deeper soils and does not occur on the more lithosolic microsites. Scattered conifers (primarily ponderosa pine) can be present in these sites as well. Small fragmented population have been documented throughout the eastern Washington portion of the Palouse subbasin.

1.4.3.3 Other Species

An overview of the Palouse subbasin wouldn't be complete unless the Palouse giant earthworm was mentioned. When Frank Smith first unearthed this giant earthworm near Pullman in 1897, he named it *Megascolides americanus*, thinking that it was closely related to Australia's fifteen-foot worms *(Megascolides australis)*. Although dwarfed by its Australian counterpart, the three-foot long Palouse is certainly a giant among worms. This species, really only distantly related to *Megascolides*, was renamed *Driloleirus* which means "lily-like worm," reflecting the flowery aroma that it emits when handled (PBI 2004a).

Since its initial discovery, very few other sightings of this species have been documented. The giant Palouse earthworms live in the deep, rich soils of the Palouse bunchgrass prairies. Thick layers of organic matter that have accumulated in the soils of the Palouse for hundreds of years sustain the giants during the wetter seasons. During summer droughts, the worms dig burrows as deep as fifteen feet, conserving water with specialized kidney-like organs. Farmers that arrived in eastern Washington prized the fertile Palouse soils, resulting in the almost complete destruction of the bunchgrass prairies that characterized this region by the late 1800's. The biggest threat to these elusive giants continues to be habitat destruction due to agriculture and development, but the introduction of the now widespread European earthworm has also helped to further the decline of our native Palouse worm. A documented sighting of this rare creature has not been recorded since 1978, when one was unearthed in the Palouse country of Washington State (PBI 2004).

1.4.3.4 Washington Priority Habitats and Species

The WDFW publishes a Priority Habitats and Species (PHS) list and a Species of Concern (SOC) list (WDFW 2004). The PHS list is a catalog of habitats and species considered to be priorities for conservation and management. Priority species require protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. Priority species include state Endangered, Threatened, Sensitive, and Candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or tribal importance that are vulnerable. Priority habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. A priority habitat may consist of a unique vegetation type or dominant plant species, a described successional stage, or a specific structural element. The PHS list is located in Appendix A.

The SOC list, published by the Wildlife Management Program, includes only native Washington Fish and Wildlife species that are listed as Endangered, Threatened, or Sensitive, or as Candidates for these designations. Endangered, Threatened, and Sensitive species are legally established in Washington Administrative Codes. Candidate species are established by WDFW policy (SOC species found in Appendix B).

1.4.3.5 Idaho Endangered Species

Idaho Department of Fish and Game (IDFG) established and maintains programs for the conservation of endangered and threatened species. The goal is to de-list species based on recovery. In Idaho, the USFWS (as of November 2001) lists ten animal species (invertebrates and vertebrates) as endangered and eight animal and four plant species as threatened (IDFG 2004). The list of Idaho federally listed species is found in Appendix B.

1.4.3.6 Wildlife Species

There are an estimated 348 wildlife species that occur in the Palouse subbasin, and are listed in Table 2 (Ashley and Stovall 2004). Eighty-seven percent of the wildlife species that occur in the Washington Subbasin Planning Ecoregion occur in the Palouse subbasin. All of the amphibian species and reptile species that occur in the Washington Subbasin Planning Ecoregion occur in the Palouse subbasin. Fifteen species in the Palouse subbasin are non-native.

Nine wildlife species that occur in the subbasin are listed federally and 56 species are listed in Washington and Idaho as threatened, endangered, or candidate species (Appendix B). A total of 92 bird species are listed as Washington or Idaho State Partners in Flight priority and focal species (Appendix C), and a total of 71 wildlife species are managed as game species in Washington and Idaho (Table 3).

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004)

Amphibians		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	Tiger Salamander	*Ambystoma tigrinum*
Native	Long-toed Salamander	*Ambystoma macrodactylum*
Native	Idaho Giant Salamander	*Dicamptodon aterrimus*
Native status not confirmed	Rough-skinned Newt	*Taricha granulosa*
Native	Tailed Frog	*Ascaphus truei*
Native	Great Basin Spadefoot	*Scaphiopus intermontanus*
Native	Western Toad	*Bufo boreas*
Native	Woodhouse's Toad	*Bufo woodhousii*
Native	Pacific Chorus (Tree) Frog	*Pseudacris regilla*
Native	Oregon Spotted Frog	*Rana pretiosa*
Native	Columbia Spotted Frog	*Rana luteiventris*
Native	Northern Leopard Frog	*Rana pipiens*
Non-native	Bullfrog	*Rana catesbeiana*
Native	Painted Turtle	*Chrysemys picta*
Native	Northern Alligator Lizard	*Elgaria coerulea*
Native	Short-horned Lizard	*Phrynosoma douglassii*
Native	Sagebrush Lizard	*Sceloporus graciosus*
Native	Western Fence Lizard	*Sceloporus occidentalis*
Native	Side-blotched Lizard	*Uta stansburiana*
Native	Western Skink	*Eumeces skiltonianus*
Native	Rubber Boa	*Charina bottae*
Native	Racer	*Coluber constrictor*
Native	Ringneck Snake	*Diadophis punctatus*
Native	Night Snake	*Hypsiglena torquata*
Native	Striped Whipsnake	*Masticophis taeniatus*
Native	Gopher Snake	*Pituophis catenifer*
Native	Western Terrestrial Garter Snake	*Thamnophis elegans*
Native	Common Garter Snake	*Thamnophis sirtalis*
Native	Western Rattlesnake	*Crotalus viridis*
Birds		
Native	Pied-billed Grebe	*Podilymbus podiceps*
Native	Red-necked Grebe	*Podiceps grisegena*
Native	Eared Grebe	*Podiceps nigricollis*
Native	Western Grebe	*Aechmophorus occidentalis*
Native	Clark's Grebe	*Aechmophorus clarkii*
Native	Double-crested Cormorant	*Phalacrocorax auritus*
Native	American Bittern	*Botaurus lentiginosus*
Native	Great Blue Heron	*Ardea herodias*
Native	Great Egret	*Ardea alba*
Native	Black-crowned Night-heron	*Nycticorax nycticorax*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	Turkey Vulture	*Cathartes aura*
Native	Canada Goose	*Branta canadensis*
Native	Tundra Swan	*Cygnus columbianus*
Native	Wood Duck	*Aix sponsa*
Native	Gadwall	*Anas strepera*
Native	American Widgeon	*Anas americana*
Native	Mallard	*Anas platyrhynchos*
Native	Blue-winged Teal	*Anas discors*
Native	Cinnamon Teal	*Anas cyanoptera*
Native	Northern Shoveler	*Anas clypeata*
Native	Northern Pintail	*Anas acuta*
Native	Green-winged Teal	*Anas crecca*
Native	Canvasback	*Aythya valisineria*
Native	Redhead	*Aythya americana*
Native	Ring-necked Duck	*Aythya collaris*
Native	Greater Scaup	*Aythya marila*
Native	Lesser Scaup	*Aythya affinis*
Native	Harlequin Duck	*Histrionicus histrionicus*
Native	Bufflehead	*Bucephala albeola*
Native	Common Goldeneye	*Bucephala clangula*
Native	Barrow's Goldeneye	*Bucephala islandica*
Native	Hooded Merganser	*Lophodytes cucullatus*
Native	Common Merganser	*Mergus merganser*
Native	Ruddy Duck	*Oxyura jamaicensis*
Native	Osprey	*Pandion haliaetus*
Native	Bald Eagle	*Haliaeetus leucocephalus*
Native	Northern Harrier	*Circus cyaneus*
Native	Sharp-shinned Hawk	*Accipiter striatus*
Native	Cooper's Hawk	*Accipiter cooperii*
Native	Northern Goshawk	*Accipiter gentilis*
Native	Swainson's Hawk	*Buteo swainsoni*
Native	Red-tailed Hawk	*Buteo jamaicensis*
Native	Ferruginous Hawk	*Buteo regalis*
Native	Rough-legged Hawk	*Buteo lagopus*
Native	Golden Eagle	*Aquila chrysaetos*
Native	American Kestrel	*Falco sparverius*
Native	Merlin	*Falco columbarius*
Native	Gyrfalcon	*Falco rusticolus*
Native	Peregrine Falcon	*Falco peregrinus*
Native	Prairie Falcon	*Falco mexicanus*
Non-native	Chukar	*Alectoris chukar*
Non-native	Gray Partridge	*Perdix perdix*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Non-native	Ring-necked Pheasant	*Phasianus colchicus*
Native	Ruffed Grouse	*Bonasa umbellus*
Native	Sage Grouse	*Centrocercus urophasianus*
Native	Spruce Grouse	*Falcipennis canadensis*
Native	Blue Grouse	*Dendragapus obscurus*
Native	Sharp-tailed Grouse	*Tympanuchus phasianellus*
Non-native	Wild Turkey	*Meleagris gallopavo*
Native	Mountain Quail	*Oreortyx pictus*
Native	Gambel's quail	*Callipedia gambelii*
Native	California Quail	*Callipepla californica*
Native	Virginia Rail	*Rallus limicola*
Native	Sora	*Porzana carolina*
Native	American Coot	*Fulica americana*
Native	Killdeer	*Charadrius vociferus*
Native	Black-necked Stilt	*Himantopus mexicanus*
Native	American Avocet	*Recurvirostra Americana*
Native	Greater Yellowlegs	*Tringa melanoleuca*
Native	Lesser Yellowlegs	*Tringa flavipes*
Native	Solitary Sandpiper	*Tringa solitaria*
Native	Spotted Sandpiper	*Actitis macularia*
Native	Upland Sandpiper	*Bartramia longicauda*
Native	Long-billed Curlew	*Numenius americanus*
Native	Semipalmated Sandpiper	*Calidris pusilla*
Native	Western Sandpiper	*Calidris mauri*
Native	Least Sandpiper	*Calidris minutilla*
Native	Baird's Sandpiper	*Calidris bairdii*
Native	Pectoral Sandpiper	*Calidris melanotos*
Native	Stilt Sandpiper	*Calidris himantopus*
Native	Long-billed Dowitcher	*Limnodromus scolopaceus*
Native	Common Snipe	*Gallinago gallinago*
Native	Wilson's Phalarope	*Phalaropus tricolor*
Native	Red-necked Phalarope	*Phalaropus lobatus*
Native	Ring-billed Gull	*Larus delawarensis*
Native status not confirmed	California Gull	*Larus californicus*
Native status not confirmed	Herring Gull	*Larus argentatus*
Native	Thayer's Gull	*Larus thayeri*
Native	Glaucous Gull	*Larus hyperboreus*
Native	Caspian Tern	*Sterna caspia*
Native	Common Tern	*Sterna hirundo*
Native	Forster's Tern	*Sterna forsteri*
Native	Black Tern	*Chlidonias niger*
Non-native	Rock Dove	*Columba livia*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	Mourning Dove	*Zenaida macroura*
Native	Yellow-billed Cuckoo	*Coccyzus americanus*
Native	Barn Owl	*Tyto alba*
Native	Flammulated Owl	*Otus flammeolus*
Native	Western Screech-owl	*Otus kennicottii*
Native	Great Horned Owl	*Bubo virginianus*
Native	Snowy Owl	*Nyctea scandiaca*
Native	Northern Pygmy-owl	*Glaucidium gnoma*
Native	Burrowing Owl	*Athene cunicularia*
Native	Barred Owl	*Strix varia*
Native	Great Gray Owl	*Strix nebulosa*
Native	Long-eared Owl	*Asio otus*
Native	Short-eared Owl	*Asio flammeus*
Native	Boreal Owl	*Aegolius funereus*
Native	Northern Saw-whet Owl	*Aegolius acadicus*
Native	Common Nighthawk	*Chordeiles minor*
Native	Common Poorwill	*Phalaenoptilus nuttallii*
Native	Black Swift	*Cypseloides niger*
Native	Common Poorwill	*Phalaenoptilus nuttallii*
Native	Black Swift	*Cypseloides niger*
Native	Vaux's Swift	*Chaetura vauxi*
Native	White-throated Swift	*Aeronautes saxatalis*
Native	Black-chinned Hummingbird	*Archilochus alexandri*
Native	Calliope Hummingbird	*Stellula calliope*
Native	Broad-tailed Hummingbird	*Selasphorus platycercus*
Native	Rufous Hummingbird	*Selasphorus rufus*
Native	Belted Kingfisher	*Ceryle alcyon*
Native	Lewis's Woodpecker	*Melanerpes lewis*
Native	Williamson's Sapsucker	*Sphyrapicus thyroideus*
Native	Red-naped Sapsucker	*Sphyrapicus nuchalis*
Native	Downy Woodpecker	*Picoides pubescens*
Native	Hairy Woodpecker	*Picoides villosus*
Native	White-headed Woodpecker	*Picoides albolarvatus*
Native	Three-toed Woodpecker	*Picoides tridactylus*
Native	Black-backed Woodpecker	*Picoides arcticus*
Native	Northern Flicker	*Colaptes auratus*
Native	Pileated Woodpecker	*Dryocopus pileatus*
Native	Olive-sided Flycatcher	*Contopus cooperi*
Native	Western Wood-pewee	*Contopus sordidulus*
Native	Willow Flycatcher	*Empidonax traillii*
Native	Hammond's Flycatcher	*Empidonax hammondii*
Native	Gray Flycatcher	*Empidonax wrightii*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	Western Wood-pewee	*Contopus sordidulus*
Native	Willow Flycatcher	*Empidonax traillii*
Native	Hammond's Flycatcher	*Empidonax hammondii*
Native	Gray Flycatcher	*Empidonax wrightii*
Native	Dusky Flycatcher	*Empidonax oberholseri*
Native	Pacific-slope Flycatcher	*Empidonax difficilis*
Native	Cordilleran Flycatcher	*Empidonax occidentalis*
Native	Say's Phoebe	*Sayornis saya*
Native	Western Kingbird	*Tyrannus verticalis*
Native	Eastern Kingbird	*Tyrannus tyrannus*
Native	Loggerhead Shrike	*Lanius ludovicianus*
Native	Northern Shrike	*Lanius excubitor*
Native	Cassin's Vireo	*Vireo cassinii*
Native	Warbling Vireo	*Vireo gilvus*
Native	Red-eyed Vireo	*Vireo olivaceus*
Native	Gray Jay	*Perisoreus canadensis*
Native	Steller's Jay	*Cyanocitta stelleri*
Native	Clark's Nutcracker	*Nucifraga columbiana*
Native	Black-billed Magpie	*Pica pica*
Native	American Crow	*Corvus brachyrhynchos*
Native	Northwestern Crow	*Corvus caurinus*
Native	Common Raven	*Corvus corax*
Native	Horned Lark	*Eremophila alpestris*
Native	Tree Swallow	*Tachycineta bicolor*
Native	Violet-green Swallow	*Tachycineta thalassina*
Native	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Native	Bank Swallow	*Riparia riparia*
Native	Cliff Swallow	*Petrochelidon pyrrhonota*
Native	Barn Swallow	*Hirundo rustica*
Native	Black-capped Chickadee	*Poecile atricapillus*
Native	Mountain Chickadee	*Poecile gambeli*
Native	Chestnut-backed Chickadee	*Poecile rufescens*
Native	Red-breasted Nuthatch	*Sitta canadensis*
Native	White-breasted Nuthatch	*Sitta carolinensis*
Native	Pygmy Nuthatch	*Sitta pygmaea*
Native	Brown Creeper	*Certhia americana*
Native	Rock Wren	*Salpinctes obsoletus*
Native	Canyon Wren	*Catherpes mexicanus*
Native	House Wren	*Troglodytes aedon*
Native	Winter Wren	*Troglodytes troglodytes*
Native	Marsh Wren	*Cistothorus palustris*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	American Dipper	*Cinclus mexicanus*
Native	Golden-crowned Kinglet	*Regulus satrapa*
Native	Ruby-crowned Kinglet	*Regulus calendula*
Native	Western Bluebird	*Sialia mexicana*
Native	Mountain Bluebird	*Sialia currucoides*
Native	Townsend's Solitaire	*Myadestes townsendi*
Native	Veery	*Catharus fuscescens*
Native	Swainson's Thrush	*Catharus ustulatus*
Native	Hermit Thrush	*Catharus guttatus*
Native	American Robin	*Turdus migratorius*
Native	Varied Thrush	*Ixoreus naevius*
Native	Gray Catbird	*Dumetella carolinensis*
Native	Northern Mockingbird	*Mimus polyglottos*
Native	Sage Thrasher	*Oreoscoptes montanus*
Non-native	European Starling	*Sturnus vulgaris*
Native	Bohemian Waxwing	*Bombycilla garrulus*
Native	Cedar Waxwing	*Bombycilla cedrorum*
Native	Orange-crowned Warbler	*Vermivora celata*
Native	Nashville Warbler	*Vermivora ruficapilla*
Native	Yellow Warbler	*Dendroica petechia*
Native	Yellow-rumped Warbler	*Dendroica coronata*
Native	Townsend's Warbler	*Dendroica townsendi*
Native	American Redstart	*Setophaga ruticilla*
Native	Northern Waterthrush	*Seiurus noveboracensis*
Native	Macgillivray's Warbler	*Oporornis tolmiei*
Native	Common Yellowthroat	*Geothlypis trichas*
Native	Wilson's Warbler	*Wilsonia pusilla*
Native	Yellow-breasted Chat	*Icteria virens*
Native	Western Tanager	*Piranga ludoviciana*
Native	Spotted Towhee	*Pipilo maculatus*
Native	American Tree Sparrow	*Spizella arborea*
Native	Chipping Sparrow	*Spizella passerina*
Native	Brewer's Sparrow	*Spizella breweri*
Native	Vesper Sparrow	*Pooecetes gramineus*
Native	Lark Sparrow	*Chondestes grammacus*
Native	Black-throated Sparrow	*Amphispiza bilineata*
Native	Sage Sparrow	*Amphispiza belli*
Native	Savannah Sparrow	*Passerculus sandwichensis*
Native	Grasshopper Sparrow	*Ammodramus savannarum*
Native	Fox Sparrow	*Passerella iliaca*
Native	Song Sparrow	*Melospiza melodia*
Native	Lincoln's Sparrow	*Melospiza lincolnii*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Birds		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	White-crowned Sparrow	*Zonotrichia leucophrys*
Native	Dark-eyed Junco	*Junco hyemalis*
Non-native	House Sparrow	*Passer domesticus*
Native	Lapland Longspur	*Calcarius lapponicus*
Native	Snow Bunting	*Plectrophenax nivalis*
Native	Black-headed Grosbeak	*Pheucticus melanocephalus*
Native	Lazuli Bunting	*Passerina amoena*
Native	Bobolink	*Dolichonyx oryzivorus*
Native	Red-winged Blackbird	*Agelaius phoeniceus*
Native	Western Meadowlark	*Sturnella neglecta*
Native	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Native	Brewer's Blackbird	*Euphagus cyanocephalus*
Native	Brown-headed Cowbird	*Molothrus ater*
Native	Bullock's Oriole	*Icterus bullockii*
Native	Black Rosy-finch	*Leucosticte atrata*
Native	Pine Grosbeak	*Pinicola enucleator*
Native	Cassin's Finch	*Carpodacus cassinii*
Native	House Finch	*Carpodacus mexicanus*
Native	Red Crossbill	*Loxia curvirostra*
Native	Common Redpoll	*Carduelis flammea*
Native	Pine Siskin	*Carduelis pinus*
Native	American Goldfinch	*Carduelis tristis*
Native	Evening Grosbeak	*Coccothraustes vespertinus*
Mammals		
Non-native	Virginia Opossum	*Didelphis virginiana*
Native	Masked Shrew	*Sorex cinereus*
Native	Preble's Shrew	*Sorex preblei*
Native	Vagrant Shrew	*Sorex vagrans*
Native	Montane Shrew	*Sorex monticolus*
Native	Water Shrew	*Sorex palustris*
Native	Merriam's Shrew	*Sorex merriami*
Native	Pygmy Shrew	*Sorex hoyi*
Native	California Myotis	*Myotis californicus*
Native	Western Small-footed Myotis	*Myotis ciliolabrum*
Native	Yuma Myotis	*Myotis yumanensis*
Native	Little Brown Myotis	*Myotis lucifugus*
Native	Long-legged Myotis	*Myotis volans*
Native	Fringed Myotis	*Myotis thysanodes*
Native	Long-eared Myotis	*Myotis evotis*
Native	Silver-haired Bat	*Lasionycteris noctivagans*
Native	Western Pipistrelle	*Pipistrellus hesperus*
Native	Big Brown Bat	*Eptesicus fuscus*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) *(*continued*)*

Mammals		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Native	Hoary Bat	*Lasiurus cinereus*
Native	Spotted Bat	*Euderma maculatum*
Native	Townsend's Big-eared Bat	*Corynorhinus townsendii*
Native	Pallid Bat	*Antrozous pallidus*
Native	American Pika	*Ochotona princeps*
Non-native	Eastern Cottontail	*Sylvilagus floridanus*
Native	Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*
Native	Snowshoe Hare	*Lepus americanus*
Native	White-tailed Jackrabbit	*Lepus townsendii*
Native	Black-tailed Jackrabbit	*Lepus californicus*
Native	Least Chipmunk	*Tamias minimus*
Native	Yellow-pine Chipmunk	*Tamias amoenus*
Native	Red-tailed Chipmunk	*Tamias ruficaudus*
Native	Yellow-bellied Marmot	*Marmota flaviventris*
Native	Townsend's Ground Squirrel	*Spermophilus townsendii*
Native	Washington Ground Squirrel	*Spermophilus washingtoni*
Native	Columbian Ground Squirrel	*Spermophilus columbianus*
Native	Golden-mantled Ground Squirrel	*Spermophilus lateralis*
Non-native	Eastern Gray Squirrel	*Sciurus carolinensis*
Non-native	Eastern Fox Squirrel	*Sciurus niger*
Native	Red Squirrel	*Tamiasciurus hudsonicus*
Native	Northern Flying Squirrel	*Glaucomys sabrinus*
Native	Northern Pocket Gopher	*Thomomys talpoides*
Native	Great Basin Pocket Mouse	*Perognathus parvus*
Native	Ord's Kangaroo Rat	*Dipodomys ordii*
Native	American Beaver	*Castor canadensis*
Native	Western Harvest Mouse	*Reithrodontomys megalotis*
Native	Deer Mouse	*Peromyscus maniculatus*
Native	Northern Grasshopper Mouse	*Onychomys leucogaster*
Native	Bushy-tailed Woodrat	*Neotoma cinerea*
Native	Southern Red-backed Vole	*Clethrionomys gapperi*
Native	Heather Vole	*Phenacomys intermedius*
Native	Meadow Vole	*Microtus pennsylvanicus*
Native	Montane Vole	*Microtus montanus*
Native	Long-tailed Vole	*Microtus longicaudus*
Native	Water Vole	*Microtus richardsoni*
Native	Sagebrush Vole	*Lemmiscus curtatus*
Native	Muskrat	*Ondatra zibethicus*
Non-native	Norway Rat	*Rattus norvegicus*
Non-native	House Mouse	*Mus musculus*
Native	Western Jumping Mouse	*Zapus princes*
Native	Common Porcupine	*Erethizon dorsatum*

Table 2. Wildlife Species Occurrence for the Palouse Subbasin (Ashley and Stovall 2004) (continued)

Mammals		
Native or Non-native Origin	**Common Name**	**Scientific Name**
Non-native	Nutria	*Myocastor coypus*
Native	Coyote	*Canis latrans*
Native	Gray Wolf	*Canis lupus*
Native	Red Fox	*Vulpes vulpes*
Native	Black Bear	*Ursus americanus*
Native	Raccoon	*Procyon lotor*
Native	Fisher	*Martes pennanti*
Native	Ermine	*Mustela erminea*
Native	Long-tailed Weasel	*Mustela frenata*
Native	Mink	*Mustela vison*
Native	Wolverine	*Gulo gulo*
Native	American Badger	*Taxidea taxus*
Native	Western Spotted Skunk	*Spilogale gracilis*
Native	Striped Skunk	*Mephitis mephitis*
Native	Northern River Otter	*Lutra canadensis*
Native	Mountain Lion	*Puma concolor*
Native	Lynx	*Lynx canadensis*
Native	Bobcat	*Lynx rufus*
Native	Elk	*Cervus elaphus*
Native	Mule Deer	*Odocoileus hemionus*
Native	White-tailed Deer	*Odocoileus virginianus*
Native	Moose	*Alces alces*

Table 3. Wildlife Game Species of the Palouse Subbasin (Ashley and Stovall 2003b)

Washington Game Species (Common Name)		Idaho Game Species (Common Name)	
Bullfrog	Ruffed Grouse	Greater White-fronted Goose	Sharp-tailed Grouse
Greater White-fronted Goose	Spruce Grouse	Snow Goose	Wild Turkey
Snow Goose	Blue Grouse	Ross's Goose	Gambel's Quail
Ross's Goose	Wild Turkey	Canada Goose	Mountain Quail
Canada Goose	Mountain Quail	Wood Duck	California Quail
Wood Duck	California Quail	Gadwall	American Coot
Gadwall	American Coot	American Widgeon	Wilson's Snipe
Eurasian Widgeon	Wilson's Snipe	Mallard	Mourning Dove
American Widgeon	Band-tailed Pigeon	Blue-winged Teal	American Crow
Mallard	Mourning Dove	Cinnamon Teal	Nuttall's (Mountain) Cottontail
Blue-winged Teal	Eastern Cottontail	Northern Shoveler	Snowshoe Hare
Cinnamon Teal	Nuttall's (Mountain) Cottontail	Northern Pintail	American Beaver
Northern Shoveler	Snowshoe Hare	Green-winged Teal	Muskrat
Northern Pintail	White-tailed Jackrabbit	Canvasback	Red Fox
Green-winged Teal	Black-tailed Jackrabbit	Redhead	Black Bear
Canvasback	Black Bear	Ring-necked Duck	Raccoon
Redhead	Mountain Lion	Lesser Scaup	American Marten
Ring-necked Duck	Rocky Mountain Elk	Bufflehead	Mink
Greater Scaup	Mule Deer	Common Goldeneye	American Badger
Lesser Scaup	White-tailed Deer	Barrow's Goldeneye	Northern River Otter
Surf Scoter	Moose	Hooded Merganser	Mountain Lion
Bufflehead		Common Merganser	Bobcat
Common Goldeneye		Red-breasted Merganser	Rocky Mountain Elk
Barrow's Goldeneye		Ruddy Duck	Mule Deer
Hooded Merganser		Chukar	White-tailed Deer
Common Merganser		Gray Partridge	Moose
Red-breasted Merganser		Ring-necked Pheasant	
Ruddy Duck		Ruffed Grouse	
Chukar		Sage Grouse	
Gray Partridge		Spruce Grouse	
Ring-necked Pheasant		Blue Grouse	

1.4.4 Palouse Subbasin Fauna and Responses to Habitat Changes

1.4.4.1 Amphibians and Reptiles

In recent decades, biologists have documented worldwide declines in amphibian populations (MAP 2004). Several species are now extinct, and other once-thriving populations have diminished greatly in numbers. Research is finding amphibian deformities also appear to be on the rise across the United States, but limited information exists for the Pacific Northwest or the Palouse subbasin. Possible causes of declines and deformities include habitat degradation and loss, introduction of pathogens, fish and other animals in to ecosystems, thinning of the ozone layer and increased exposure to ultraviolet radiation, environmental contaminants, and commercial exploitation (Beebee 1996). Although a lack of long-term data contributes to incomplete evaluations of amphibian and reptile population trends, information is available documenting the loss of riparian and wetland habitats.

1.4.4.2 Birds

The ferruginous hawk is classified as a Washington State threatened species. Three ferruginous hawk territories occur in the Palouse subbasin within areas of shrub-steppe habitat. The regional decline in abundance of ferruginous hawks has been tied to shrub-steppe habitat alteration and fragmentation associated with agricultural conversion and grazing, and with subsequent declines in abundance of prey species. Black-tailed jackrabbits, white-tailed jackrabbits, and Washington ground squirrels are important prey for nesting ferruginous hawks in Washington. All three species of mammals currently are candidates for Washington State threatened and endangered listing within Washington due to their low and/or declining abundance. The Washington ground squirrel is also a candidate for federal listing.

Golden eagles are classified as a Washington State species of concern. Golden eagles occur in shrub-steppe habitats throughout Washington. Data collected since 1987 suggests that less than 50% of 200 historic golden eagle territories in Washington are currently occupied (Ashley and Stovall 2004). Two golden eagle territories have been documented in the Palouse subbasin. Reasons for low site occupancy in the subbasin may be related to low prey abundance in shrub-steppe habitats near nest sites. Principle prey, such as black-tailed jackrabbits, white-tailed jackrabbits, and Washington ground squirrels, have declined dramatically, largely as a result of conversion and degradation of shrub-steppe habitat. A further concern may be toxic lead poisoning, possibly associated with lead shot or bullets in the carcasses of prey.

Bald eagles, listed as ESA federally threatened, primarily winter in the Palouse subbasin. No recent nesting has been recorded in this subbasin. Maintaining high quality habitat for prey species such as fish and waterfowl, enhancing nesting opportunities, and protecting potential winter roost sites are critical if bald eagles are to occupy the subbasin year round. The bald eagle population in eastern Washington is currently increasing.

Burrowing owls are classified as a Washington State species of Concern. Burrowing owls appear to be associated with open habitats, including shrub-steppe, and are declining within most of their historic range in Washington. Some of the declines appear to be related to long-term loss in availability of potential burrows. However, in some parts of the subbasin, burrowing owls have declined at locations where burrows are available. The decline in number of burrows may be an indirect result of declines of burrowing mammals including rabbits, badgers, and ground squirrels. Burrowing owls appear to be declining in the Palouse subbasin based on incidental observations and recent inventories.

Many species that are associated with cliff habitat appear to be at risk due to the declining quality, quantity, and availability of native habitat near cliffs. Declining habitat has led to species such as jackrabbits, ground squirrels, and marmots, which are used by golden eagles and other raptors.

The Columbian sharp-tailed grouse is listed as Washington State threatened. Sharp-tailed grouse were endemic to the Palouse Prairie prior to the major conversion to agriculture (Ashley and Stovall 2003b). This species was found in the Palouse subbasin as recently as the 1940s and 1950s. Sharp-tailed grouse are now extirpated from the area. Two populations remain in eastern Washington: one population in central Lincoln County; and the other in Douglas and Okanagan Counties. The northwest corner of the subbasin lies within WDFW's sharp-tailed grouse management zone (Zone 4). The conversion of grasslands to crop production eliminated critical nesting and brood rearing habitat. Likewise, elimination of brushy upland draws and deciduous trees in riparian areas, used as winter habitat, also contributed to the sharp-tails' decline within this subbasin.

The sage grouse is listed as Washington State threatened. The current population in Washington is estimated to be around 1,000 with about 700 of the birds residing in a contiguous subpopulation in Douglas and Grant Counties. Sage grouse no longer are found in the Palouse subbasin, but did occur in this area as late as the 1940s. Sage grouse require large continuous expanses of sagebrush punctuated by wet meadows and grasslands.

Mountain quail are native to the Idaho portion of the subbasin and listed as Idaho Species of Concern. Found in brushy mountainsides, coniferous forests, forest and meadow edges, and dense undergrowth, sightings as recent as 2000 have been made near Moscow Mountain. The population in Idaho has been declining for the last 30 years, however, mountain quail status in the Idaho portion of the subbasin is unknown.

Gray (Hungarian) partridge are a common resident in the agricultural fields of the subbasin. This species was introduced from Europe in the early 1900's and is an important upland game species. The lack of winter habitat, consisting of trees and shrubs adjacent to grain fields, may be the primary limiting factor for this species in the subbasin.

Ring-neck pheasants were first introduced from Asia in 1881 and are an important upland game bird species. Pheasants feed primarily on waste grain, weed seeds, wild fruits and berries, forbs and grasses, and insects. Once common throughout agricultural areas, pheasant numbers declined considerably when fencerows were eliminated from nearly all of the region's agricultural fields in the 1950s. Winter cover is also a limiting factor for this species in the subbasin.

According to Rule (2004), there are 22 species of ducks, the tundra swan and one sub-species of Canada goose that nest and/or migrate through the subbasin (Table 4). A comprehensive evaluation of waterfowl use of the subbasin has not recently been done, so population numbers throughout the year are not available except for some limited localities. Based on the occurrence of wetland habitat, the highest density of breeding waterfowl would occur in the northern and western portion of the subbasin in the potholes and sloughs of the channeled scablands. In this area wetlands constitute at least 16% of the landscape and there are as many as 10 individual wetland basins per square mile. Population surveys on Turnbull National Wildlife Refuge, located within the heart of the channeled scablands, indicate that mallards, redheads, gadwall, cinnamon teal and ruddy ducks make up more than 50% of waterfowl breeding population and total waterfowl breeding pair densities exceed 100 pairs/square mile. The refuge, however, is an area where the wetland complex is relatively intact. As much as 70% of the wetlands in the reminder of the scablands area have been altered for agricultural purposes. The large, historically permanent wetland sloughs have been the most impacted. These basins have been ditched and drained to create seasonally flooded pastures and hay meadows. The result is an abundance of seasonal wetlands in spring for migration and pair formation, but a shortage of wetland habitat for late-season over water nesters, brood rearing and fall migration. Mid- to late-season nesters such as the cinnamon teal, gadwall and redhead have been the most impacted by this alteration.

Grasslands, CRP fields, and shrub-steppe habitats with good grass cover in the spring provide nesting habitat for upland nesting ducks. The small isolated wetlands and seasonally flooded cropland found throughout the Palouse Prairie portion of the subbasin provide little waterfowl habitat (Rule 2004). Many these small open-water areas are farm ponds that have been constructed by private landowners, primarily for recreation (fish ponds) and livestock water resources. These provide marginal waterfowl nesting habitat, though deep ponds do provide some diving duck habitat. Developed and improved wetlands are providing some nesting and brood-rearing habitat for local ducks and geese in the Idaho portion of the subbasin.

Rule (2004) states that although most species of waterfowl listed in Table 4 utilize the subbasin during the spring and fall migration periods, there are a few that are either more abundant during migration (northern pintail and American widgeon) or only utilize the subbasin during that time period (tundra swan). In the spring, natural wetlands and flooded hay fields, croplands, and pastures make excellent waterfowl migration habitat which is abundant during normal to wet years. In the fall migration habitat is limited through summer drawdown and drying of seasonal wetlands and flooded agricultural lands. At this time intact permanent wetland basins such as those on Turnbull National Wildlife Refuge, and the lakes, rivers and perennial streams of the subbasin provide waterfowl with this habitat. Although large numbers of waterfowl move through this area during the fall, drainage of many wetlands and the creation of additional wetland habitat adjacent to farm fields in the Central Basin has shifted much of the flyway west.

Table 4. Waterfowl Species Utilizing the Palouse Subbasin for Nesting and Migration Stop-over (Rule 2004)

Waterfowl Species	Subbasin Utilization
Canada Goose *Branta Canadensis*	Nesting, migration, wintering
Tundra Swan *Cygnus columbianus*	Migration
Wood Duck *Aix sponsa*	Nesting, migration
Gadwall *Anas strepera*	Nesting, migration
American Widgeon *Anas Americana*	Migration, nesting
Mallard *Anas platyrhynchos*	Nesting, migration, wintering
Blue-winged Teal *Anas discors*	Nesting, migration
Cinnamon Teal *Anas cyanoptera*	Nesting, migration
Northern Shoveler *Anas clypeata*	Nesting, migration
Northern Pintail *Anas acuta*	Migration, nesting
Green-winged Teal *Anas crecca*	Nesting, migration, wintering
Canvasback *Aythya valisineria*	Migration, nesting
Redhead *Aythya Americana*	Nesting, migration
Ring-necked Duck *Aythya collaris*	Nesting, migration
Greater Scaup *Aythya marila*	Migration
Lesser Scaup *Aythya affinis*	Nesting, migration
Harlequin Duck *Histrionicus histrionicus*	Nesting
Bufflehead *Bucephala albeola*	Nesting
Common Goldeneye *Bucephala clangula*	Nesting, migration, wintering
Barrow's Goldeneye *Bucephala islandica*	Nesting, migration, wintering
Hooded Merganser *Lophodytes cucullatus*	Nesting, migration , wintering
Common Merganser *Mergus merganser*	Nesting, migration, wintering
Ruddy Duck *Oxyura jamaicensis*	Nesting, migration

All native birds commonly found in the United States, with the exception of native resident game birds and introduced species, are protected under the Migratory Bird Treaty Act, administered by the USFWS. The USFWS's migratory bird conservation activities are focused on population assessment; international, national and flyway coordination; habitat management; and regulating take. The Pacific Region cooperates with Washington and Idaho in a Partners in Flight program. See Appendix C for a list of Partners in Flight species in the Palouse subbasin.

The North American Landbird Conservation Plan (Rich et a. 2004) outlines species of continental importance to the Intermountain West avifaunal biome (the Palouse subbasin is located in the Intermountain West avifaunal biome). Landbirds listed as focal species in Assessment 1.4.5 Focal Species, and in the North American Landbird Conservation Plan include Brewer's sparrow, sage thrasher, sage sparrow, flammulated owl, and white-headed woodpecker. Rich et al. (2004) state that logging and fire suppression have changed the age class, structure, tree density, and species composition of the conifer forests with negative consequences for many birds. Conversion of shrublands for agriculture, invasion of non-native grasses, overgrazing of grasses and forbs, development, sagebrush eradication, and changes in fire regimes have caused considerable loss and degradation of habitat, with subsequent declines of associated bird populations. Rich et al. (2004) affirm that riparian areas across the Intermountain West avifaunal biome have been substantially degraded by development of many types, including de-watering and alteration of water flows, road construction, invasion of non-native species, logging, severe overgrazing, and recreation.

The Oregon/Washington Landbird Conservation Plan (PIF 2004) reports that the principal post-settlement conservation issues affecting bird populations (in the Columbia Plateau) include habitat loss and fragmentation resulting from conversion to agriculture; and habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes. Most species of neotropical migratory birds within the Interior Columbia Basin identified as being of high management concern were shrub-steppe species.

According to the Idaho Bird Conservation Plan (Idaho Partners in Flight 2000), the natural hydrographs of nearly all major rivers in Idaho have been altered by channelization, dams/reservoirs, and water diversions impacting migratory bird habitat. Prior to settlement, most large rivers throughout Idaho spread across wide valley bottoms and supported forested and shrub wetlands, ponds, wet meadows, and marshes. Throughout the last century, dikes or levees were constructed in many of these systems to contain spring floods. Cottonwood forests were removed and wetlands were drained or filled for agricultural development. Many cottonwood forests and shrublands that were once plentiful and dynamic within these systems are now restricted to relatively small streamside bands within the levees or to islands within the river. Along with the loss of cottonwood forests came the loss of several bird species.

1.4.4.3 Mammals

A list of rodents that exist across the subbasin is found in Table 2. A lack of data contributes to incomplete evaluations in historic or current populations, or population responses to habitat changes.

White-tailed jackrabbits and black-tailed jackrabbits, listed as a Washington state species of concern, are closely associated with shrub-steppe habitats. Consequently, their populations have shown some of the same downward trends as other shrub-steppe obligates. White-tailed jackrabbits tend to be closely associated with the more mesic shrub-steppe habitats, and black-tailed jackrabbits with the relatively arid and/or disturbed sites. Although population figures are not available, the long-term declines appear to be dramatic (Ashley and Stovall 2004).

Washington ground squirrels, listed as a Washington state species of concern, are a species endemic to Washington and Oregon and have declined dramatically in both states. They are associated with relatively deep soils within shrub-steppe communities. Because the deep soil habitats were preferred areas for conversion, most are now used for dryland and/or irrigated agriculture. The widespread loss and fragmentation of shrub-steppe has resulted in dramatic declines in the statewide population of Washington ground squirrels. Most of the known populations of ground squirrels are within the Crab Creek subbasin (along the northwest border of the Palouse subbasin). The remaining populations appear to be at risk of extinction due to isolation from each other and the continued risk of habitat conversion, fragmentation, and degradation.

Prior to settlement by Anglo-Saxon pioneers, bat populations within the Palouse subbasin were confined to naturally occurring habitat (both rock and vegetative). The conversion of native habitats to agricultural lands has negatively impacted bat populations across the subbasin (Gillies 2004b). Similarly, pesticides and herbicides have negatively impacted bats and their prey base.

Loss of forested areas has reduced the populations of bats that rely on this habitat type for roosts (i.e. Pallid bat, Townsend's big-eared bat, big brown bat, hoary bat, silver-haired bat, Western small-footed myotis, long-eared myotis, little brown myotis, fringed myotis, and Yuma myotis). Cliff and rock dwelling species (i.e. pallid bat, Townsend's big-eared bat, big brown bat, ailver-haired bat, Western small-footed myotis, long-eared myotis, little brown myotis, long-legged myotis, Yuma myotis) have faired better since these habitats are generally not developed.

Past and present bat populations within the subbasin are difficult to estimate for any specific species due to their life histories, volant lifestyle, unwillingness to be readily trapped, and sensitivity to marking techniques. According to Gillies (2004a) it is believed that populations are declining at local, regional, and global levels. Reasons for the decline include habitat degradation, alteration, and fragmentation; roost disturbance and destruction; pesticide applications; and public unawareness would only lead to declines if it causes destructive behaviors or prevents positive behaviors. In the Palouse subbasin, habitat alteration and pesticide applications have affected bat populations. The conversion of prairies to agriculture altered their prey base, and the consequent application of pesticides, reduces that prey base. Mining activity is fairly limited on the Palouse. According to emergence surveys conducted in 2003 (Gillies 2004a) at the abandoned mines on the Palouse Ranger District, some mines were found to have activity. The potential for mines to be closed for hazard abatement is a serious threat to existing bat populations.

The bat species found within the Palouse subbasin (specifically within the Palouse Prairie ecosystem), as reported by the Idaho Bat Conservation Strategy, includes pallid bat, Townsend's big-eared bat, big brown bat, hoary bat, silver-haired bat, western small-footed bat, long-eared myotis, little brown bat, fringed myotis, long-legged myotis, and Yuma myotis.

The creation of new roosting and hibernacula habitat through mining operations undoubtedly benefited some species (i.e. Townsend's big-eared bat, long-legged myotis, and long-eared myotis), but the full extent is unknown (Gillies 2004b). However, indirect impacts may be substantial in areas adjacent to cliffs and mines where native foraging habitat has been degraded, converted to agriculture, urbanized, or otherwise altered. Increased focus on this suite of species is needed, as is consideration when management activities are planned, particularly in terms of mine closure activities.

The availability of roost sites is thought to be the greatest factor limiting bat populations. Specific microclimate requirements, which vary by species and/or sex, limit bat use to specific locations within areas where suitable habitat appears to be widely distributed. Within the Palouse subbasin, steep canyon walls, cliffs, and rock outcrops provide caves, cracks and fissures that are used as roosts, hibernacula and maternal colonies. Mature forests provide habitat for other species, like pallid and hoary bats. Areas forested with ponderosa pine, Douglas fir, and various shrubs provide locations for these activities as well in snags, under peeling bark, and within dense foliage.

Raccoon, coyote, bobcat, badgers, mink, muskrat, beaver, and river otter are the primary furbearers in the subbasin. All but the coyote and muskrat are significantly lower in abundance than they were historically (Cook 2001). In general, the declines appear to be related to an overall decline in habitat quality and quantity with an associated decline in food and/or prey base.

Fisher and lynx are closed to harvest in Idaho and Washington. There has been a closure to beaver harvest in Latah County since the early 1990s. Trapping participation in other areas has dropped due to successive years of low fur prices. Most furbearer animal populations are likely increasing in the Idaho portion of the subbasin due to reduced harvest, but the extent is not known (Cook 2001).

According to Daubenmire (1970), by the time the first European settlers came to eastern Washington, any antelope that might still have been present were very few and confined to the driest part of the steppe. The few deer and elk present at settlement remained close to the forest border or riparian thickets. Populations of whitetail deer in the Palouse were low until the early 1900s when settlement changed the landscape. Land was cleared for agricultural purposes, and logging converted dense forests into a mosaic of succession types. Deer populations probably peaked in the 1940s-1950s, followed by a decline. Given their secretive habits and preference for densely canopied cover, whitetail deer are extremely difficult to enumerate. The whitetail deer population is monitored through harvest surveys, which suggests that the population is increasing (Cook 2001). Whitetail deer in the subbasin are susceptible to Epizootic Hemorrhagic Disease (EHD), and outbreaks occur periodically with varying severity. Due to the susceptibility of whitetail deer to EHD and periodic die-offs, inter-specific competition between whitetail deer and mule deer may be insignificant within the subbasin. Both mule and whitetail deer are very dependant on the shrub and riparian habitats in this subbasin during snowy winter conditions.

Mule deer currently occur primarily in shrub-steppe habitat in the subbasin but use other habitats including CRP fields and cereal crops if the cropland is near shrub-steppe. Whitetail deer are dominant in the timbered areas throughout the subbasin. Whitetail and mule deer populations have increased in agricultural areas typically in response to the habitat created as a result of the CRP. Today, increased hunter harvest is encouraged in agricultural areas of the Washington portion of the Palouse subbasin in order to reduce deer-related crop depredation problems (McCanna 2004).

Like whitetail deer, mule deer populations were historically low in the subbasin. Populations have increased in agricultural areas partially in response to the habitat created as a result of the CRP (McCanna 2004). Mule deer prefer more open habitats of grassland-shrub types than whittails. As habitat types limit mule deer numbers, the mosaics in habitats including forests, grassland, brush fields and agricultural crops favor whitetail deer. In Washington, the mule deer population is monitored through harvest surveys which suggests that the population is increasing.

Rocky Mountain elk were present in the woodland and shrub-steppe habitats of eastern Washington and Idaho portion of the subbasin prior to the arrival of settlers (Ashley and Stovall 2003b). The current elk population in the Palouse subbasin is presumed to result from immigration from north central Idaho. This herd ranges over several thousand acres in portions of Lincoln, Whitman, south Spokane, and Latah counties. Recently, elk numbers have increased (Ashley and Stovall 2004). Elk in this subbasin provide significant recreational, aesthetic, and economic opportunities. Historically, elk herds were scattered and numbers low in the Idaho portion of the subbasin. Elk numbers did not significantly change until the wildfires of 1910, 1919 and 1934 burned over large areas, creating early to mid-seral conditions lush with forage and browse highly desired by elk. Maturation of brush fields, loss of winter range, and increased vulnerability of elk to hunters due to logging and road building caused a decline of elk numbers in the 1950s to 1970s. Timber harvest in the 1980s and 1990s in much if IDFG Unit 8A (Latah County) opened up forests to early successional habitat, and an increased availability of crops such as lentils, rapeseed and grain have bolstered populations. A switch to antlered-only harvest in 1976, with antlerless harvest by controlled permits only, has increased populations (Cook 2001).

Black bears occur occasionally in the shrub-steppe areas of the Palouse subbasin. The highest concentrations of bears, however, are found in the more timbered, mountainous areas of the subbasin located in Idaho. Even though WDFW's Black Bear Management Plan does refer to black bears in this subbasin, the number of bear in this area is very small.

The historical numbers of moose is not known. However, the population has increased significantly within the last 20 years in the Idaho portion of the subbasin. Logging, which created favorable shrub response, coupled with bulls-only hunting which reduced the number of antlerless moose killed during open seasons, set the stage for increased numbers of moose. Current populations are incidentally surveyed during aerial surveys for elk. Consequently, some moose are not counted as the surveys are seldom flown at elevations where moose normally winter. Moose prefer dense subalpine fir and Pacific yew plant associations, little of which is found in the subbasin. Favored summer habitats include open wet meadows adjacent to forested areas and shrub fields created by timber harvest disturbance. Although according to Rule (2004), there are increasing numbers of moose in southern Spokane County in the forested scabland areas.

It is not known what the historic mountain lion (cougar) population was in the subbasin. Currently, mountain lion numbers have increased in response to healthy white-tailed deer, elk and other prey populations. Mandatory hunter check-in of hide and skull provides an index of population size, sex and age structure.

1.4.5 Focal Species

At the subbasin planning level, habitat management was emphasized and includes focal species monitoring to evaluate project success. This approach is based on the following assumption: a conservation strategy that emphasizes ecosystems is more desirable than one that emphasizes individual species. With this approach, there is a much greater likelihood of maintaining key habitat attributes and providing functioning ecosystems for wildlife because the most important habitat conditions and habitat attributes for wildlife are described through this group of species. These selected species are referred to as focal species because they are the focus for describing desired habitat conditions and attributes. The rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation, most in need of restoration, or most important in a functioning ecosystem.

Focal species are representative of some habitat condition or feature that subbasin planners believe was important for wildlife species in a functioning ecosystem of that habitat type. Although conservation is directed towards focal species, establishment of conditions favorable to focal species also will likely benefit a wider group of species with similar habitat requirements. Monitoring of habitat attributes and focal species will provide a means of tracking progress towards conservation. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in this approach.

Focal species were selected using a combination of several factors including:

- Specialist species that are obligate or highly associated with key habitat
- Primary association with habitat types for breeding, rearing, and feeding features/ conditions important in functioning ecosystems
- Declining population trends or reduction in their historic breeding range
- Special management concern or conservation status such as threatened, endangered, species of concern, management focal species, etc.
- Recreational value
- Species' representation of a guild

Focal species were chosen to represent the six habitat types in the Palouse subbasin (Assessment section 1.4.2.3 Habitat Types within the Palouse Subbasin) and displayed in Table 5. Species selection rationale and habitat attributes are outlined in further detail in Table 6 through Table 11.

Table 5. Focal Species within Palouse Subbasin Wildlife Habitat Types

Habitat Types	Focal Species (Common Names)
Agriculture	Gray (Hungarian) Partridge Ring-necked Pheasant California Quail
Shrub-steppe	Sage Sparrow Sage Thrasher Brewer's Sparrow Mule Deer
Ponderosa Pine Forest	White-headed Woodpecker Flammulated Owl Big Brown Bat Yellow Pine Chipmunk
Grassland	Spalding's Catchfly Grasshopper Sparrow Sharp-tailed Grouse Loggerhead Shrike Lazuli Bunting
Mixed Conifer Forest	Pileated Woodpecker Silver-haired bat Southern Red-backed Vole Rocky Mountain Elk
Riparian and Wetland	Water Howellia Great Basin Spadefoot Yellow Warbler Common Snipe Red-winged Blackbird Great Blue Heron Common Yellowthroat Wood Duck Mallard Redhead Beaver

Table 6. Focal Species Selection for Agriculture Habitat Type within Palouse Subbasin

Agriculture Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Gray (Hungarian) Partridge	(Groves et al. 1997) (USFWS 1984) Depends on broadleaf foliage in winter, insects in early summer Builds nest in shallow depression in grass or shrubs, most nests found in areas of permanent cover on cropland periphery Prefers cropland fields of small grains throughout seasons Brushy field edges and shelterbelts used for winter shelter, summer shading and nesting	Food, reproduction, thermal cover	Indicator of adequate mixture of annual cropland with permanent grass/shrub field edges and draws Recreational value or importance
Ring-necked Pheasant	(Groves et al. 1997) (Ware and Tirhi 1999) Diet consists mainly of cultivated grains, green vegetation in spring, and may eat some insects, mice and snails Shrub/tree riparian area adjacent to croplands considered high value for nesting, escape and thermal cover	Food, escape cover, thermal cover	Indicator of adequate mixture of annual cropland with adjacent shrub/tree riparian areas Recreational value or importance WA Priority Species
California Quail	(Groves et al. 1997) (Calkins et al. 1999) (NRCS 2001) Generally prefers leaves and seeds of annual vegetation over perennial vegetation Requires cover for roosting, escaping, and loafing; water; and broken disturbed spaces for foraging Optimal distance between available water 0.5 miles	Food, cover	Indicator of micro-habitats which include cover for food production and water supply within defined area Recreational value or importance

Table 7. Focal Species Selection for Shrub-Steppe Habitat Type within Palouse Subbasin

Shrub-Steppe Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Sage Sparrow	(Vander Haegen 2003b) (Vander Haegen et al. date unavailable) Requires large contiguous patches of sagebrush and shrubs (>2,470 acres), with sagebrush cover ranging 10 to 25%, and shrubs averaging >15 inches in height Mated male territory size range from 2 to 11 acres Requires herbaceous cover >10% and open ground >10% Shrubs that are at least 75% living are selected for nesting, nests always located in living portion of plant Shrubs used for nesting generally between 16 to 40 inches	Food, reproduction	Indicator of large, contiguous blocks of healthy sagebrush dominated shrub-steppe habitat WA Priority Species WA Species of Concern WA Partners in Flight Species ID Partners in Flight Species North American Landbird Conservation Plan (Rich et al. 2004) Well documented life-history attributes (Knick et al. 2003)
Sage Thrasher	(Vander Haegen 2003b) (Groves et al. 1997) Optimum habitat is blocks of shrub-steppe >40 acres, with sagebrush cover 5 to 20%, with shrubs averaging 32 inches tall Herbaceous cover 5 to 20% with 10% of the ground bare (requiring less than 10% non-native herbaceous cover)	Food, reproduction	Indicator of healthy, tall sagebrush dominated shrub-steppe habitat WA Priority Species WA Species of Concern WA Partners in Flight Species ID Partners in Flight Species North American Landbird Conservation Plan (Rich et al. 2004) Well documented life-history attributes (Knick et al. 2003)
Brewer's Sparrow	(Groves et al. 1997) (Ashley and Stovall 2004) (Royal BC Museum 2004) Builds nest in sagebrush between 8 and 20 inches, or in low trees Forages on the ground Prefers large, living sagebrush for nesting, sagebrush cover 10 to 30% Requires 2.5 acres per two breading pair	Food, reproduction	Indicator of healthy sagebrush dominated shrub-steppe habitat WA Partners in Flight Species ID Partners in Flight Species ID protected non-game species North American Landbird Conservation Plan (Rich et al. 2004)

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Table 7. Focal Species Selection for Shrub-Steppe Habitat Type within Palouse Subbasin (continued)

Shrub-Steppe Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Mule Deer	(Groves et al. 1997) (Ashley and Stovall 2004) Home range size may be from 90 to 600 acres Browsers rather than grazers, rely on shrubs as a primary energy source Utilizes big sagebrush, antelope bitterbrush 30 to 60% canopy cover of preferred shrubs <5 feet Number of preferred shrub species >3 Mean height of shrubs >3 feet 30 to 70% canopy cover of all shrubs <5 feet	Food and winter cover	Indicator of healthy diverse shrub layer in shrub-steppe habitat WA Priority Species Recreational value or importance

Table 8. Focal Species Selection for Ponderosa Pine Habitat Type within Palouse Subbasin

Ponderosa Pine Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
White-headed Woodpecker	(Lewis and Roderick 2002) (Garrett et al. 1996) (Groves et al. 1997) Utilizes large patches of old growth forest with large, decayed trees and snags Home range averaging between 255 acres and 525 acres Forage in bark of ponderosa pines Feed heavily on seeds of unopened pinecones during winter Nests primarily in ponderosa pine snags averaging 41 feet in height with a mean dbh of 20 inches Larger trees and snags characterize immediate surrounding of active nest sites Canopy closure in sites containing nesting birds averaged 7% Regularly drink from open water sources	Reproduction	Obligate for large patches of healthy old-growth ponderosa pine forest WA Priority Species WA Species of Concern ID Species of Concern ID status imperiled WA Partners in Flight Species ID Partners in Flight Species North American Landbird Conservation Plan (Rich et al. 2004)
Flammulated Owl	(Hays and Roderick 2003) (Groves et al. 1997) (Ashley and Stovall 2004) Interspersion of grassy openings and dense thickets Coniferous trees >40 feet tall Sagebrush height >20 inches Herbaceous cover >10% Open ground >10%	Food, Reproduction	WA Priority Species WA Species of Concern ID Species of Concern WA Partners in Flight Species ID Partners in Flight Species North American Landbird Conservation Plan (Rich et al. 2004)

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Table 8. Focal Species Selection for Ponderosa Pine Habitat Type within Palouse Subbasin (continued)

Ponderosa Pine Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Big Brown Bat	(Groves et al. 1997) Uses large diameter trees, broken tree tops Prefers roosting sites that do not get hot Forages around forest canopy Diet includes up to 10 orders of insects Distance from day roost to foraging area averaging 1 mile	Food	Indicator of mature forest
Yellow Pine Chipmunk	(Groves et al. 1997) Low shrubs, grasses, forbs and course woody debris Berries and lichens are most important foods Digs a burrow 8 to 20 inches deep 2.5 acres needed to support densities of 7 to 36 chipmunks	Food	Indicator of healthy forest understory

Table 9. Focal Species Selection for Grassland Habitat Type within Palouse Subbasin

Grassland Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Spalding's Catchfly	(Hitchcock et al. 1964) Requires open grasslands with a minor, sparse shrub component Prefers north facing slopes	Life history	ESA Listed WA Threatened Species
Grasshopper Sparrow	(CPIF 2000) (Dechant et al. 1998) (Ashley and Stovall 2004) Habitat needs are <30% total shrub cover, large patch size, bunchgrasses Territory size small, <5 acres Breed in both native and non-native vegetation Native bunchgrass cover >15% and comprising >60% of the total grass cover, with bunchgrass height >10 inches Native shrub cover <10% Non-native and agricultural grasslands (CRP) with grass-forb cover >90%, shrub cover <10%, variable grass heights between 6-18 inches	Food, reproduction	Indicator of healthy grasslands with a limited amount of shrub presence WA Priority Species WA Partners in Flight Species ID Partners in Flight Species
Sharp-tailed Grouse	(Schroeder and Tirhi 2003) (Groves et al. 1997) (NRCS 2001) Depend on grass-dominated intermixed with deciduous trees and shrubs for food and cover Lack of winter habitat may be a limiting factor Deciduous trees and shrub habitat need to occur within 4 miles within potential or actual breeding habitat Ground nesters preferring dense cover of grasses, forbs, and/or shrubs Optimal distance between available water 1 mile	Food, cover, reproduction	Indicator of healthy grasslands w/ deciduous trees and shrubs WA Priority Species WA Threatened Species ID Species of Concern WA Partners in Flight Species ID Partners in Flight Species Well documented life-history attributes (Knick et al. 2003)

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Table 9. Focal Species Selection for Grassland Habitat Type within Palouse Subbasin (continued)

Grassland Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Loggerhead Shrike	(Vander Haegen 2004) (Yosef 1996) (Groves et al. 1997) Large expanses of open grassland used foraging Prefers deciduous trees and shrubs, well-spaced, often spiny shrubs and low trees Shrubs interspersed with short grasses, forbs and bare ground Uses exposed perches Uses dense foliage for nesting Mean territory size ranges from 19 to 84 acres	Food, reproduction	Indicator of open grasslands with dense, deciduous trees and shrubs in near proximity WA Priority Species WA Species of Concern ID Species of Concern WA Partners in Flight Species ID Partners in Flight Species
Lazuli Bunting	(Groves et al. 1997) Species avoid grazed areas During migration and in winter, found in open, grassy, and weedy areas Strongly associated with dense shrub layer, willow subcanopy, and herbaceous ground cover Deciduous trees and shrubs in early successional stages of shrub growth Prefers riparian thickets with nearby open grasslands	Reproduction and cover	Indicator of riparian thickets with nearby open grasslands

Table 10. Focal Species Selection for Mixed Conifer Habitat Type within Palouse Subbasin

Mixed Conifer Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Pileated Woodpecker	(Groves et al. 1997) (Lewis and Azerrad 2003) (Bull and Jackson 1995) Uses larges snags and large decaying live trees for roosting and nesting, creates nesting cavities used by other forest wildlife species Prefers mature and old-growth forests, may use forests as young as 40 years if snags are present Uses stumps and downed woody debris for forage	Food, reproduction (nesting)	Indicator of mature and/or early successional forest stages of younger forests Depends on cavities WA Priority Species WA Species of Concern WA Partners in Flight Species
Silver-haired Bat	(Groves et al. 1997) Diet requires small insects found along water courses, impoundments and ponds Requires snags and green trees for breeding and recruitment Requires fringe area between riparian corridor and open areas	Food, reproduction	Indicator of mature conifer habitat within close proximity to riparian corridor
Southern Red-backed Vole	(Groves et al. 1997) (Allen 1983) Prefers cool, moist coniferous forests with large amounts of ground cover Tree roots and mossy logs are optimal habitat for forage Forage on truffles and disperse the mycorrhizal inoculum necessary for the establishment and successful growth of conifers Also forage on coniferous seeds	Food, reproduction, thermal cover	Indicator of healthy forest understory
Rocky Mountain Elk	(Groves et al. 1997) Requires diverse conifer forest habitats which includes mature stands, dense brush understory used for escape and thermal cover.	Thermal cover	WA Priority Species Recreational value or importance

Table 11. Focal Species Selection for Riparian and Wetland Habitat Type within Palouse Subbasin

Riparian and Wetland Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Water Howellia	(Lichthard and Moseley 2000) Requires vernal, freshwater ponds, or quiet water of abandon river oxbow sloughs with water depths between 1 and 2 meters Requires ephemeral ponds that dry out to varying degrees by the end of growing season with bottom surfaces of firm clay and organic sediments	Life history	ESA federally listed threatened
Great Basin Spadefoot	(Groves et al. 1997) Requires vernal pools in shrub-steppe, associated with open habitats, with water available at least every few years	Life history	Indicates healthy vernal wetland presence
Yellow Warbler	(Groves et al. 1997) Riparian habitat generalist Selects nesting sites based on nest concealment	Food, cover and reproduction	Represents species which reproduce in riparian shrub habitat and make extensive use of adjacent wetlands with lotic characteristics ID Partners in Flight Species
Common Snipe	(Groves et al. 1997) Prefers herbaceous wetlands with permanent to seasonal water regime Diet consists primarily of animal foods including insects, crayfish, crabs, earthworms, and mollusks	Food, reproduction	Indicates herbaceous wetlands and sparse grass presence
Red-winged Blackbird	(Groves et al. 1997) Breeds in wetlands where habitat edges are abundant, often perches on old erect vegetation Occupies riparian habitats exclusively, or nearly so, during breeding season Requires tall grasslands or emergent vegetation for breeding and wintering	Reproduction	Indicators of cattail ditch type wetlands First indicator for response to wetland restoration ID protected non-game species

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Table 11. Focal Species Selection for Riparian and Wetland Habitat Type within Palouse Subbasin (continued)

Riparian and Wetland Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Great Blue Heron	(Quinn and Milner 1999) (Groves et al. 1997) Colonial breeder that prefers to nest in tallest available trees (at least 23 feet in deciduous or evergreen) near wetlands Requires food availability within close proximity to nesting habitat (within 1 to 2 miles) 300 meter (984 foot) habitat protection buffer around colony periphery, and 100 meter buffer zone around forage area; restricting human-caused disturbing activities	Reproduction	Lack of presence and suitable indicates human disturbance Carnivore that forages on a variety of vertebrates in shallow water Cultural significance WA Priority Species ID Protected non-game species
Common Yellowthroat	(Groves et al. 1997) Habitat favors cattail marshes and emergent wetlands Requires wetland presence near shrub area	Reproduction	Indicator of a minimum size emergent wetland ID Protected non-game species
Mallard	(Groves et al. 1997) Requires open, shallow water for foraging opportunities; optimal where water depth is less than 16 inches	Food	Indicator of productive, shallow seasonal wetland habitat
Wood Duck	(Lewis and Kraege 2000) (Groves et al. 1997) Needs freshwater wetlands with an abundance of vegetative cover for all seasons Abundant plant and invertebrate food bases close to suitable nest sites are essential components of breeding habitat Builds nest in tree cavity, or may use cavity left by other species – does not excavate cavity Forages in flooded timber and shallow wetlands with scrub/shrub emergent vegetation	Food, reproduction	Represents species which populates vegetatively diverse wetlands with forest habitat component ID protected non-game species

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Table 11. Focal Species Selection for Riparian and Wetland Habitat Type within Palouse Subbasin (continued)

Riparian and Wetland Habitat Type			
Focal Species	**Habitat Attributes**	**Life Requisite**	**Reason for Selection**
Redhead	(Groves et al. 1997) Uses deep, open water in winter Builds nest over shallow water Requires a bullrush community with a semi- to semi-permanent water regime	Food, reproduction	Nesting by redheads is an indicator of wetland restoration which includes successful emergent vegetation establishment (excluding cattail dominance) ID Partners in Flight Species
Beaver	(Knutson and Naef 1997) (Groves et al. 1997) Dependant on slow-flowing streams for dam construction Prefer adjacent stands of successional growth trees, rather than mature forests Typically feed within 100 yards of the edge of their pond	Food, cover	Indicator of healthy regenerating deciduous stands Cultural significance WA Priority Species

1.4.6 Fish Resources

1.4.6.1 Historic Fish Species

As reported in the Palouse Subbasin Summary (Cook 2001), the historic fish assemblage in the lower Palouse River (below Palouse Falls) prior to European settlement consisted primarily of anadromous and resident salmonids (a family of fish including the salmon, trout, whitefish, and char); cyprinids (freshwater fish of the family that includes minnows); and catastomids (suckers). The anadromous salmonid fish species below the falls included Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). A diverse assemblage of fish species, primarily composed of cottidae (sculpins), cyprinids, and catastomids may have existed above the falls. Native salmonids were not historically recorded in the Palouse subbasin above Palouse Falls, although native salmonid presence in the subbasin is probable at low densities (Donely 2004).

1.4.6.2 Listed Fish Species

All the Snake River spring, summer, and fall Chinook were listed by the National Oceanic and Atmospheric Administration (NOAA Fisheries, previously National Marine Fisheries Service) as threatened species on April 22, 1992. A petition to further list them as endangered is still pending the outcome of proposed changes to the Endangered Species Act (ESA). The bull trout was officially listed by the US Fish and Wildlife Service (USFWS) as threatened under the ESA in June of 1998.

1.4.6.3 Current Fish Species Present in the Palouse Subbasin

Fish resources within the Palouse subbasin are reduced by habitat and water quality degradation, and remain limited by degraded in-stream, riparian, and upland habitat conditions, which have contributed to degraded water quality, extreme seasonal fluctuations in water quantity, and subsequent degraded in-stream habitat conditions. The existing fish community in the lower Palouse River (below Palouse Falls) includes of anadromous salmonid species Chinook salmon and steelhead trout, as well as native resident species including largescale sucker, redside shiner, northern pikeminnow, and chiselmouth. Recent fish survey work conducted by WDFW below the Palouse Falls have confirmed the presence of sub-adult bull trout, rainbow trout/juvenile steelhead, tench, bluegill, yellow perch, northern pikeminnow, carp, chiselmouth, redside shiner, and dace.

Table 12 lists the fish species reported to exist in the Palouse subbasin (Cook 2001).

Table 12. Fish Species Present in Palouse Subbasin

Species	Presence / Populations	Native Status[9]	ESA Status
Bull trout* (*Salvelinus confluentus*)	Unknown/Unknown		Threatened
Steelhead trout*/ Rainbow trout (*Oncorhynchus mykiss*)	Occasional/Unknown	Not confirmed[10]	
Fall Chinook salmon* (*Oncorhynchus tshawytscha)*	Occasional/Stable		
Mountain whitefish* (*Prosopium williamsoni)*	Occasional/Unknown		
Brook trout (*Salvelinus fontinalis)*	Occasional/Unknown		
Brown trout (*Salmo trutta*)	Occasional/Unknown		
Northern pikeminnow (*Ptychocheilus oregonensis)*	Common/Stable	Native	
Speckled dace (*Rhinichthys osculus)*	Common/Unknown		
Longnose dace (*Rhinichthys cataractae*)	Occasional/Unknown		
Redside shiner (*Richardsonius balteatus*)	Common/Unknown	Native	
Chiselmouth (*Acrocheilus alutaceus*)	Occasional/Unknown	Native	
Peamouth (*Mylocheilus caurinus*)	Occasional/Unknown	Native	
Largescale sucker (*Catostomas macrocheilus*)	Occasional/Unknown	Native	
Longnose sucker (*Catostomas catostomus)*	Occasional/Unknown	Native	
Bridgelip sucker (*Catostomas columbianus*)	Common/Stable		
Mountain sucker (*Catostomas platyrhynchus*)	Occasional/Unknown		
Slimy sculpin (*Cottus cognatus*)	Occasional/Decreasing	Native	
Mottled sculpin (*Cottus bairdi*)	Occasional/Unknown	Native	
Piaute sculpin (*Cottus beldingi*)	Common/Unknown	Native	
Torrent sculpin (*Cottus rhotheus*)	Occasional/Unknown	Native	
Tench (*Tinca tinca*)	Occasional/Unknown		
Walleye (*Stizostedion vitreum*)	Occasional/Stable		
Tiger muskelluge (*Tiger Muskellunge*)	Occasional/Unknown		
Largemouth bass (*Micropterus salmoides*)	Occasional/Stable		
Brown bullhead (*Ictalurus nebulosus*)	Occasional/Unknown		
Yellow bullhead (*Ictalurus natalis*)	Occasional/Unknown		
Smallmouth bass (*Micropterus dolomieui*)	Occasional/Stable		
Brook stickleback (*Culaea inconstans*)	Occasional/Increasing		
Goldfish (*Carassius auratus*)	Occasional/Unknown		
Yellow perch (*Perca flavescens*)	Occasional/Unknown		
Carp *Cyprinus carpio*)	Common/Unknown		
Bluegill (*Lepomis macrochirus*)	Occasional/Unknown		
Crappie (*Pomoxis spp.*)	Occasional/Stable		
Channel catfish (*Ictaluris punctatus*)	Occasional/Stable		
Grass pickerel (*Esox americanus vermiculatus*)	Occasional/Unknown		
Green sunfish (*Lepomis cyanellus*)	Occasional/Unknown		
Pumpkinseed (*Lepomis gibbosus*)	Occasional/Unknown		

* Denotes presence below Palouse Falls only

9 Status determined for waters above (upstream) of Palouse Falls only.

10 Native status of rainbow trout and other salmonids not confirmed in Palouse subbasin waters above Palouse Falls (see section 1.4.6.1 Historic Fish Species).

A 1980 fish survey was conducted by WDFW at 13 sampling locations within the Palouse River system, including locations below Palouse Falls, and above the falls within the Union Flat Creek, Cow Creek, and South Fork Palouse River drainages, and the mainstem Palouse River (Cook 2001). The species composition of the downstream section (below the falls) was composed of eight native species and three exotics, whereas the upstream collections contained eleven native species and nine exotics. Salmonids were not collected below the falls. The only salmonids collected above the falls were observed in the upper reaches of the North Fork Palouse River in Idaho, and identified as rainbow trout and brook trout. Historic stocks of native species that continue to inhabit the Palouse River above the falls include chiselmouth, northern pikeminnow, largescale sucker, redside shiner, speckled dace, and cottid species (sculpin).

Thirty-seven fish species have been documented within the Palouse subbasin, with at least 14 species in the Idaho portion of the subbasin. All native species found within Idaho are non-game fish. No ESA listed species have been documented as occurring above the Palouse Falls.

A summary of fisheries data was obtained for the Palouse River Tributaries Subbasin Assessment and TMDL (Henderson 2003), and reported in Table 13. The table summarizes fish data for the 303(d) listed streams and other major tributaries in the Palouse River (North Fork Palouse River, Idaho portion of the subbasin). Data was obtained from DEQ, IDFG, Clearwater National Forest (CNF), the St. Joe National Forest, and Potlatch Corporation. The table displays age classes of salmonids and non-salmonid species, as well as the total number collected in the survey. The table also notes when young of the year were observed, an indicator that successful spawning and rearing occur in the stream. Age class determination was based on information in the CNF surveys, the determination was made by the CNF fish biologist. This data demonstrates whether or not the water quality of each waterbody provides protection, maintenance, and propagation of a salmonid fish population.

Table 13. Fisheries Data for the Palouse River (North Fork Palouse River, Idaho portion of the subbasin) (Henderson 2003)

Stream	Beneficial Use Reconnaissance Program Data 1996	Beneficial Use Reconnaissance Program Data 2002	CNF	Other
Big Creek (upper)	Rainbow 2+j(2), Dace (4), Sculpin (45)	Dace (31), Redside Shiner (36), Sculpin (14)		Cutthroat (UN), Brook Trout (UN)[a] Rainbow (1), Sculpin (14)[b]
Big Creek (lower)	Dace (59), Redside Shiner (16), Sculpin (12)	Dace (49), Redside Shiner (9), Sculpin (4)		
Deep Creek (east fork)	Dry	Dace (20), Redside Shiner (2)		
Deep Creek (middle fork)	Dry	Dace (35) Redside Shiner (48)		
Deep Creek (lower)	Dace (259), Redside Shiner (180), Pumpkin Seed (2), Sculpin (17), Sucker (16)	No Data		
Flannigan Creek (upper)	Rainbow 2+j(3), Dace (48), Redside Shiner (3) Sculpin (45)	Dry		
Flannigan Creek (lower)	Dace (290), Sucker (13), Northern pike minnow (22)	Dry		
Gold Creek (upper)	Rainbow 3+j(13)	Rainbow 3+j(12)		
Gold Creek (lower)	Dace (529), Redside Shiner (66) Crawfish (2)	Redside Shiner (29), Sucker (2), Northern pike minnow (17), Dace (23)		
Gold Creek (Crane Creek tributary)	Brook Trout 1+j (16), Sculpin (5)	No Data		
Hatter Creek (upper)	Rainbow 1+j(2), Brook Trout 1+j(2), Sculpin (6)	Brook Trout 2+j(3), Sculpin (1)		
Hatter (lower)	Dace (126), Redside Shiner (24), Sculpin (11)	Rainbow 3+j(6), Dace (8), Redside Shiner (14), Sucker (3) Sculpin (6)		
West Fork Rock Creek (upper)	Dry	Dry		
West Fork Rock Creek (lower)	Dry	Dry		
Palouse River (middle)	Rainbow 3+j(15), Brook Trout 2+j(4)	Brook Trout 3+j(16), Sculpin (UN)	Brook Trout 3+j(16), Sculpin (UN)	Cutthroat (UN)[a] Brook Trout (UN)[a]
Palouse River (upper)	Rainbow 1(1), Brook Trout 3+j(12)	Brook Trout 3+j(16), Sculpin (UN)	Brook Trout 3+j(16), Sculpin(UN)	Cutthroat (UN)[a] Brook Trout (UN)[a]

UN – Unknown
( ) – total number of fish
#+j – Number of age classes including young-of-the-year juvenile
[a] St. Joe National Forest-1938
[b] Potlatch Corporation-1998

1.4.6.4 Native Fish

Native resident species in the Palouse subbasin include two members of the catostomidae family (suckers), largescale sucker (*Catastomus macrocheilus*) and bridgelip sucker (*Catostomus columbianus*), and four members of the cyprinidae family (minnows), including peamouth (*Mylocheilus caurinus*), northern pikeminnow (*Ptychocheilus oregonensis*), chiselmouth (*Acrocheilus alutaceus*), and redside shiner (*Richardsonius balteatus*). Four cottidae species (sculpins) are endemic to the Palouse subbasin, including slimy sculpin (*Cottus cognatus*), mottled sculpin (*Cottus bairdi*), Paiute sculpin (*Cottus beldingi*), torrent sculpin (*Cottus rhotheus*). Native salmonids were not historically recorded in the Palouse subbasin above Palouse Falls, although native salmonid presence in the subbasin is probable at low densities (Donely 2004).

Some adfluvial largescale suckers migrate upstream from lakes as evident from a study in Rock Lake and Rock Creek by McLellan et al. (2000). Wydoski and Whitney (2003) report the largescale sucker is limited to the Pacific Northwest and found in both the Idaho and Washington streams. The bridgelip sucker is found throughout both the larger streams in Idaho and Washington within the subbasin. The bridgelip is more prevalent in smaller streams than the largescale sucker (Wydoski and Whitney 2003).

Wydoski and Whitney (2003) report the peamouth inhabits both lakes and streams in the northern Idaho and eastern Washington areas of the subbasin. The northern pikeminnow occurs in the Palouse River mainstem and tributaries throughout the subbasin (Wydoski and Whitney 2003). Hybrids between northern pikeminnow and chiselmouth were reported from Lower Granite Reservoir on the Snake River. The chiselmouth's current distribution is confined to eastern Washington, the Idaho panhandle, northern Oregon, and southern British Columbia (Wydoski and Whitney 2003). The chiselmouth population in eastern Washington is reportedly common to abundant. The mottled sculpin is reportedly found in the Palouse River below the Cow Creek confluence (Wydoski and Whitney 2003).

Torrent sculpin is found in the Idaho portion of the North Fork Palouse River system, but not reported in the Washington portion of the subbasin. Slimy, mottled, and Paiute sculpin presence is not reported to currently occur in the subbasin.

1.4.6.5 Trout

Various trout species are broadcast throughout the subbasin. Population densities of rainbow trout within the Washington portion of the subbasin are primarily related to stocking of trout made by past and present fish management agencies in bodies of water such as Chapman Lake, Rock Lake, Sprague Lake, other lowland lakes within the Cow Creek and Rock Creek drainages, and Union Flat Creek. Limited natural trout spawning is known to occur in portions of Rock Creek and tributaries, in particular, Cottonwood Creek (Scholz 2003). Rainbow trout and brook trout are also known to naturally reproduce in portions of Union Flat Creek (Wydoski and Whitney 2003) and in the upper reaches of the Palouse River and tributaries in the Idaho portion of the subbasin.

Resident salmonid reproduction is confined to stream reaches where water temperature remains relatively cool in the summer months. This condition appears to be the result of spring influences in Palouse River mainstem and tributaries within the Washington portion of the subbasin, and intact riparian and instream habitat maintains suitable summer water temperature within the forested Idaho portion of the subbasin.

The distribution and relative abundance of resident salmonids is generally unknown. Rainbow trout from several origins have been introduced throughout the Palouse subbasin. WDFW has regularly stocked rainbow trout in to Chapman Lake, Rock Lake, Williams Lake, Hog Canyon Lake, Fish Trap Lake, Sprague Lake and other smaller water bodies within the subbasin. Stream surveys conducted by the CNF, IDFG, DEQ, and others have never documented cutthroat trout in the Idaho portions of the subbasin.

North Fork Clearwater River strain steelhead trout have also been stocked in the Idaho portion of the subbasin. The steelhead trout were part of an unfed fry experiment conducted by the US Fish and Wildlife Service National Biological Survey in the Palouse River (Idaho portion of the subbasin). Fry were sampled at regular intervals and mostly removed from the population during the experiment. It is possible, but unlikely, that survivors may have established a resident population.

The first stocking of rainbow trout occurred in 1950 in the North Fork Palouse River (Idaho portion of the subbasin). The size of rainbow trout stocked has been "catchable" (8-12 inches), to provide an immediate return to the creel. There is evidence that natural reproduction is occurring, as they have been recently sampled in streams where stocking never occurred or has been curtailed (Idaho portion of the subbasin). Stock of rainbow planted has varied over the years depending on egg availability.

Population densities of brown trout and their overall relative distribution within the subbasin are unknown. Population relative abundance estimates developed for brown trout in Rock Lake indicate that brown trout represent 23% of the fish community composition in this lake. The WDFW regularly stocks approximately 10,000 catchable size brown trout in Rock Lake.

Brown trout were introduced from 1979-1986 in the Palouse River (Idaho portion of the subbasin), primarily near Laird Park. It was hoped that brown trout would be more suited to available habitat and water conditions, and hence provide a sport fishery. The last brown trout sampled through various fish surveys was in 1992, in the small North Fork Palouse River tributary of Hatter Creek. It is believed that stocking failed to establish a population.

Brook trout were first introduced into the Palouse River (Idaho portion of the subbasin) in 1936. Subsequent stocking occurred in Big Sand Creek, Little Sand Creek, and the East Fork of Meadow Creek—all tributaries to the upper Palouse River. Brook trout have established themselves in many tributaries (headwater streams) as well as the mainstem Palouse River where habitat conditions and water temperature allow their persistence.

1.4.6.6 Kokanee

Kokanee (land locked sockeye salmon) are annually stocked by the WDFW into Chapman Lake, and are known to successfully spawn in Chapman Lake adjacent to spring water influence areas. Kokanee have been observed downstream of Chapman Lake in Rock Lake. Suitable habitat conditions and adequate zooplankton production have limited natural Kokanee expansion within the watershed below Chapman Lake.

1.4.6.7 Warm Water Fish

According to Wydoski and Whitney (2003), grass pickerel occur in Down's Lake, an isolated drainage between Rock and Cow Creek drainages. This species also occurs in Rock Lake and Rock Creek, Fishtrap Lake and connecting streams, and through Cow and Finnell Lakes and their connecting streams that drain into the Palouse River. Sprague Lake contained grass pickerel prior to being reclaimed with rotenone in 1985. An occasional grass pickerel has been collected in Sprague Lake in sampling between 1991 and 1999. Wydoski and Whitney (2003) report that grass pickerel were once more widely distributed in eastern Washington than their present range, based on reports of fish species recovered during chemical renovations of 14 lakes by WDFG.

Crappie, pumpkinseed, bluegill, and yellow perch are present in Chapman Lake, Rock Lake, and Sprague Lake. The establishment of these species in Rock Lake and Chapman Lake were likely the result of illegally planted fish introduced by anglers throughout the years. Sprague Lake has been managed as a mixed species fishery for many years by WDFW. WDFW has periodically stocked Sprague Lake with a variety of warm water fish species including black crappie, white crappie, largemouth bass, smallmouth bass, bluegill, walleye, and channel catfish. Smallmouth bass have also been stocked in the Palouse River (Idaho portion of the subbasin). The number of smallmouth bass stocked was small in Idaho, and these fish never established a population within Idaho. The number of smallmouth bass stocked in Washington is significant with well established populations in the mainstem Palouse River (Donley 2004).

Wydoski and Whitney (2003) state that tench, a native to streams and lakes of Europe, was stocked in Fourth of July Lake during 1895 to 1896. Tench are currently found in Sprague, Silver, Hog Canyon, Fish Trap, and Downs Lakes, and multiple private waters throughout the Washington portion of the subbasin.

Wydoski and Whitney (2003) report common carp, native to Asia, were introduced throughout the United States, especially in the years following the Civil War. The first introductions into Idaho and Washington were made in 1882, and by 1894 the lower Columbia River was populated with this species. Today, this species occurs in numerous lakes throughout the Palouse subbasin and the lower mainstem Palouse River (below the Cow Creek confluence) and within the Cow Creek drainage.

Three introduced exotic species of the catfish family also occur within the Palouse subbasin (Wydoski and Whitney 2003). The most common is the brown bullhead which is found in many lakes and low gradient/low velocity streams across the subbasin. With its original range from

Nova Scotia south to Florida, west to Louisiana, northwest to North Dakota and Saskatchewan, and east to Nova Scotia, this bullhead was introduced in the western United States as early as 1874. The channel catfish and yellow bullhead occur in multiple waters including Sprague Lake, Downs Lake, and multiple private waters (Donley 2004). The black bullhead are rare in eastern Washington, but are reported to be the Sprague Lake watershed.

Wydoski and Whitney (2003) report that the redside shiner is found in the larger mainstem river and side streams and two dace are widely distributed throughout smaller streams across the subbasin: longnose dace and speckled dace.

1.4.7 Fish Habitat

1.4.7.1 Lakes Within the Palouse Subbasin

The subbasin has 42 lakes that contain water throughout the year. In addition, there are numerous seasonal lakes and potholes that dry up during summer months. Most natural lakes are found in the Rock Creek and Cow Creek drainages. Many of the lakes have no outlets and are large water filled depressions with basalt bottoms. Many lakes within the Washington portion of the subbasin are turbid through late summer, limiting primary and secondary production in the lakes. Surface areas of the lakes range from under 20 acres to the 2,190 acres of Rock Lake. Total water surface of lakes in the subbasin is estimated at more than 8,500 acres (13 square miles). Housing and development along the lake shores is limited.

Rock Lake is connected to upstream Bonnie Lake by Rock Creek. Rock Lake is unique to the subbasin. Rock Lake has a maximum depth of 350 feet with a mean depth of 170 feet (McLellan et al. 2000). Other lakes in the subbasin have a maximum depth of less than 50 feet. Lakes within the Rock Creek drainage with managed fisheries, in addition to Rock and Bonnie Lakes, include Chapman Lake. Many small lakes with no outlets are scattered across the topography of the Rock Creek drainage.

Sprague Lake is the largest lake (with a surface area of approximately 2,000 acres) in the Cow Creek drainage, which comprises the eastern most portion of the subbasin. Other lakes in the Cow Creek drainage with inlets and outlets include Cow, Hallin, and Finnell Lakes. Lakes within the drainage with managed fisheries, in addition to Sprague Lake, includes Silver, Badger, Amber, Williams, and Fish Trap Lakes.

For the most part, the small lakes within the Washington portion of the subbasin have homogeneous habitat due to the steep basalt cliffs that surround the lakes. Basalt shorelines limit trout spawning areas (McLellan et al. 2000). The most complete report available on subbasin limnological and fisheries lakes evaluation includes that of Rock Lake (McLellan et al. 2000). Rock Lake was classified in the McLellan et al. report (2000) as meso-oligotrophic, while Cow and Sprague Lakes were classified as meso-eutophic (RPU 2000). Because of the shortage of published evaluations, this information was used to characterized the other lakes within this portion of the subbasin. Lakes in this region are shallow, relatively high in nutrients, and have seasonally high levels of turbidity. According to McLellan et al. (2000), upland farming practices have caused nutrient and sediment loadings to most of the lakes in the Washington portion of the subbasin.

1.4.7.2 Lake Management Within the Palouse Subbasin

Within the Palouse subbasin there are sixteen lakes that are actively managed by WDFW to provide a quality fishing experience. Managed lakes are popular with sport fisherman and are economically important to WDFW, the State of Washington and surrounding communities (Donley 2004). Lowland lake fishing as a whole generates millions of angler days annually for the State of Washington, and opening day fisheries are billed as the largest single fishing season opener in the State of Washington. There are an estimated 300,000 anglers statewide that participate in just the opening day lowland lake fisheries. Lakes with managed fisheries include:

- Amber Lake
- Badger Lake
- Bonnie Lake
- Chapman Lake
- Cow Lake
- Downs Lake
- Finnell Lake
- Fishtrap Lake
- Fourth of July Lake
- Gilchrist Pond
- Hallin Lake
- Hog Canyon Lake
- Pampa Pond
- Rock Lake
- Sprague Lake
- Williams Lake

Five management strategies are applied to these lakes (Table 14) (Donley 2004): trout only opening day lowland lake; mixed species opening day lowland lakes; selective gear trout only opening day lowland lake; mixed species year round lowland lakes; and warmwater fisheries year round lowland lakes. Additionally, there are lakes with special rules intended for resource protection. The rules for all WDFW lakes within the subbasin are available in the annually published WDFW Fishing Rules pamphlet.

Trout only opening day lowland lakes are currently managed as put and take fisheries. These lakes are stocked with high density trout populations, and are managed as harvest driven fisheries. Stocking densities are adjusted based on lake size and productivity, fish species, and size of fish available for stocking. Stocking densities range for 200 to 600 fish per surface acre. Rotenone is used to maintain the trout only single species management strategy; lakes in the program are treated every 7 to 10 years with rotenone, if needed to eliminate unwanted species of fish.

Opening Day mixed species lowland lakes are waters stocked with trout to provide for moderate catch rate trout fisheries. Stocking densities vary from 75 to 200 fish per surface acre based on lake size and productivity, species composition of the lake and the size of fish available for stocking. These lakes are also managed to provide for moderate harvest of self-sustaining warmwater fish populations. Because of the presence of warmwater fish populations these lakes provide a protracted fishery opportunity as opposed to the aforementioned trout only lakes.

Selective gear opening day trout only lowland lakes are waters stocked with trout to provide for moderate to high catch rates. Stocking densities vary from 50 to 100 fish per surface acre based on lake size and productivity, species composition of the lake and the size of fish available for stocking. These lakes are restricted to single barbless lures, no bait. These types of lakes are intended to attract catch and release anglers. There is generally a small harvest allowed with length limits (harvest limit is 2 fish greater than 14 inches in length).

Mixed species year round lowland lakes are stocked with a limited number of trout; 10 to 100 fish per surface acre. The objective is to provide a trout fishery that has modest catch rates of larger trout. Some of these lakes can produce trout of trophy proportions. These lakes are also managed to provide harvest of self-sustaining warmwater fish populations. The warmwater fisheries in these lakes are targeted on panfish or large predator fish harvest depending on the lake type, productivity and the species that are most productive in the available habitat.

Warmwater only lowland lakes are managed for harvest of self sustaining warmwater fish species. There may be limited trout stocking to provide fishery potential during periods of time when warmwater fish are not available to the fishery. Stocking densities are on the order of less than 10 fish per surface acre. Because of the presence of warmwater fish populations, these lakes provide a protracted fishery as opposed to most of the aforementioned lakes.

1.4.7.3 Streams Within the Palouse Subbasin

Over 398 miles of stream are within the Palouse River drainage. The major tributaries and their representative percentage of the overall subbasin include (USDA SCS 1978):

- Cow Creek (Adams County) (20%)
- Palouse River Mainstem (15%)
- North Fork Palouse River (15%)
- Rock Creek (13%)
- Union Flat Creek (10%)
- Pine Creek (9%)
- South Fork Palouse River (9%)
- Cottonwood Creek (5%)
- Rebel Flat Creek (2%)
- Thorn Creek (2%)

Little fish stream survey information is available across the subbasin. Streams within the Washington portion of the subbasin that support reproducing populations of resident salmonids include portions of the Palouse River, Rock Creek, Cow Creek, Cottonwood Creek and Union

Flat Creek (Scholz 2003). Streams within the Idaho portion of the subbasin that support reproducing populations of resident salmonids include the upper and middle Palouse River (Idaho portion of the subbasin North Fork), upper Big Creek, upper Flannigan Creek, upper Gold Creek, and Hatter Creek.

Streams across the Palouse subbasin (above Palouse Falls) do not have active cold water fisheries management plans in place by either state fish management agency.

Table 14. WDFW Lake Management Strategies (Donley 2004)

Lake Name	Management Strategy
Amber Lake	Selective gear trout only
Badger Lake	Opening day trout only
Bonnie Lake	Mixed species year round
Chapman Lake*	Mixed species opening day
Cow Lake	Mixed species year round
Downs Lake	Mixed species opening day
Finnell Lake	Mixed species year round
Fishtrap Lake	Opening Day trout only
Fourth of July Lake	Opening Day trout only
Gilchrist Pond	Opening Day trout only
Hallin Lake	Mixed species year round
Hog Canyon Lake	Opening Day trout only
Pampa Pond	Opening Day trout only
Rock Lake	Mixed species year round
Silver Lake	Mixed species year round
Sprague Lake*	Mixed species year round
Williams Lake	Opening Day trout only

* Special rules apply for management of individual species, outlined in WDFW Fishing Rules pamphlet.

1.5 Limiting Factors

Factors or conditions most responsible for wildlife and fish declines in the Palouse subbasin are referred to as **limiting factors**. At the Palouse subbasin planning level, technical experts involved in providing information for the subbasin summaries and management planning process identified nine primary categories of limiting factors, including:

- Agricultural conversion
- Exotic vegetation encroachment
- Timber harvest
- Fire suppression
- Urban development
- Road development
- Hydropower development
- Other factors

Settlement of the Palouse subbasin in the last nearly two centuries has modified animal and plant associates in a multitude of ways. Wildlife and fish, and their associated habitats within the subbasin, have been substantially altered by human activities both in and outside of the subbasin, most commonly with negative impacts to terrestrial and aquatic species. Some species have already been extirpated and many other terrestrial and aquatic species and their respective habitats are currently at risk within the subbasin. Without appropriate management, planning and implementation, these valuable and unique resources may be further compromised.

While the past century and a half represents a very small portion of the total history of the biota of the Palouse subbasin and surrounding region, it has been one of drastic change and of particular significance to the current human population (Tisdale 1961). A description of the natural vegetative condition has been reconstructed in considerable detail from two main sources: the records of travelers who saw the country prior to appreciable change; and by the work of ecologists who have studies such relatively undisturbed remnants as remain (Tisdale 1961).

Knick et al. (2003) states livestock grazing, conversion to agriculture or urban areas, energy and natural resource development, habitat treatment, and even restoration activities, had direct as well as indirect consequences on loss of habitat and wildlife in the Palouse subbasin. The magnitude of these effects is difficult to quantify. Direct effects, such as extent of fragmentation or total area lost, rarely have been linked to a specific land use, and cumulative effects have not been estimated over the large geographic extent. The analyses is often hindered because large-scale maps have been unavailable, inconsistent across administrative boundaries, or limited by coarse spatial and thematic resolution. Similarly, an assessment of landscape changes caused by land use has been precluded by lack of maps depicting habitats at comparable resolutions to contrast different times.

The following tables (Tables 15 – 21) summarize the limiting factors based on factors within and out of the subbasin that currently inhibit focal species populations, and factors that led to the decline of each focal species and of ecological functions and processes. References to appropriate sections of this report discussing limiting factors are cited in the tables. The following tables serve as the working hypothesis, which in turn served as the basis for management plan development.

Table 15. Summary of Agricultural Conversion Limiting Factor

Limiting Factor: Agricultural Conversion	References
- Loss and fragmentation of shrub-steppe habitat - Loss and fragmentation of grassland habitat - Loss of riparian and floodplain habitat - After-harvest crop residue reduced or destroyed - Intermittent streams and draws with woody vegetation denuded and channelized - Soil compaction, accelerated erosion, and reduction in water infiltration and soil holding capacity - Commercial fertilizer over-application and resulting excess nutrient contribution to receiving waters - Unmanaged livestock grazing and winter feeding operations and resulting excess sediment, bacteria and nutrient contributions to receiving waters	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.2.4 Agricultural Habitat Type 1.4.2.5 Shrub-Steppe Habitat Type 1.4.2.7 Grassland Habitat Type 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.1 Agricultural Conversion 1.5.2 Exotic Vegetation Encroachment

Table 16. Effects of Exotic Vegetation Encroachment

Limiting Factor: Exotic Vegetation Encroachment	References
- Loss of biodiversity through displacement of native plant species with monocultures of exotic species - Loss of important native food plants - Changes in structure of habitats altered breeding habitat and thermal cover - Changes in natural disturbance regimes altering habitat structure and species composition	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.2.4 Agricultural Habitat Type 1.4.2.5 Shrub-Steppe Habitat Type 1.4.2.7 Grassland Habitat Type 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.1 Agricultural Conversion 1.5.2 Exotic Vegetation Encroachment

Table 17. Effects of Timber Harvest

Limiting Factor: Timber Harvest	**References**
- Loss of old growth timber habitat through harvest activities - Loss of forest habitat through clearcuts - Loss of forest habitat through harvest activities - Water quality degradation from harvest activities and road construction - Negative hydrograph alterations from harvest activities and road construction - Habitat fragmentation from harvest activities and road construction - Wildlife disturbance from roads	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.2.6 Ponderosa Pine Habitat Type 1.4.2.8 Mixed Conifer Habitat Type 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.3 Timber Harvest

Table 18. Effects of Fire Suppression

Limiting Factor: Fire Suppression	**References**
- Loss of species diversity in ponderosa pine habitat - Change in forest community (dominance by shade tolerant trees) - Increased timber harvest activities and road construction from wildland fire fuel reduction efforts	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.2.6 Ponderosa Pine Habitat Type 1.4.2.7 Grassland Habitat Type 1.4.2.8 Mixed Conifer Habitat Type 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.4 Fire Suppression

Table 19. Effects of Urban Development

Limiting Factor: Urban Development	**References**
- Loss of riparian areas and floodplains through urban sprawl - Fragmentation of mixed conifer and agricultural habitat types from urban sprawl - Channelization and vegetation removal of intermittent drainage ways from secondary road development - Water quality degradation from sedimentation in receiving streams from unsurfaced roadways and construction activities - Bacteria and nutrient contributions to receiving streams from substandard septic tank maintenance - Bacteria and nutrient contributions to receiving streams from small farm and ranches with animal concentrations	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.5 Urban Development

Table 20. Effects of Hydropower Development

Limiting Factor: Hydropower Development	References
- Increased loss of native habitat from agricultural conversion and increased agricultural lands - Water quality degradation in Snake River due to upland erosion and subsequent sedimentation from land use activities	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.2.4 Agricultural Habitat Type 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.1 Agricultural Conversion 1.5.5 Hydropower Development

Table 21. Effects of Other Limiting Factors

Limiting Factor: Other Limiting Factors	References
- Loss of instream habitat in upper watershed from historic mining activities - Impacts to migratory fisheries in Palouse River below Palouse Falls due to out of basin fishing pressures and habitat alterations - Impacts to migratory bird populations in the subbasin due to out of basin habitat alterations	1.2.5 Water Quality 1.4.1 Historic Habitats 1.4.2.3 Wildlife Habitat Types within the Palouse Subbasin 1.4.6.3 Current Fish Species Present in the Palouse Subbasin 1.5.6 Other Limiting Factors

1.5.1 Agricultural Conversion

Ashley and Stovall's work (2004) cited that changes in land use over the past century including agricultural conversion resulted in the loss of over half of Washington's shrub-steppe habitat and a reduction in grassland habitat by 97%. The breakup of formerly contiguous grassland and shrub-steppe habitats by agricultural conversion has resulted in a highly fragmented landscape (Vander Haegen et al. date unavailable). The breakup of formerly contiguous habitats has had detrimental effects on species occurrence and population dynamics. Vander Haegen et al. documents many studies that cite the decline of bird species across the Palouse subbasin. The fragmented landscape, along with an increase in habitat edge, has resulted in elevated rates of nest predation and parasitism from and increase in the number of predators. Fragmentation of the shrub-steppe landscape has disrupted the dynamics of dispersal and immigration that allows populations to persist over large areas. Stochastic events may cause the extirpation of a species from one habitat patch, necessitating recruitment from nearby patches to reestablish a population. Highly fragmented landscapes have lower connectivity, meaning the dispersing individuals must cross unfavorable lands to move from one habitat patch to another. Species with small home ranges and limited dispersal capabilities, such as many small mammals and reptiles, are most likely to be affected.

The magnitude of agricultural conversion of Washington's shrub-steppe habitat is extensive and its effect on wildlife is magnified by a pattern of land alteration that has resulted in extreme fragmentation of the remaining habitat (Ashley and Stovall 2004). Fragmentation of previously extensive landscapes can influence the distribution and abundance of birds through redistribution of habitat types and through the pattern of habitat fragmentation, including characteristics such as decreased patch area and increased habitat edge. Fragmentation also can reduce avian productivity through increased rates of nest predation, increased nest parasitism, and reduced pairing success of males.

Few extensive tracts of interior grassland or shrub-steppe remains in the Palouse subbasin. Palouse wildlife species had adapted to expansive landscapes of steppe and shrub-steppe communities. Wildlife that depended on the remnant native habitat now are subjected to adverse population pressures, including isolation of breeding populations; competition from similar species associated with other, now adjacent, habitats; and increased nest predation by generalist predators.

Ware and Tirhi (1999) suggest the limiting factors for upland game birds, such as the ring-necked pheasant, in the region are loss of permanent nesting and winter cover. Specific problems due to agricultural conversion include the loss of cattail and willow stands, woody plants, windbreaks, and brushy fencerows.

The Oregon/Washington Landbird Conservation Plan (PIF 2004) reports that the principal post-settlement conservation issues affecting bird populations (in the Columbia Plateau) include habitat loss and fragmentation resulting from conversion to agriculture; and habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes. Conversion of shrub-steppe lands to agriculture adversely affects landbirds in two ways: 1) native habitat is in most instances permanently lost, and 2) remaining shrub-steppe is isolated and embedded in a highly fragmented landscape of multiple land uses, particularly agriculture. Fragmentation resulting from agricultural development or large fires fueled by cheatgrass can have several negative effects on landbirds. These include: insufficient patch size for area-dependent species, and increases in edges and adjacent hostile landscapes, which can result in reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Additionally, fragmentation of shrub-steppe has likely altered the dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale. Most species of neotropical migratory birds within the Interior Columbia Basin identified as being of high management concern were shrub-steppe species.

Agriculture conversions concentrated in low elevation valleys have significantly impacted valley bottom grasslands, shrublands, cottonwood dominated riparian areas. Agricultural conversions in higher elevation lands (once dominated by grasslands) have significantly reduced the brush laden draws. Similarly, conversion of xeric hillsides and benches to cropland has eliminated and/or severally altered much of the once abundant interior grassland habitat. Agricultural conversions in higher elevation lands (once dominated by trees and shrubs) have significantly reduced the brush laden draws, and tree and shrub dominated riparian areas. Agricultural development has altered or destroyed vast amounts of native shrub-steppe habitat in the lowlands, and fragmented the riparian/floodplain habitat.

Large expanses of grasslands are currently used for livestock ranching. Deeper soil sites are mostly converted to agriculture. Drier grasslands and canyon grasslands, those with shallower soils, steeper topography, or hotter, drier environments, were more intensively grazed and for longer periods than were deep-soil grasslands. Evidently, these drier native bunchgrass grasslands have been changed irreversibly to persistent annual grass and forb communities.

Agricultural conversion of grasslands and shrub-steppe areas to cropland has accelerated soil erosion, increased sediment loads to receiving streams, contributed nonpoint source pollution including excessive nutrients and agricultural chemicals.

Fish resources within the Palouse subbasin are limited by long standing in-stream, riparian, and upland habitat alterations which have contributed to degraded water quality, water quantity, and in-stream habitat conditions. In part as a result of agricultural conversion, the Palouse subbasin riparian areas are void of many of the woody vegetation types. Riparian areas are not connected to many of the floodplains which provided seasonal water storage components that once protected water quality and moderated flow release. Many farm fields were drained in the 1960s through 1980s eliminating wetlands, changing water storage capacity, and contributing to changes in hydrology of local streams. Conversion of grasslands to annual croplands, in combination with the riparian degradation and lowland drainage has resulted in a modified hydrograph. The hydrograph of today's subbasin would show a much flashier system than before agricultural conversion; whereby the peaks are often higher than historical recordings, and the summer base flows are lower. Rule (2004) states that an estimated 70% of the wetlands within the Channel Scablands were drained in the early 1900s to provide farm ground and pastureland.

1.5.1.1 Agricultural Practices

Current Farming Practices

Of the over 1.3 million acres of agricultural lands within the Palouse subbasin, an estimated 50% of the cropland fields are rated as highly erodable by NRCS (Roe 2001). Approximately 10% of the farmable cropland is currently in the Conservation Reserve Program (CRP) where farmland is left idle for a period of at least 10 years while being maintained in a permanent cover crop of grass, or a mixture of grass and legumes.

The common crop rotation in the Idaho and eastern Washington portion of subbasin today is either a winter wheat/spring cereal grain rotation, a winter wheat/spring cereal grain/spring legume (pea or lentil) rotation, or a winter wheat/spring legume rotation. In the most western portion of the subbasin, a winter wheat/fallow rotation is common because of less precipitation. Research has shown that maximizing residues from the previously harvested crop reduces erosion potential on the farm fields. It is becoming more common for a no-till seeding operation to follow the low residue crop (lentils or spring wheat). Minimum tillage operations, designed to minimize ground disturbance and maximize surface residue cover, are used throughout the watershed.

According to the Palouse Cooperative River Basin Study (USDA-SCS 1978), soil loss by water induced erosion within the subbasin ranges from moderate (with an average soil loss between 7 to 10 tons per acre per year) across much of the watershed to severe (with an average soil loss of 10 to 13 tons per acre per year). Estimated soil erosion, using an enhanced level of conservation, results in reduced soil loss from sheet and rill erosion. According to current prediction models, soil erosion is reduced from 10 to 5.1 tons/acre/year using minimum tillage operations in a winter wheat/spring cereal grain/spring legume rotation. Erosion is reduced from 12 to 4.2 tons/acre/year in a winter wheat/spring cereal grain rotation (Roe 2001).[11] Soils within the watershed are generally categorized as having a *T* of 5. *T* refers to the tons per acre of soil that can be lost without reducing the productivity of the soil. In other words, acres with a sheet and rill erosion exceeding *T* are fields where the predicted soil loss from farming practices exceeds 5 tons/acre/year.

Cropland fields are most susceptible to soil erosion during the period of November through March. Although, localized, high intensity rainstorms can cause heavy runoff and soil erosion any month of the year. Continued soil erosion can result in reduced long-term productivity of the soil. Reducing topsoil results in loss of soil moisture holding ability. Sheet and rill erosion on cropland acres within the watershed is influenced by many factors, including the kind of soil; length and steepness of the slope; aspect of the slope; the amount, intensity and frequency of precipitation; the temperature of the soil before and during precipitation or snow melt; kind and degree of previous erosion on the field; and land management (USDA-SCS 1978). After soil has

[11] Soil loss predicted by the Revised Universal Soil Loss Equation. Five factors are used to predict erosion rates over a long-term average. Equation factors used in the winter wheat/spring cereal grain/spring legume rotation include R=120, K=.32, LS=2.94, C=.097, P=.92 for the lower remaining residue scenario and R=120, K=.32, LS=2.94, C=.055, P=.81 for the higher remaining residue scenario. Equation factors used in the winter wheat/spring cereal grain rotation include R=120, K=.32, LS=2.94, C=.120, P=.92 for the lower remaining residue scenario and R=120, K=.32, LS=2.94, C=.045, P=.81 for the higher remaining residue scenario.

been washed from its place of origin, some of it is deposited after traveling only a short distance; some may be deposited a considerable distance away.

Ephemeral gullies are formed when runoff is concentrated and runs off the field with an erosive velocity that cuts a ditch in the cropland fields. When gully erosion does occur, sediment delivery is high. Gully erosion can be problematic in conventionally farmed fields. Where the fields are worked between crop rotations, the gully is groomed closed with tillage between crops, but can re-form during the following critical erosion period. This results in gully erosion and sediment transport off the field one to two times per year. Typical gullies within the farm field are, on the average, approximately 0.5 feet deep, 1 foot wide and 1,000 feet long. Silt loam soils weigh approximately 90 pounds per cubic foot, therefore estimating one gully can contribute 23 tons of soil. When water is concentrated and conveyed through primary and secondary road culverts, the runoff is concentrated and often cuts a gully across downstream cropland fields.

Commercial fertilizer is applied to the fields typically when cereal grains, grasses and canola crops are grown. Commercial fertilizer usually contains sources of nitrogen, phosphorus and sulfur. Most of the nitrogen (in the form of nitrate) in runoff water from the subbasin originates from agricultural land (USDA-SCS 1978), and most results from subsurface drainage of these lands. The soil surface, which is most subject to soil erosion, is low in nitrate concentrations when nitrate ions are leached down into the soil profile by percolating fall rainwater. If high erosion rates occur before the nitrate are leached into the lower soil profile, the runoff waters and the soil it carries will contain high concentrations of nitrogen. When soil erosion rates are high, high nitrogen (in the form of nitrate) levels can also be carried into streams along with eroded soils. Excess nitrogen levels in receiving waters can contribute to algae blooms, reduce dissolved oxygen and elevate pH levels.

Phosphorus is strongly bonded to soil particles. Therefore, soil phosphorus does not leach appreciably into subsurface waters, but is transported easily with soil from eroding fields. Phosphorus in receiving streams also contributes to excess algae growth, which in turn can reduce the stream's dissolved oxygen levels and increase the water's pH.

Herbicides for weed control are the most common chemicals applied to cropland in the subbasin (USDA-SCS 1978). They usually are applied in the spring, after the high rainfall season. Nearly all studies indicate that, except when heavy rainfall occurs shortly after treatment, concentrations in runoff waters are very low. The total volume of herbicides running off the land during a crop year is much less than 5% of what was applied (USDA-SCS 1978). Toxicity of these chemicals is extremely variable; some can persist in the aquatic environment for a long time. Even very low levels of these chemicals in the runoff may be enough for environmental concern. Use of agricultural chemicals has increased with changing technology; many tillage operations have been replaced with the use of herbicides. A conundrum occurs with the need to maximize surface residue levels by reducing tillage operations in seedbed preparation and seeding, which in turn, increases the need for more herbicide use. Ware and Tirhi (1999) suggest ring-neck pheasant populations are limited in the region due to evidence that pesticides contribute to lower chick production, chick viability, and degenerated nervous systems.

Many small, intermittent streams were converted to, and are now managed as drainage ditches, streams were ditched and straightened and riparian vegetation has been removed. Tillage occurs up to the water's edge in many places, leaving no buffer between croplands and streams. According to Cook (2001), continuous tillage of the land has either pushed many of the native wildlife species into limited portions of the basin or caused their extirpation from the Palouse subbasin. Only wildlife species that have been able to adapt to constantly tilled ground with relatively little thermal cover such as the ring-neck pheasant, Hungarian partridge and certain migratory waterfowl have survived.

Erosion has significant impacts on wildlife and fish. As soil is depleted, capacity of land to produce wildlife and wildlife habitat is diminished. Relationships may be subtle. In intensively farmed areas such as the Palouse, reduction of wildlife populations by erosion may be reversed at first as eroded areas are abandoned to native vegetation. But as the soil resource is lost, so too will wildlife populations decline. Severe sedimentation, intermittent stream flows, and high water temperatures limit fish populations. Most reaches of the Palouse subbasin are unsuitable for fish, particularly valued game fish. Fish populations in the streams and lakes are affected because of the sediment-covered spawning beds in the streams of the subbasin. Penetration of light into the lakes is drastically reduced by high sediment levels. Lack of adequate light has reduced primary and secondary productivity in these lakes.

Erosion Associated With Livestock

It is estimated that today, fewer than a third of the farms have livestock. A typical farm in the watershed runs an average herd size between 20 and 40 in their cow-calf operation. It is common for a producer to graze the animals on bottomlands during the spring, summer and fall months and move the animals to a winter-feeding operation for the winter. An estimated 14% of the riparian areas within the watershed are grazed. Accelerated erosion exists within the grazed riparian areas, caused by stock trails leading to the water's edge, winter-feeding operation areas that are without vegetative cover, denuded streambanks and unarmored cattle crossings. For pasturelands managed under conventional practices an estimated 0.9 tons/acre/year erosion can occur with a 10% sediment delivery ratio for sheet and rill erosion and 0.5 tons/acre/year ephemeral gully erosion with a 60% sediment delivery occurs from ephemeral gully erosion (Rasmussen et al. 1995).

Livestock Grazing

According to Vander Haegen et al. (date unavailable), the legacy of livestock grazing in the shrub-steppe regions of Oregon and Washington began about 1700 when the Shoshone Indians brought horses into southeastern Oregon from the Spanish missionaries at Santa Fe. By 1730, horses had reached the Columbia Basin, where the Nez Perce and Cayuse built herds into the thousands by 1800. The impact of these horses on the local grassland ecology is unrecorded. Cattle grazing as an industry did not begin east of the Cascades until the late 1860s, but quickly expanded, reaching its zenith in the late 1870s. At about the same time, thousands of horses were needed for cattle raising and cattle began competing with hundreds of thousands of sheep grazing the area. By 1885 the range was showing signs of deterioration, including exotic seed contaminants and weed establishment.

Tisdale (1961) reports changes occurring in the subbasin and surrounding area caused by impacts from domestic livestock range. The major change has been the replacement of native perennials by introduced species, mainly annuals of Mediterranean origin. These changes due to grazing use occurred quite early in the settlement period, as indicated by observation on the effect of overgrazing. The era of peak numbers of livestock and major damage appears to have been approximately that of 1890 to 1910. Tisdale (1961) continues by stating that the question may well be asked, "Why did the vegetation of the Palouse change so quickly under the impact of grazing, when other types, notably the Mixed Prairie of the Great Plains, showed greater tolerance?" Tisdale's (1961) explanation is two fold. First, the absence of large herds of native grazing animals suggests that the plant species, or at least the races of the plant species dominating these grasslands, had not developed under the selection pressure of close grazing such as existed on the Great Plains to the east. Secondly, the moisture pattern of the region, with a pronounced summer drought period, made these grasses extremely vulnerable to grazing in late spring or early summer.

According to Daubenmire (1970), the first cattle were brought into the steep region of Washington in 1834. It was estimated that the numbers had increased to about 200,000 by 1855. Sheep raising developed principally in the 1880s, along with the rapid spread of agriculture at that time. It was during this period that wild horse herds became common in the steppe; wild horses were eliminated by the mid 1900s.

Daubenmire (1970) further states that ungulate pressure played no significant part in the evolution of ecotypes of the native steppe plants. East of the Rocky Mountains, where large herds of native ungulates have roamed uninterruptedly from Oligocene time to present, rangelands recover quite rapidly when given respite from excessive animal use, but in no part of the Washington steppe has a restoration of density bee documented. Instead, period of overuse by domestic animals further reduced the density of the large perennial grasses that highly adapted alien species claimed the relinquished territory. Daubenmire (1970) observed the striking inability of native species to endure heavy use, or to regain population densities later, must reflect their long history of freedom from grazing pressure.

The legacy of livestock grazing throughout the Columbia Plateau, including the Southeast Washington Subbasin Planning Ecoregion and the Palouse subbasin Idaho component, has had widespread impacts on vegetation structure and composition. One of the most severe impacts has been the increased spread of exotic plants. Unmanaged grazing by livestock can reduce the abundance of some native plants while increasing that of others and can allow exotic species to enter and in some cases dominate communities. The effects of livestock grazing on grassland and shrub-steppe vegetation can influence use of sites by birds and other wildlife species, although the direction of influence (positive or negative) may vary. Invasion of exotic plants changes floristics (numerical distribution of plants and plant groups) and vegetation structure and can have adverse effects on site use by some wildlife species.

Shrub density and annual cover increase, whereas bunchgrass density decreases with livestock use. Repeated or intense disturbance, particularly on drier sites, leads to cheatgrass dominance and replacement of native bunchgrasses. Dry and sandy soils are sensitive to grazing, with native and desirable grasses replaced by cheatgrass. As in native Palouse grasslands, the forbs and bunchgrasses native to shrub-steppe in Washington are most likely not adapted to severe grazing because large grazing animals were presumably not present in large numbers for several thousand years prior to the introduction of domestic livestock (Mack and Thompson 1982).

Livestock grazing has been listed as a threat to the ESA and Washington listed (threatened) plant species, Spalding's catchfly (USFWS 2004). The catchfly is reported to occur in native grasslands that are in reasonably good ecological condition, although small, isolated populations have persisted in areas that have had moderate grazing pressure (Hitchcock et al. 1964).

Other Contributions Associated with Livestock

Winter-feeding operations located in close proximity to surface water areas can be a source of other water quality contaminants. Surface water runoff during storm events can carry bacteria and nutrients, such as nitrogen and phosphorus compounds, to receiving streams.

Agricultural activities (cultivation and hayland) are the dominant land uses along the stream banks. Approximately 85% of the riparian areas within the subbasin are estimated to be directly effected by human land use (agricultural activities, grazing or urban). The remaining riparian vegetative habitat is of poor quality and fragmented (Cook 2001). Impacts from disturbed riparian areas include lack of floodplain protection, reduced shade element to deter water temperature increases, accelerated downstream stream velocities, and impacted fish and wildlife habitats. Unmanaged grazing and winter-feeding operations within disturbed riparian areas results in excess nutrient, sediment, and bacteria contributions to receiving waters.

Sediment Delivery and Sedimentation

Erosion rates typically represent the amount of soil displaced from slopes, not the amount transported to water bodies. However, because some of the eroded soil is transported to water bodies, a relation would be expected between watershed-wide erosion rates and loads of suspended sediment carried by streams (Ebbert and Roe 1998). By comparing sediment transport during periods of storm runoff, trends in erosion rates and transport can be inferred (Ebbert and Roe 1998). Over 80% of sediment transport from the Palouse River watershed occurs during storm runoff (USDA-SCS 1978). Average concentrations of suspended sediment tend to be higher during storms producing large discharges, and also when the predicted erosion rates are highest (Ebbert and Roe 1998).

Delivered sediment can fill creek beds, deteriorate aquatic habitats and lessen capacity to carry high flood flows. Recreation lakes, the Lower Monumental hydroelectric storage reservoir on the Snake, and the lower Palouse River areas are filling with sediment. This has depleted storage capacity, degraded fishery habitat, increased dredging costs, and caused loss of recreation facilities. Nutrients and other pollutants can be transported with soil particles, contributing to water quality degradation. In the Palouse subbasin, only part of the eroded soil is delivered to the stream system. Not all of the eroded sediment leaves the watershed. Much is deposited in stream channels or in floodplains.

According to the USDA-SCS (1978) report, delivery rates vary from 25 to 45% from Palouse cropland, depending on the physical watershed characteristics. Delivery rates were estimated from rangeland, pastureland and roads at approximately 11%, and a 90% delivery rate is predicted to occur from stream channel erosion (USDA-SCS 1978). According to Rasmussen et al. (1995), for highly erodible lands farmed under conventional practices, that is to say without an enhanced level of conservation, an estimated 10% sediment delivery ratio for sheet and rill erosion occurs on cropland areas and 40% sediment delivery occurs from ephemeral gully erosion within cropland acres. For non-highly erodable lands farmed under conventional practices, an estimated 10% sediment delivery ratio for sheet and rill erosion occurs on cropland areas with negligible erosion from ephemeral gully erosion within cropland acres. Sheet and rill erosion for non-highly erodable lands is estimated to erode at 2.8 tons/acre/year with a 10% sediment delivery ratio. For pasturelands managed under conventional practices, an estimated 10% sediment delivery ratio for sheet and rill erosion, and a 60% sediment delivery occurs from ephemeral gully erosion. Approximately 1 ton of sediment per acre per year is estimated to leave the watershed according to the values estimated Palouse Cooperative River Basin Study (USDA-SCS 1978).

1.5.2 Exotic Vegetation Encroachment

According to Belsky and Gelbard (1997), exotic weed invasions are possibly the greatest threat facing the grasslands and shrublands of the arid and semiarid west today. Species-rich ecosystems are being converted into monotonous weedlands as aggressive weeds replace native plants and degrade habitat for native wildlife. The term “noxious weed” has specific legal definitions. Designated noxious weeds are generally exotics (non-native), that negatively impact agriculture, navigation, fish, wildlife, or public health to such an extent that a state or the federal government has identified them as such. Other species of non-native or (rarely) native plants may also be invasive to the point of adversely affecting natural resources, and are also in need of containment.

Some of the most notorious invaders—non-native species such as cheatgrass (*Bromus tectorum*), medusahead, (*Taeniatherum caput-medusae*), knapweed (*Centaurea spp.*), yellow star thistle (*Centaurea solstitialis*), and leafy spurge (*Euphorbia esula*)—have already spread over more than 100 million acres of western lands and are invading new areas at the rate of 5,000 acres per day. Once established, exotic, introduced and noxious weeds reduce biodiversity by crowding out native plants, displacing wildlife species that depend on native plants, disrupting watershed function, and nutrient and energy flow. According to Gamon (2004), a major invader in the Cow Creek (Washington) drainage is bulbous bluegrass (*Poa bulbosa*), and in northern Whitman and southern Spokane Counties, ventenata (*Ventenata dubia*) is a major increaser with disturbance.

Ground-disturbing activities have created sites for the establishment of weeds. Weed invasion has also been accelerated by activities that substantially reduce native vegetative cover, such as heavy grazing and frequent fires. Weeds continue to spread to new sites by many common activities such as importation and transportation by agricultural activities (farming) and dispersed recreation.

Noxious weeds, primarily yellow starthistle, spotted and diffuse knapweed, rush skeletonweed (*Chondrilla juncea*), leafy spurge, and introduced annual grasses have taken over thousands of acres of wildlife habitat within the within the Southeast Washington Subbasin Planning Ecoregion (Ashley and Stovall 2004). In the Idaho portion of the subbasin, hawkweed (*Hieracium spp.*) and white bryony (*Bryonia alba*) are just a couple of the noxious weeds invasive to wildlife habitat areas. Noxious weeds are listed by county in Appendix D.

Yellow starthistle displaces native plant species and reduces plant diversity in drier sites and, when in solid stands, can drastically reduce forage production for wildlife. Birds, wildlife, humans, domestic animals, whirlwinds, and vehicles may transport the seeds. Yellow starthistle can grow more rapidly than most perennial grasses. It is deep-rooted, grows more aggressively than annual grasses, and can accelerate soil erosion by reducing soil cover.

Knapweeds are members of the Asteraceae family. Spotted and diffuse knapweed are deep tap rooted perennials that are long lived. Knapweeds are spread by wind, animals, and vehicles. Knapweeds reduce the biodiversity of plant populations, increase soil erosion, threaten natural area preserves, and replace wildlife forage on range and pasture.

Rush skeletonweed is also in the Asteraceae family. It can be a perennial, a biennial, or a short-lived perennial, depending on its location. The seeds are adapted to wind dispersal but are also spread by water and animals, and can also spread by its roots. Rush skeletonweed reduces forage for wildlife. Its extensive root system enables it to compete for the moisture and nutrients that grasses need to flourish.

Leafy spurge is a perennial belonging to the Spurge family. The root system can penetrate the soil 8 to 10 feet and will spread horizontally, enabling plant colonies to increase in size to out compete more desirable native vegetation for space, nutrients, water, and sunlight. The seeds are in a capsule and, when dry, the plant can project the seeds as far as 15 feet. Seeds may be viable in the soil up to 8 years. Like most weed species, leafy spurge is spread by vehicles, mammals, and birds. Leafy spurge root sap gives off a substance that inhibits the growth of grasses and reduces forage for wildlife, reduces soil protection and can increase soil erosion.

Annual grasses such as cheatgrass, bulbous bluegrass (*Poa bulbosa*), medusahead, tall oatgrass (*Arrhenatherum elatius*), and others have become naturalized throughout the Palouse subbasin and have either completely displaced or compete heavily with native grasses and forbs in most areas. Although annual grasses, and perennial grasses such as Kentucky bluegrass and smooth brome, may provide forage for big game and some bird species, they severely impact native plant communities and can add significantly to the fire fuel load resulting in hotter wildfires that increase damage to native vegetation.

Hawkweed, another member of the Asteraceae family, is found in the wetter areas of the Idaho portion of the Palouse subbasin. Both yellow and orange hawkweed (*Hieracium pratense* and *Hieracium aurantiacum* respectively) grow in the area. Hawkweed spreads aggressively by seeds, stolons, and rhizomes. The weed is perennial with shallow, fibrous roots. The stolons are extensive, creating a dense mat of hawkweed plants that practically eliminates other vegetation, out-competing native varieties, leaving undesirable species.

White bryony, a member of the Cucurbitaceae family, is a herbaceous perennial vine that forms dense mats which shade out all vegetation it grows upon. White bryony's major destructive potential is to native vegetation, forest communities, and urban horticulture. The vine is found throughout out the central portions of the Palouse subbasin. The seeds are spread by birds and it is reported to have spread rapidly within Whitman and Latah counties since 1975.

Oxeye daisy (*Leucanthemum vulgare*), of the family Asteraceae, is a perennial herb that aggressively invades grasslands in higher precipitation zones. The plants form dense populations and displace plant species diversity.

Left unchecked, exotic and noxious weeds can pose a significant threat to ecosystem health. An integrated program of prevention through education and awareness; detection, inventory and monitoring; planning; and treatment of existing populations with coordination between appropriate agencies landowners will help to reduce existing infestation levels and lessen the establishment of new populations.

1.5.3 Timber Harvest

In the Idaho portion of the Palouse subbasin, logging began in the 1880's, originally to clear land and provide wood for homes. The major logging boom took off in 1905 with the creation the Potlatch mill and the town of Potlatch. The mill operated until the early 1980s, peaking in the 1940s. USFS logging activity and associated road construction was at its peak in the 1960s and 1970s, and has tapered off considerably.

Land use pressures changed habitats which directly affects the presence, distribution and abundance of wildlife species in the subbasin. Timber harvest activities have impacted the subbasin's hydrograph, increasing runoff and timing of high and low flows, left a high degree of road densities in the timbered areas, contributed to erosion, and disturbed headwater instream habitat. Road densities are high in the northern and eastern most portion of the subbasin in Idaho, contributing to easy hunter access and high harvest. On the positive side, timber harvest activities have created large tracts of seedtree cuts or clearcuts, with meadows and early successional brushfields, which provides summer and winter range for deer and elk. Although many of those cuts are now in advanced seral stages that do not benefit deer and elk in the same way. Revegetation has changed the composition of both ponderosa pine and mixed conifer stands.

1.5.4 Fire Suppression

According to Ashley and Stovall (2004), in the Southeast Washington Subbasin Planning Ecoregion, fire suppression in the ponderosa pine habitat type has resulted in the loss of species diversity by allowing the spread of shade tolerant species such as grand fir. Prior to fire suppression, wildfires kept shade-tolerant species from encroaching on established forest communities. The lack of fire within the ecosystem has resulted in significant changes to the forest community and has negatively impacted wildlife. Changes in forest habitat components have reduced habitat availability, quality, and utilization for wildlife species dependent on timbered habitats.

The grasslands and shrub-steppe types are prone to natural fire since the pattern of dry, hot summers produces a ready fuels supply, and lightning-caused fires are common (Tisdale 1985). Tisdale (1985) also presumes that fire may have been used by Native Americans prior to European settlement, but the lack of big game in the area and scarcity of shrubby vegetation may have largely removed motivation for such action. Fire is presumed to have been a minor factor in the grasslands and shrub-steppe types of the Palouse subbasin in the century since settlement began.

According to USFWS (2004), fire suppression in grassland habitat included in the Palouse subbasin has allowed an unnatural increase in woody plants, which overtook Spalding's catchfly habitat, decreasing its numbers. In addition to fire suppression, USFWS (2004), cites livestock grazing, herbicide spraying, noxious weed infestation, recreation, conversion of prairie into farmland, and urban development as threats to the Spalding's catchfly. Hitchcock et al. (1964) reports that fire may have historically played a role in maintaining habitat particularly in sites that are interspersed with ponderosa pine forest.

Daubenmire (1970) cites that there is no evidence that the distribution of vegetation types or species in eastern Washington is related to the past use of fire. Sagebrush will reinvade after each fire, but soil and climate prevent it from invading any of the other types of steppe communities.

Fires covering large areas of shrub-steppe habitat can eliminate shrubs and their seed sources and create eastside grassland habitat (Ashley and Stovall 2004). Fires that follow heavy grazing or repeated early season fires can result in annual grasslands consisting almost entirely of noxious plants like cheatgrass, medusahead, knapweed, or yellow starthistle. In bunchgrass grasslands, mostly perennials resprout after natural fires. Grassland composition remains very similar to its composition prior to the fire, except the crust moss and lichen species are destroyed and may not recover. Wildfire can promote the spread of annual grass and weed species to the detriment of native plants.

1.5.5 Urban Development

In addition to losses of habitat from grazing and agriculture, there have been permanent losses of Palouse habitats to urban and rural residential growth. Resource managers are concerned by the growing number of ranchettes, subdivisions, subdivided cropland, and floodplain encroachment. Rural development often occurs near wooded areas, lakes, or streams. The increasing number of dwellings poses a threat to water quality due to the increased amount and dispersion of potential nutrient sources immediately adjacent to waterways, displaces habitat and wildlife.

According to Knick et al. (2003), urbanization, roads, and powerlines continue to fragment ecological systems. This loss represents a major challenge for restoration because essential components of the system may be disrupted or lacking entirely. Knick et al. (2003) claims this loss of continuous habitat reaches, as a result of urbanization and agricultural conversion, may be irreversible.

The lower reaches of the North Fork and South Fork Palouse Rivers are confined to a concrete lined channel for nearly 0.5 miles as the stream enters the town of Colfax. This results in a loss of riparian habitat and channelizes the stream which contributes to hydrograph modifications.

Ferguson et al. (2001) discuss effects of urbanization on wildlife and habitats, and state that predation rates on wildlife are higher in urban areas in comparison to similar exurban areas; with an increase in edge comes an increase in nest predation and brood parasitism. Their research suggests that increased predation in urban areas may be attributed to human pets—cats and dogs. Building and barren ground reduce and simplify vegetation within patches, and provide hunting areas for domestic cats and dogs that may effectively reduce the local abundance of vertebrate prey.

1.5.5.1 Septic Systems

Rural residents are on individual septic systems for domestic waste treatment. Improperly installed or failing septic systems are a source of water quality impairments. Households installing or replacing septic systems within the last 30 years are required to acquire a permit (on-site sewage disposal permit) from Whitman County that insures proper placement, size and function of a septic system (Skyles 2001). Literature on suggested system maintenance is distributed along with the permit. Although the permitting process has been in place since the early 1960s, was not aggressively enforced until the late 1980s (Skyles 2001). Most of the existing homes within the watershed were in place before the County permitting process became ordinance. The extent of improperly operating septic systems within the watershed is not known.

Households installing or replacing septic systems within Latah County are required to obtain a permit prior to the building permit process, in which a site evaluation will be performed and a site plan, which must be followed, will be created by the Idaho State Health and Welfare Department (IHWD), to ensure proper installation and use of septic systems within Latah County. IHWD provides informational literature to permit holders on the septic system maintenance.

1.5.5.2 Road Development

The transportation system within the subbasin is a potential limiting factor to wildlife populations. Road densities and placement can have a negative impact on elk use of important habitat. More than 65 species of terrestrial vertebrates in the interior Columbia River basin have been shown to be negatively affected by roads (Ashley and Stovall 2004). Roads can negatively affect terrestrial vertebrate habitats and populations as well as water quality and fish populations.

Habitat fragmentation, due to road construction and improper culvert placement, has also prevented migration of fish and amphibian species within and/or between some subbasin tributaries. Increasing road densities can reduce big game habitat effectiveness and increase vulnerability to harvest. Motorized access facilitates firewood cutting and commercial harvest, which can reduce the suitability of habitats surrounding roads to species that depend on large trees, snags, or logs. Roads also aid the spread of noxious weeds. Road construction and maintenance has contributed to channelization and relocation of natural streams, causing a loss of fisheries habitat, and has negatively impacted the subbasin's hydrograph.

1.5.5.3 Roadway Erosion

Approximately 200 miles of unsurfaced roadways exist within the watershed. Unsurfaced (graveled and un-maintained) roadways contribute an estimated 12 tons/acre/year of sediment at a 60% sediment delivery ratio (Rasmussen et al. 1995).

1.5.6 Hydropower Development

Hydropower development on the Snake and Columbia Rivers provided water to limited irrigated cropland acres within the Palouse subbasin. This allowed conversion of grasslands and shrub-steppe habitat to cropland. A positive economic impact is realized by the dam and lock system offering an economic way to ship wheat and other products to ports. This available shipping mechanism led to an increase in agricultural conversion, resulting in a loss of native habitats.

Ashley and Stovall (2004) estimated that the loss of riparian habitat within the Southeast Washington Subbasin Planning Ecoregion caused by the impoundment of Lower Granite Dam resulted in a loss of habitat for 11,000 summer and 17,000 winter birds. There has been some recovery, but the carrying capacity for wildlife in the Southeast Washington Subbasin Planning Ecoregion has been undeniably lowered. Since impoundment, the recovery of riparian habitat has been slowed due to shallow soils along the current banks of the reservoir in comparison to soils formed in a natural riparian ecosystem.

Barge navigation along the Lower Snake River, from the confluence of the Clearwater River to the confluence of the Snake River and the Columbia, provides major, year-round water transportation route for agricultural and timber industry product transport. This form of transportation has had a positive economic impact on this region. On the negative side, barge traffic on the Lower Snake produces wave action throughout the length of the system. Along with barge traffic comes the continuous maintenance of the channel due to sediment deposition.

1.5.7 Other Limiting Factors

Global or regional limitations can reduce a species that inhabits the Palouse subbasin seasonally but travels outside the drainage in other times of the year. Many migrant populations are declining due to global or national limiting factors such as habitat destruction, climate changes, or pollution that are effecting the worldwide distribution of a species. Unknown reasons for declining plant and wildlife communities are still being studied for many species. Some historic community locations are on private property and unavailable for current surveys, or some species may be responding negatively to unknown environmental variables in addition to well documented factors.

According to Tisdale (1961), changes in animal populations commenced as soon as white settlement began, due to disturbance of habitat and to hunting pressure. Conspicuous decreases in native mammals include the population of white-tailed jack rabbit, which has been largely replaced by the black-tailed jack rabbit. The Columbian ground squirrel, on the other hand, has increased. Changes in bird life include a marked reduction in the population of sharp-tail grouse and the introduction and naturalization of several species including the ring-neck pheasant and Hungarian partridge. Tisdale (1961) describes the populations of deer and elk, while probably reduced on the grasslands proper, appeared to have increased in adjacent forests and other areas due to disturbance of the vegetation by cutting and fire.

In the mid-1850s several gold strikes were made in the upper Palouse River watershed and the Hoodoo Mining District was formed with many placer mines operating near the headwaters in Idaho. The population in the Palouse country grew rapidly during the 1870s and 1880s because of mining opportunities. A decline in mining activity by the end of the 1880s resulted, although some placer mining continued through the 1950s in the upper Palouse River area. The mine tailings are still present along the upper Palouse River (North Fork in Idaho), and along with the tailings, the legacy of stream channelization and instream habitat modifications.