Historical land & resource use in the Grande Ronde basin, Oregon

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ABSTRACT

In the past century the Grande Ronde basin in northeastern Oregon has been subject to numerous changes in land use and resource development practices including mining, logging, road construction, grazing, and irrigated agriculture. The impacts from these practices are spread throughout the basin and surrounding areas and have caused considerable changes to terrestrial and aquatic habitats. Many observed habitat impacts, including increased water temperature, loss of riparian vegetation, erosion, increased stream channelization, and increased sedimentation have more than one potential source, thus, it is often difficult to pinpoint the exact cause of a change in conditions. Vannote et al.'s (1980) river continuum concept (RCC) hypothesizes that physical variables within a river system will follow a gradient from headwaters to mouth, and this gradient should prompt a series of biotic adjustments that will conform to the continuum. This paper asserts that due to the extensive land use activity present in the Grande Ronde basin, land use impacts are prevalent enough to cause discontinuities in the predicted physical continuum of the Grande Ronde River.

INTRODUCTION

Humans have long been attracted to the Grande Ronde basin (Fig 1). The area's pre-European inhabitants, such as the Nez Perce, relied on the large annual salmon runs for their subsistence lifestyle. During the 19^{th} century, "gold fever" swept the eastern United States (U.S.) after numerous gold discoveries in the West occurred, which brought more people through Oregon, some of whom ultimately settled in the Grande Ronde basin (Reavis 2004). The discovery of gold in the West ushered in a new era: within years the Nez Perce found themselves without land in the basin, and the newcomers quickly made their mark with numerous mines, logging endeavors, and homesteads, and plenty of roads to connect all of their projects.

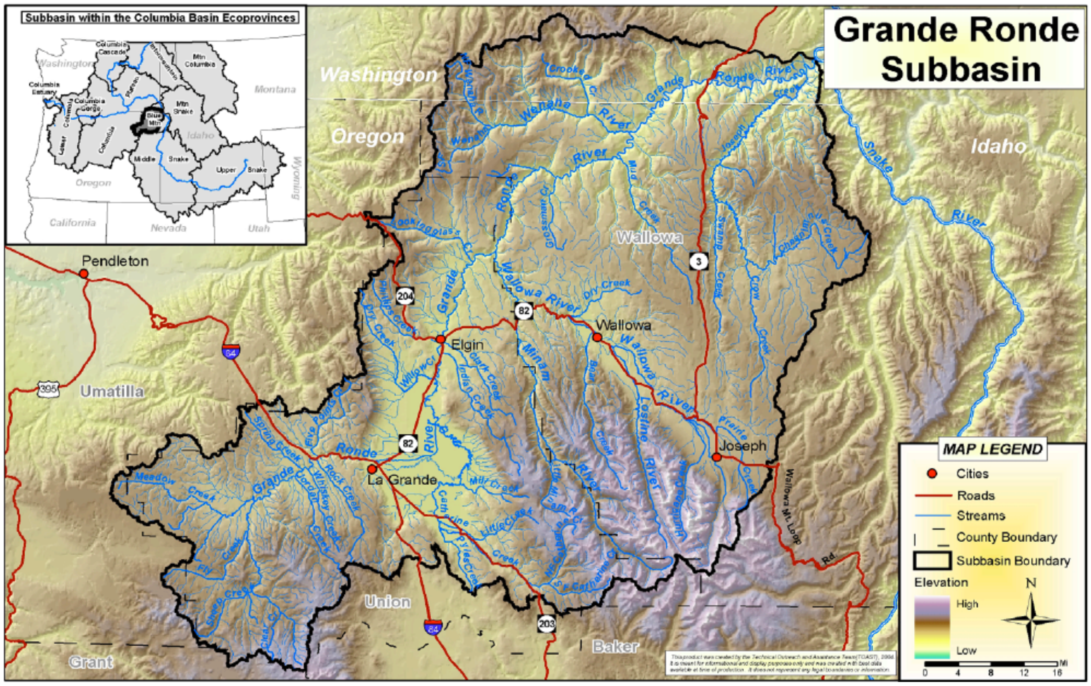

Figure 1. The Grande Ronde basin is located in northeastern Oregon, and also encompasses parts of Washington. (Nowak and Kuchenbecker 2004)

However, this rapid development did not come without a price. Within a century, the environmental effects from the settler's heavy use of the land began to show. For example, by the 1920s 50% of the federally managed rangelands in the western U.S. were in fair to poor condition based on vegetative potential (based on modeling systems), and today not much has improved (Wissmar et al. 1994). Today, the cumulative effects of land and resource use have significantly impacted the basin landscape and have created a plethora of problems for native plants and animals, changing numerous ecosystems in the region. In order to understand the current land use issues in the Grande Ronde basin, it is helpful to take a look at the history of the area, and early patterns of human settlement.

HUMAN SETTLEMENT

Native Americans

Historically, the Columbia River Plateau was a highly productive area with plenty of opportunities for hunting and fishing, which made it relatively easy for people to live off of the land. This is evident in that there were several Native American tribes that inhabited the area for thousands of years before European settlers arrived in the early 19th century. One of the most powerful tribes in the region were the Nez Perce; whose territory covered parts of Washington, Oregon, and Idaho, including portions of the Grande Ronde and Snake River basins (Walker and Sturtevant1998). Like other tribes, the Nez Perce were a migratory people who followed seasonal patterns of food abundance, often depending on salmon runs in the Grande Ronde River.

In 1855 the Nez Perce ceded most of their 13 million acres of ancestral territory to the federal government in exchange for money and a guarantee that 7.5 million acres of their lands would remain intact, in the form of a reservation (Walker and Sturtevant 1998). However, the treaty was violated five years later when gold was discovered on Nez Perce lands, prompting European settlers to rush in and stake claim (Walker and Sturtevant 1998). As a result, settlers put increasing pressure on the federal government to open more of the Nez Perce's land for settlement and mining, and in 1863 the governor of the Washington Territory, Isaac Ingalls Stevens, urged the Nez Perce to sign a new treaty that would reduce their land holdings to 780,000 acres. While this prospect caused discord amongst the Nez Perce, resulting in only a fraction of the tribal leaders signing the treaty, it was enough to allow the federal government to open up the area to settlement.

However, many of the Nez Perce viewed the treaty as non-binding, including Chief Joseph, who opted not to vacate territory in the Wallowa Valley ceded to the government in the 1863 treaty. In an 1876 meeting between Civil War veteran General Oliver Howard and Chief Joseph, the Nez Perce leader made it clear that he did not intend to honor the 1863 treaty (Walker and Sturtevant 1998). However, the following year the government gave the tribe 30 days to vacate the territory and move to a reservation in Washington. Chief Joseph was willing to comply with the request, but a band of young rebels killed a group of white settlers, which ultimately resulted in the Nez Perce War. A band of 800 Nez Perce fled the area, hoping to seek refuge in Canada. The tribe managed to outmaneuver 10 military units for over 1,700 miles, but were caught 40 miles from the Canadian border and surrendered on October 5th, 1877 (Walker and Sturtevant 1998). This retreat marked the last great battle between the federal government and an Indian nation. Today Chief Joseph is remembered by several landmarks named after him, such as Joseph Creek and Chief Joseph Dam on the Columbia River.

Other tribes such as the Umatilla, Cayuse, and Walla Walla inhabited the Columbia River Plateau at the same time as the Nez Perce. Many of these tribes led similar lifestyles to the Nez Perce, subsisting off the land for their well being. Unfortunately, many of these tribes shared a similar fate to the Nez Perce, characterized by disease, displacement, and loss of territory (Walker and Sturtevant 1998).

Americans and Europeans

The area encompassing present-day Union, Baker and Wallowa counties, both located in the basin (Fig. 2) was not settled by Americans and Europeans until1861. Prior to then, mostly Native Americans lived in the basin, though some settlers from the East passed through the area but chose to continue on to the Willamette Valley farther west. Interestingly, there are records of Nez Perce members attempting to persuade settlers into staying in the valley. In one particular incident in 1851, the Nez Perce chief offered 500 ponies to a member of the traveling party if he would remain in the valley, build a mill, and break the horses belonging to the Native Americans so they would be able to work in harness. However, at this time there were still fears of "Indian savagery" amongst settlers, and the Grande Ronde basin was too far from a base of supplies to be an ideal homestead (Reavis 2004).

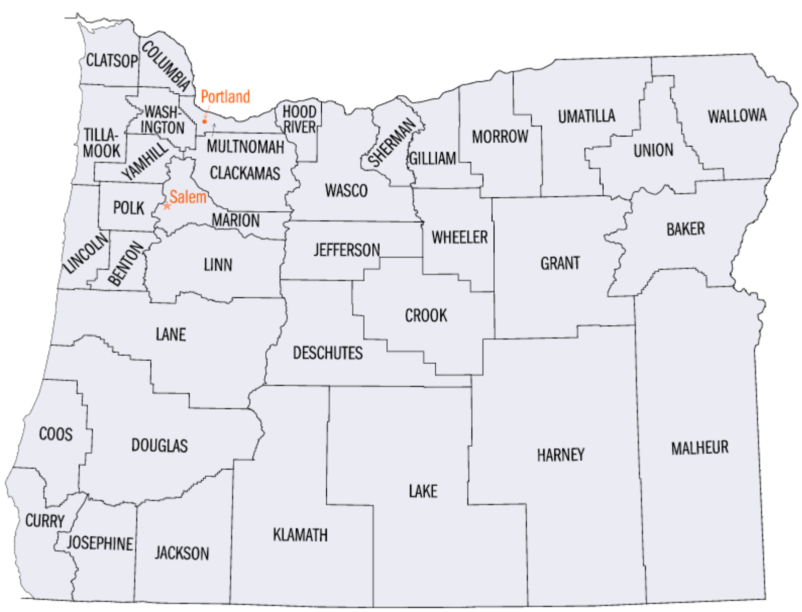

Figure 2. A map of Oregon counties. Union, Wallowa, and Baker counties are al located within the Grande Ronde basin. (National Home Search 2005)

A small settlement near Mt. Glenn (a few miles from present day La Grande, Oregon) was first erected in 1861 with 20 individuals living in 5 log cabins. The first cattle in the region came that year as well and supplied with homesteaders with plenty to eat through the winter months. In 1863, the growing population re-settled at present-day La Grande, because it was closer to the main trail that individuals took while heading west. The increased numbers of whites in the area in turn attracted more settlers, for there was more protection from any potential "Indian savagery" (Reavis 2004). There were other factors as well that attracted additional settlers to the area including the discovery of gold in Baker County (south of the Grande Ronde basin) in 1861, and the Nez Perce treaties of 1855 and 1863 which opened up more land for settlers to mine, grow crops, and raise cattle on. The city of La Grande was incorporated into the State of Oregon in 1865 and has a population of 12,500 according to the latest census.

Present Day

La Grande, and the rest of the Grande Ronde basin is found in the Blue Mountains Ecoregion (Fig. 3). Oregon contains eight ecoregions, each defined as areas of general similarity in ecosystems and in the type quality, and quantity of environmental resources according to the State of Oregon (SOER 2000). As of 2006 the Blue Mountains Ecoregion had a population of 161,000, about 4.8% of the state population despite being the largest ecoregion in the state (Oregon DFW 2006). Additionally, the region had the lowest rate of population growth in the state, at just 0.6 annually (SOER 2000). Furthermore, employment trends are well behind the rest of the state, with regional employment increasing by only 7.6% since 1990 (as compared to the state average of 25.5%) and a higher unemployment rate than the state average (SOER 2000). This can be attributed to the fact that many people rely on seasonal industries such as agriculture and lumber, and due to a loss in federal government jobs related to resource management agencies (SOER 2000). Finally, personal incomes are substantially lower in the Blue Mountains Ecoregion, compared with statewide incomes.

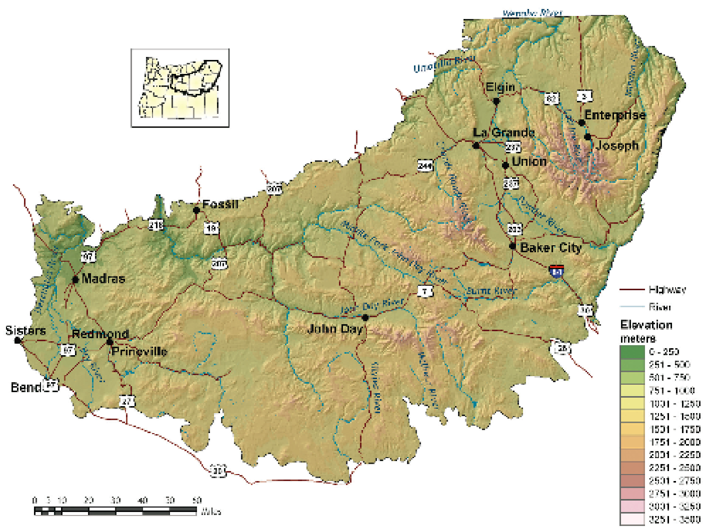

Figure 3. The Blue Mountains Ecoregion located in northeastern Oregon, is the largest in the state and includes the Grande Ronde basin. (Oregon DFW 2006)

LAND AND RESOURCE USE IN THE GRANDE RONDE BASIN

Many of the population, employment, and personal income trends described above are closely tied to the regional economy and use of natural resources. Below is a synopsis of the main land and resource activities in the Grande Ronde basin today. The list is not exhaustive, for there are certainly other basin land use activities, including recreation (in the form of hunting, rafting, and fishing). Each section includes a background of the specific practice, as well as locations (if known) within the basin where the activity is occurring. Finally, the environmental effects from each industry are discussed, and what (if anything) is being done.

Mining

Mining was one of the first industries to get started in the Grande Ronde basin. The headwaters of the river have been mined for gold since 1870, with extensive dredge mining during the early 1900s (McIntosh et al. 1994). Historically, a variety of other materials were mined in the basin as well, including: copper, silver, nickel, chromium, gravel, and building stone. Most of the mines that were once operational in the last century have ceased to operate due to lack of productivity (SOER 2000), however, evidence of past operations can still be seen along the river. In some areas of the river deemed part of a national historic site, mine tailings from past dredging operations are still present and cannot be altered due to the existing historic designation (McIntosh et al. 1994).

Today, there are still some mining operations including cyanide chemical-leach mining for gold from old mine deposits as well as the excavation of stream channels and floodplains for gravel (Wissmar et al. 1994). The rest of the active mining today is mostly small-scale hobby mining along streams using gold panning methods (SOER 2000). However, state permits are required for hobby mining, because even the smallest scale operation can have an affect on the stream ecosystem, which will be discussed below.

Effects of Mining

Past and present mining operations currently are having a profound effect on the landscape in the basin by causing erosion, releasing chemical leachates, altering stream flows, and damaging riparian habitats (Wissmar et al. 1994). Mine tailings from dredging and hydraulic mine pits and scars still found throughout the upper sections of the basin, constrict river channels and provide a continuous source of sediment to the streams (Wissmar et al. 1994). Both of the aforementioned geomorphic impacts are problematic in that the areas in which they occur are important spawning sites for many fish, including the federally listed spring Chinook salmon (McIntosh et al. 1994). The geomorphic impacts of both historic mine tailings and on-going hobby-mining of riverbed gravels are detrimental to salmonid habitat for it changes the shapes, depths, flow patterns, temperatures, and bottom substrate compositions of channels (Wissmar et al. 1994).

Logging

Logging began in the Upper Grande Ronde basin in the late 1880s and continues to be a lucrative business. From 1896 to 1990, timber harvest in the region has increased 172 percent, (Fig. 4) from 36 to 90 million board feet (mmbf) per year (McIntosh et al. 1994). Before railroads were constructed in the region, splash dam logdriving was the preferred method for transporting the logs (VanNatta 2006). Logdriving was considered a dangerous occupation; in many instances drivers had to stand on the moving logs during transport to free up logjams, but the practice had the advantage of allowing logs to be transported during any season. However, the method was put to rest when the Union Pacific Railroad extended its tracks to the area in 1919, allowing for more efficient (and less dangerous) transport.

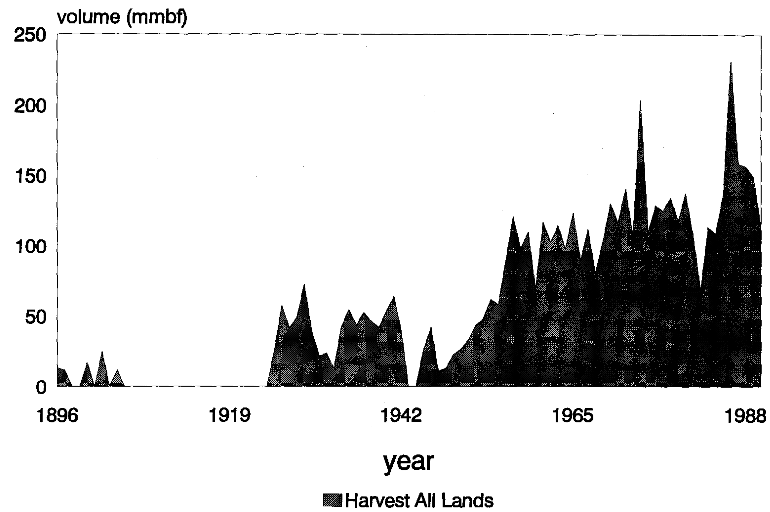

Figure 4. Volume of timber harvested (millions of board feet) for Union County, Oregon from 1896 to 1990. (McIntosh et al. 1994)

Today, the United States Forest Service (USFS) manages much of the land at higher elevations and headwater regions of the basin, while the lower portions are privately owned. Most of the timber harvested earlier in the early 1900s was predominantly in riparian areas of privately owned land. However in the later half of the 20th century, areas of higher elevations became more accessible through road construction, and began to be logged as well (McIntosh et al. 1994). Additionally, in the late 1940s the USFS began to harvest more timber in the Wallowa-Whitman National Forest in response to insect outbreaks. As a result, the USFS began to practice intense salvage logging in the 1950s, and by 1960, timber harvest was about evenly split between public and privately owned lands, with overall harvest on the increase—a trend that continues today (McIntosh et al. 1994).

Salvage logging is generally practiced in order to salvage trees that are dead or damaged due to fire, wind, insects, etc. In the Grande Ronde basin in particular, salvage logging is mainly due to fire and insect infestations. Salvage logging has come under attack in recent years due to the lack of scientific support behind the practice, as well as the many loopholes that it creates: salvage may be conducted on lands not otherwise eligible for logging, may exceed allowable sale quantities and maximum logging area rules, may be exempt from anti-clear cutting rules, and may be exempt from most forest plan standards (Beschta 1995).

Effects of Logging

Over the past century, the Grande Ronde basin has been subject to a wide range of logging practices that have had an even wider spectrum of cumulative environmental impacts on the terrestrial and aquatic landscapes. Logging causes a decrease in cavity nesting species such as birds and small mammals (Beschta et al. 1995), though clear cutting may improve habitat for species that prefer open areas (e.g. White-crowned Sparrows). Another impact on wildlife from logging is the decreased amounts of large woody debris (LWD) in the stream channel (McIntosh et al. 1994) materials which salmonids in the Grande Ronde River rely on to provide both thermal refuge from warm water temperatures and protection from certain predators (Ebersole 2003). In addition to providing thermal refuge for fish, LWD also contributes to habitat complexity and cover, increased sediment storage and routing capabilities, and stability of stream channels and floodplains (McIntosh et al. 1994). A study found that along the Upper Grande Ronde River in particular, there was a decrease in frequency of LWD per kilometer in "managed" areas (i.e. areas of human use) as opposed to areas free from human interference (McIntosh et al. 1994).

With respect to the aquatic habitat, logging causes increased amounts of surface runoff and sedimentation in streams, and increased soil compaction near streams (Wissmar et al. 1994). Logging also may contribute to increases in base flow discharge and earlier annual peak stream discharge (McIntosh et al. 1994). This is due to the decreased canopy coverage in clear cut areas, resulting in greater snowfall accumulations that melt earlier due to increased exposure to solar radiation (Harr 1983). Observations from the upper sections of the Grande Ronde River over the last 70 years are consistent with these findings, showing an increased overall base flow discharge, and an earlier peak flow (Fig. 5 and 6).

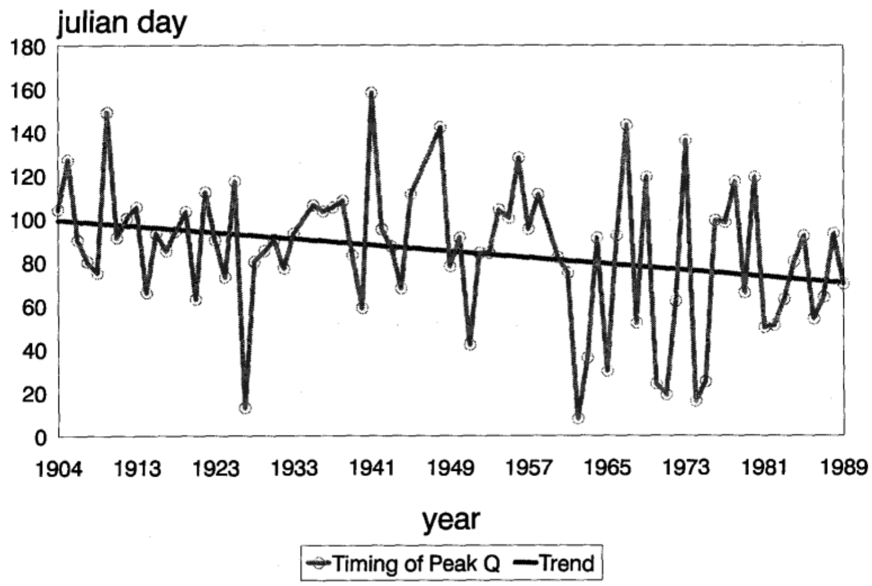

Figure 5. Trend in the timing of peak discharge based on Julian day for the Upper Grande Ronde River, 1904 to 1989. (McIntosh et al. 1994)

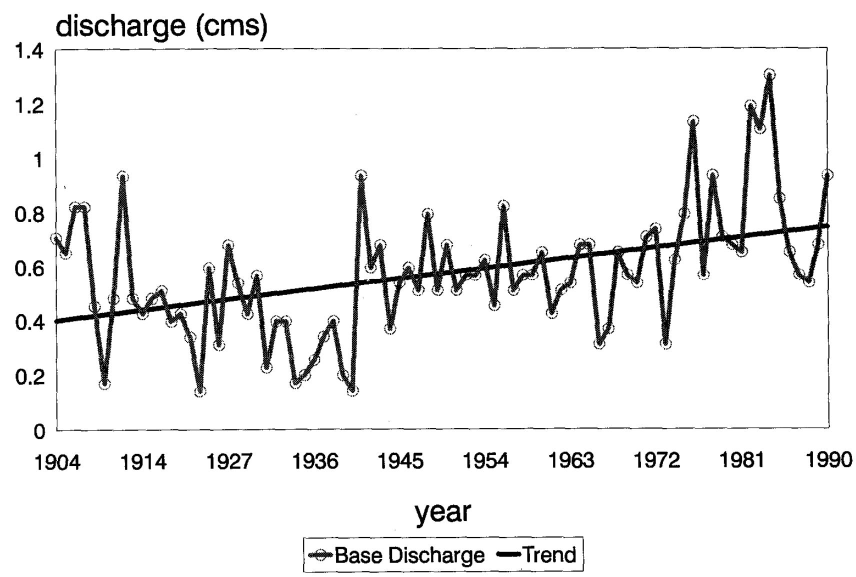

Figure 6. Trend in base discharge for the Upper Grande Ronde River in cubic meters per second (cms), 1904 to 1990. (McIntosh et al. 1994)

The Grande Ronde basin is currently the site of increasing timber production, intensive salvage logging, and fire-suppression efforts (McIntosh et al. 1994). Salvage logging practices have resulted in the removal some of the oldest, biggest trees from the region, resulting in a dense build-up of young trees in their place (SOER 2000). This creates a problem in that the increased density of young trees creates more biomass than the ecosystem is designed to support, which puts stress on the community, weakening their defenses against insects, drought, and fire (SOER 2000). Historically, western ecosystems have evolved to withstand periodic disturbances such as fire (Wissmar et al. 1994), and often fires help reset temporal patterns and processes that provide dynamic and biologically critical contributions to ecosystems (Beschta et al. 1995). However, the new landscape that is being created by salvage logging, is not as prepared to handle these disturbances, and could alter the natural-fire regime, causing more frequent and/or intense fires (Wissmar et al. 1994).

Though logging practices have changed over the last century, the effects that they have on the Grande Ronde basin have not. Logdriving relied on splash dams to supply violent bursts of water, upon dam destruction, to transport the logs down a stream or river. However, these frequent, and violent, bursts of water that erupted when a dam was broken caused considerable damage to the stream channel and surrounding landscape through erosion, flooding, and decreased LWD (McIntosh et al. 1994). In the case of the Beaver Creek splash dam, a tributary to the Grande Ronde, it was not only destructive, but it also failed to work (common among splash dams), resulting in the bankruptcy of the logging company supporting the dam (VanNatta 2006).

Irrigated Agriculture

Irrigated agriculture has greatly expanded in the past 25 years (Wissmar et al. 1994), resulting in virtually all of the region's historic wetlands being converted to agriculture (SOER 2000). Agriculture almost exclusively occurs on private land, which is generally at lower elevations near bodies of water (Fig. 7). Other water demands in the region include stock watering, rural domestic use, public water supply, and industrial consumption, but irrigation dominates the regional demands, with about 10 times more water being withdrawn for irrigation purposes than for municipal and industrial uses (Wissmar et al. 1994). Crops grown in the region include alfalfa, hay, peppermint, and other seed crops. Water demands have increased due to expansion of irrigation practices, but also due to an overall decrease in annual precipitation (McIntosh et al. 1994, Reinheimer 2007, this volume).

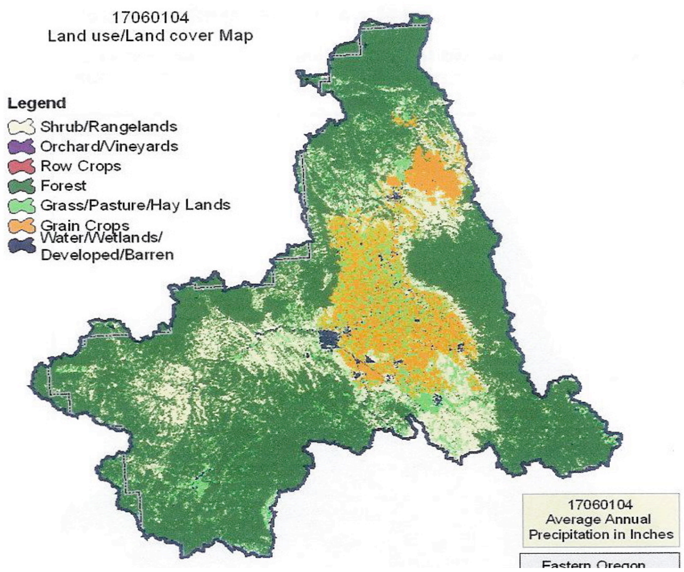

Figure 7. Land ownership map of the Upper Grande Ronde River basin. (USGS 2005)

Effects of Irrigated Agriculture

Irrigated agriculture has many effects on the surrounding environment. Water removal can raise the temperature in rivers and streams due to the cold water is being removed, and also due to the decrease in water volume in the stream. Water that is removed is conducted by a series of pumps to the crops, and then water that remains generally flows back into the water body further down from the point of removal. Upon water return, chemicals or other nutrients present in the fields often get mixed in with the water that gets returned to the stream resulting in non-point source pollution.

Pollution to streams due to irrigation can take shape in a variety of forms including contaminants (such as herbicides, pesticides, fungicides, etc.), nutrients (from fertilizer), and occasionally fecal coliforms if there are livestock present (Bianchi and Harter 2001). Additionally, irrigated agriculture often results in flow alterations to the water body, increased channelization (e.g. the State Ditch), sedimentation, and soil salinity (Bianchi and Harter 2001).

Grazing

Livestock grazing began in the Grande Ronde basin with the arrival of the miners and settlers in the later half of the 19th century (Wissmar et al. 1994). However, by the late 1880s the rangelands rapidly became depleted due to overgrazing (mostly by sheep) and caused widespread damage to riparian areas. Fortunately, the riparian areas were spared further damage due to the collapse of the sheep industry in northeastern Oregon in the early half of the 20^{th} century, which resulted in a 78% decline in domestic livestock grazing (McIntosh et al. 1994). Today, cattle make up the majority of the grazing from domestic livestock, and although grazing levels are lower than their historical average, cattle have a preference for grazing on riparian lands, which poses a significant threat to habitat degradation via erosion and soil compaction.

Effects of Grazing

As mentioned in the introduction to this paper, grazing took off at a rapid rate once livestock were introduced to the region. Overgrazing caused diminished riparian plant diversity, and significant damage to stream channels due to erosion and soil compaction, which in turn creates poor habitat for fish in riparian areas (Wissmar et al. 1994). In order to help solve this problem, alternative grazing methods must be practiced in order to minimize damage and give riparian areas time to recover.

Road Construction

Road building activities are closely linked with that of timber harvest because initially the main purpose of regional roads was to transport harvested timber. Road construction was minimal until the 1920s, but accelerated in the 1950s when the USFS began salvage logging operations (Fig. 8). Between 1978 and 1989, the amount of roads in the basin more than doubled (McIntosh et al. 1994). Currently, the road density in the basin is 2.5 km/km^2 and when roadless areas are excluded, the number jumps to 4.4 km/km^2 (McIntosh et al. 1994).

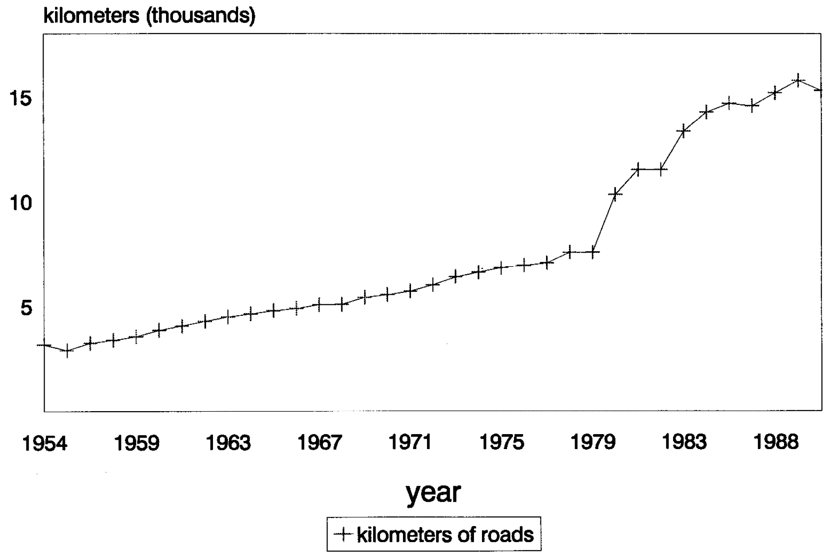

Figure 8. Total road length (kilometers) in the Wallowa-Whitman National Forest: 1945 to 1990. (McIntosh et al. 1994)

Effects of Road Construction

Though road construction has appeared to slow in recent years, the cumulative effects of road construction are worth noting. Roads are associated with a variety of negative effects on aquatic resources, including disruption of basin hydrology and increased chronic and acute sedimentation (Beschta et al. 1995). Increased sedimentation can be caused from specific instances, such as road construction (acute), or from the long-term runoff from an existing road (chronic). Basin hydrology is disrupted because often streams are diverted from their natural course to minimize interference with the road. Furthermore, existing roads as well as unused railroad tracks in the basin serve as geomorphic controls that constrain stream channels and hinder their ability to interact with the adjacent floodplain (McIntosh et al. 1994).

LAND USE AND THE RIVER CONTINUUM CONCEPT

Vannote et al.'s (1980) River Continuum Concept (RCC) hypothesizes that physical variables within a river system will follow a gradient from headwaters to mouth, and this gradient should prompt a series of biotic adjustments that will conform to the continuum (Vannote et al. 1980). Some of the variables in which the RCC hypothesizes will form a gradient include temperature, species distribution, and substrate. However, we have seen that land use plays a large role in defining ecosystem characteristics. Areas along the Grande Ronde River and its tributaries that are sites of heavy land use are predicted to form discontinuities in the predicted physical gradient. For example, portions of the river that are heavily subject to irrigation practices should have higher in-stream temperatures than what would be predicted in a system where a continuous gradient of physical conditions exists.

CONCLUSION

The Grande Ronde Basin has a long history of land use by humans. Historical and current industrial and agricultural land use has caused an array of problems for native flora and fauna throughout the basin, hindering their ability to play a role in ecosystem function. Active management roles must be taken by all parties involved to stop further habitat degradation. Land use has also had several geomorphic impacts as well. Several sections of the river have been diverted from their natural course to better suit land use needs (e.g. irrigated agriculture, roads, etc.), which hinders the channel's ability to interact with surrounding geomorphic structures, such as flood plains.

Cumulative effects of land use can take place in a variety of forms, thus making it difficult to identify a distinct cause and effect relationship. It is imperative to note that when studying the effects of land use, that one effect may have multiple causes. For example, grazing, irrigation, and logging can all contribute to increased temperatures. Land use is a significant factor in landscape characteristics as well as ecosystem function in the Grande Ronde basin. Consequently, it needs to be taken into account when attempting to apply the River Continuum Concept to the basin.

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