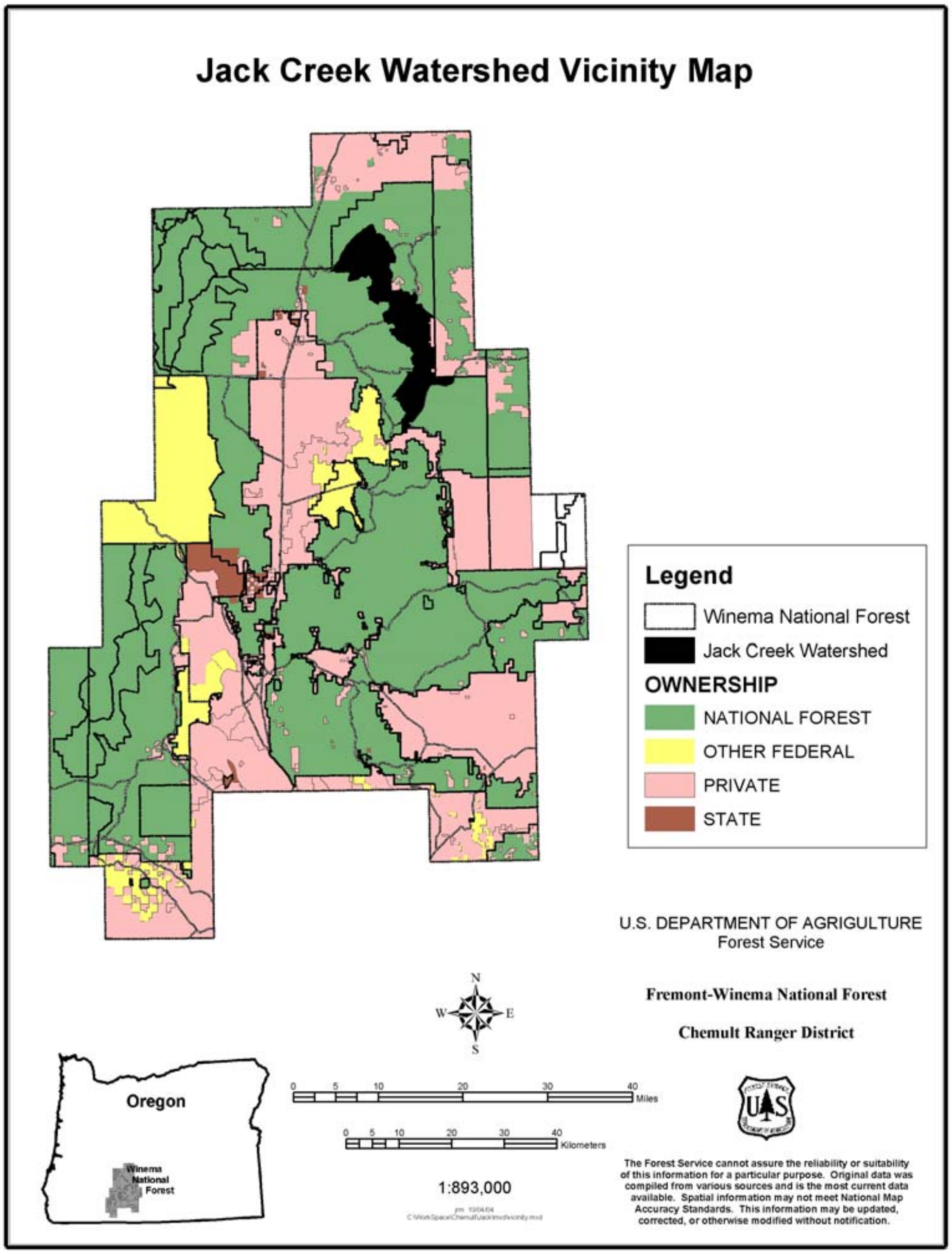
Jack Creek Watershed Analysis

Chemult Ranger District
Fremont-Winema National Forests
Klamath County, Oregon

September 30, 2004


Jack Creek Watershed Vicinity Map
Legend
Winema National Forest
Jack Creek Watershed
OWNERSHIP
NATIONAL FOREST
OTHER FEDERAL
PRIVATE
STATE
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Fremont-Winema National Forest
Chemult Ranger District
N
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S
Oregon
Winema National Forest
0 5 10 20 30 40 Miles
0 5 10 20 30 40 Kilometers
1:893,000
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Introduction / Overview

Watershed Analysis

Watershed analysis is a planning process for understanding an ecosystem at a watershed scale. The context of a watershed is used because it is a defined land area with a unique set of physical, biological and social features, recurring ecological processes, and historical land use patterns. The analysis includes reviewing existing information and identifying issues causing greatest concern for the watershed as a whole, and helping to determine when and where management activities such as restoration, and enhancement efforts are needed, and what conditions require such actions. Watershed analyses are not decision-making documents, but help in future planning and prioritization for an area. This analysis document may be amended as new information becomes available.

The watershed analysis follows the process outlined in *Federal Agency Guide for Watershed Analysis, version 2.3.* This process addresses social values, biological capabilities and physical characteristics of the landscape at the watershed level. The steps are: characterization of dominant features and processes, identification of issues, description of historic conditions, synthesis and interpretation of information, and management recommendations.

Setting

Jack Creek is located in the eastern portion of the Chemult Ranger district, and consists of approximately 59,000 acres. The analysis area encompasses slightly more acreage than the hydrologic definition of the drainage, so that areas adjacent to the drainage that are logically connected by management regimes could be included within the analysis.

From the headwaters south of Round Meadow, Jack Creek flows south through Jamison Meadow, O'Connor Meadow, Bullfrog Meadow, Davis Flat, and Rakes Meadow to private land along the Williamson River. The creek is intercepted by irrigation ditches when it enters private land and seldom, if ever, reaches the Williamson.

High elevational points include Skookum Butte, (6,067 feet) in the northwest part of the analysis area, Tea Table Mountain, (5,750 feet) in the central part of the analysis area, and the lowest points are in the Rakes Meadow area (4,600 ft.).

The analysis area is bounded by Klamath Marsh and Sugarpine Mountain on the west, Walker Mountain and Rim on the north and northwest, Pumice Butte, Parker Butte, Location Butte and Bear Butte on the east, and the Williamson River on the south.

Surrounding the analysis area are mostly National Forest lands. Tracts of private lands are adjacent on the south and southeast. The Klamath Marsh National Wildlife is nearby on the southwest.

Approximately 14,000 acres in the southernmost portion of the analysis area are within the former Klamath Indian Reservation. Members of the Klamath Tribes continue to use portions of the watershed for hunting, spiritual, and cultural activities. Most activities take place on former reservation lands, but some tribal members may pursue some of their activities elsewhere within the watershed.

Soils

Dominant Soil Types and Landforms

What are the dominant soil types and landforms within the watershed?

The geology of the area is volcanic in parent material and landform. The highlands are basalt and andesite flow material dotted with eruptive centers and flow vents. The valleys are covered with sediments deposited from upland erosion and ash/pumice deposition from the eruption of Mt. Mazama.

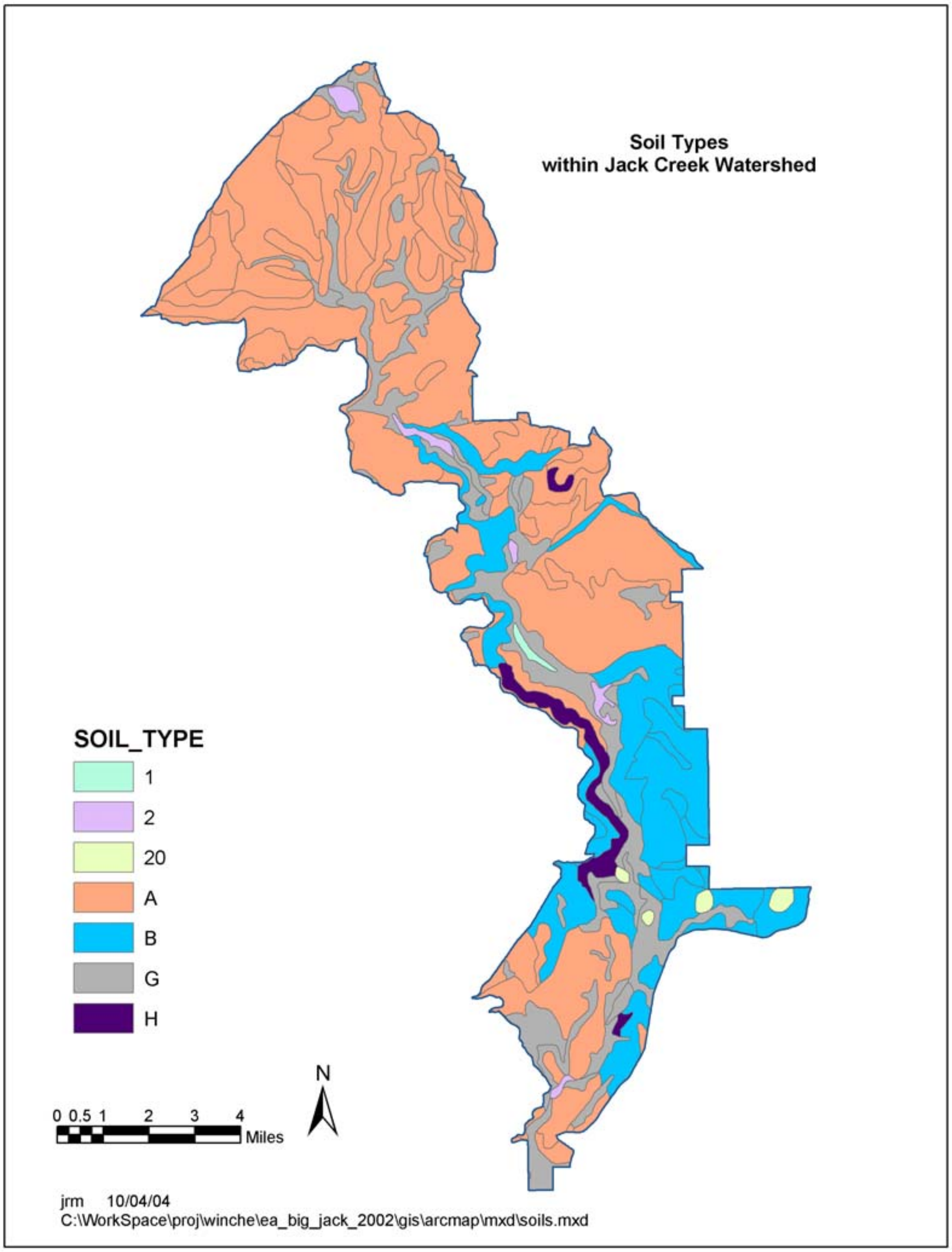
The area is predominantly composed of three soil groups:[1] "A" soils formed in deep pumice and ash deposits from Mt. Mazama; "B" soils formed in pumice and ash over a buried residual soil, "G"soils formed in sediments accumulated in the low spots of the watershed.

The A soil types have low natural fertility, are deep enough to exclude plant roots from reaching the pre-Mazama soils, are excessively drained, have rapid infiltration rates, low detrimental compaction potential, low erosion rates (due to high infiltration rates and gentle topography), and produce sand size sediments when eroded. Overland flow of snowmelt or even winter rain is very unlikely in these soils; even runoff from naturally surfaced roads is minimal. Interception of groundwater flows by road cuts is also very rare and generally occurs only in wet spring and seep areas. Some localized overland flow is possible during intense summer storms when the dry soils have significantly lowered infiltration rates. Snowmelt, after wetting the upper soil horizons, moves rapidly through the soil profile into the water table or the parent material interface.

The B soil types have low natural fertility, are shallow enough to allow the deepest rooted native plant to reach the pre-Mazama soils, are excessively drained, have rapid infiltration rates, low detrimental compaction potential, and low to moderate erosion rates. Overland flow from snowmelt or winter rains is not a frequent event in these soils, but is possible where the residual soil is relatively near the surface (20 inches or less). Some localized overland flow is possible during intense summer storms when the dry soils have significantly lowered infiltration rates. After snowmelt wets the upper soil horizon, it moves rapidly through the remainder of the pumice to the residual soil interface, then along this interface to stream banks or spring locations. Some of the water will move into the residual soil and into the groundwater table. In areas where B soils are shallowest, it is possible for roadcuts to intercept groundwater flows along the pumice/residual soil interface. This intercepted groundwater will most likely become groundwater again after a short distance of flow in the road ditch.

The G soil types form the meadows and valley bottoms. These soils have low to moderate natural fertility, are deep enough to exclude plant roots from reaching the pre-Mazama soils, are poorly drained, have rapid infiltration rates, moderate detrimental compaction potential, moderate potential for gully erosion, and produce sand and silt size sediments when eroded. Although these soils have high infiltration rates, their slope positions in valley bottoms can result in maintenance of high water tables. These are locations where long term intermittent or perennial flows occur. These are also the soils likely to respond to heavy use with gullying and downcutting of existing stream channels. Overland flow is a common sight during spring snowmelt or heavy rainfall events. Roadcuts often intercept groundwater, which occasionally flows on the surface for considerable distances before returning to the groundwater system. The remaining soils of the watershed are composed of several miscellaneous land types and soil complexes, none of which are of sufficient extent to have any effect on the hydrology of the study area.

[1] Carlson, Garwin. 1979. Soil Resource Inventory Winema National Forest, Pacific Northwest Region, Winema National Forest, Klamath Falls, Oregon.


Soil Types
within Jack Creek Watershed
SOIL_TYPE
1
2
20
A
B
G
H
N
0 0.5 1 2 3 4
Miles
jrm 10/04/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\soils.mxd

Ecological Unit Inventory

The ecological unit inventory[2] (EUI) is complete for the entire watershed. An ecological unit is defined as a category of land having a distinct combination of potential natural community, soil, landform, lithology, climate, and differing from other ecological types in its ability to produce vegetation and respond to management. The EUI describes the historic climax plant community that was likely best adapted to the unique combination of factors associated with each ecological site. The EUI also predicts the potential natural community that would be established if all successional sequences of its ecosystem were completed without additional disturbance under present environmental conditions.

The 1000 series describes upland ecological units. A and B soil types fit into this series. The 2000 series describes wetland ecological units. G soil types fit into this series.

Management recommendations and limitations have not been developed yet for each ecological unit.

Current Conditions and Trends

What are the current conditions and trends of the dominant soil types and landforms?

Compaction/Puddling

Two soil condition surveys have been completed on portions of the watershed.[3] Soil compaction is common throughout areas surveyed, including areas of past harvest, livestock use, and areas undisturbed by human uses. Trees typically respond to compaction with below normal growth and shallow root systems. Shallow rooted systems are common because of a relatively impenetrable C horizon in the dominant A and B soil groups, regardless of whether they have human disturbance. Some tree growth rates are above average in compacted areas and some below normal. Below normal tree growth appears to be more a function of cold air drainage patterns and microsite frost heaving than compaction. In short, most soils show signs of natural and/or human caused compaction, but the detrimental/beneficial effects are not known.

Soil types in the riparian system are susceptible to compaction/puddling[4] by livestock and vehicles when wet.[5] During spring and early summer riparian areas have saturated soils. The Rubble land, Chinchallo, Regcrust and Steiger soil types will dry out after the spring runoff and become resistant to compaction/puddling by cattle or vehicle traffic. The 2000, 2007, 2012 ecological units are dominated by these soil types. The Mesquito, Chocknott, Wickiup, Humic Cryaquepts and the Typic Cryaquands are the 2001, 2002, 2004, 2005 ecological units. They stay wet longer and have a higher percentage of the perennially wet soil types included than the drier ecological units. They are resistant to puddling when dry. The Cosbie, Stirfry, Chemult, Yamsay, Terric Cryosaprists and Aquandic Cryaquents are the squishy diatomaceous and organic soils that rarely dry out and are susceptible to puddling when wet. The 2006, 2008, 2017, 2018 ecological units contain these soil types. These wet soils may well be important reservoirs to sustain higher water tables in the nearby drier meadow reaches. Puddling destroys soil structure and reduces its water holding capacity.

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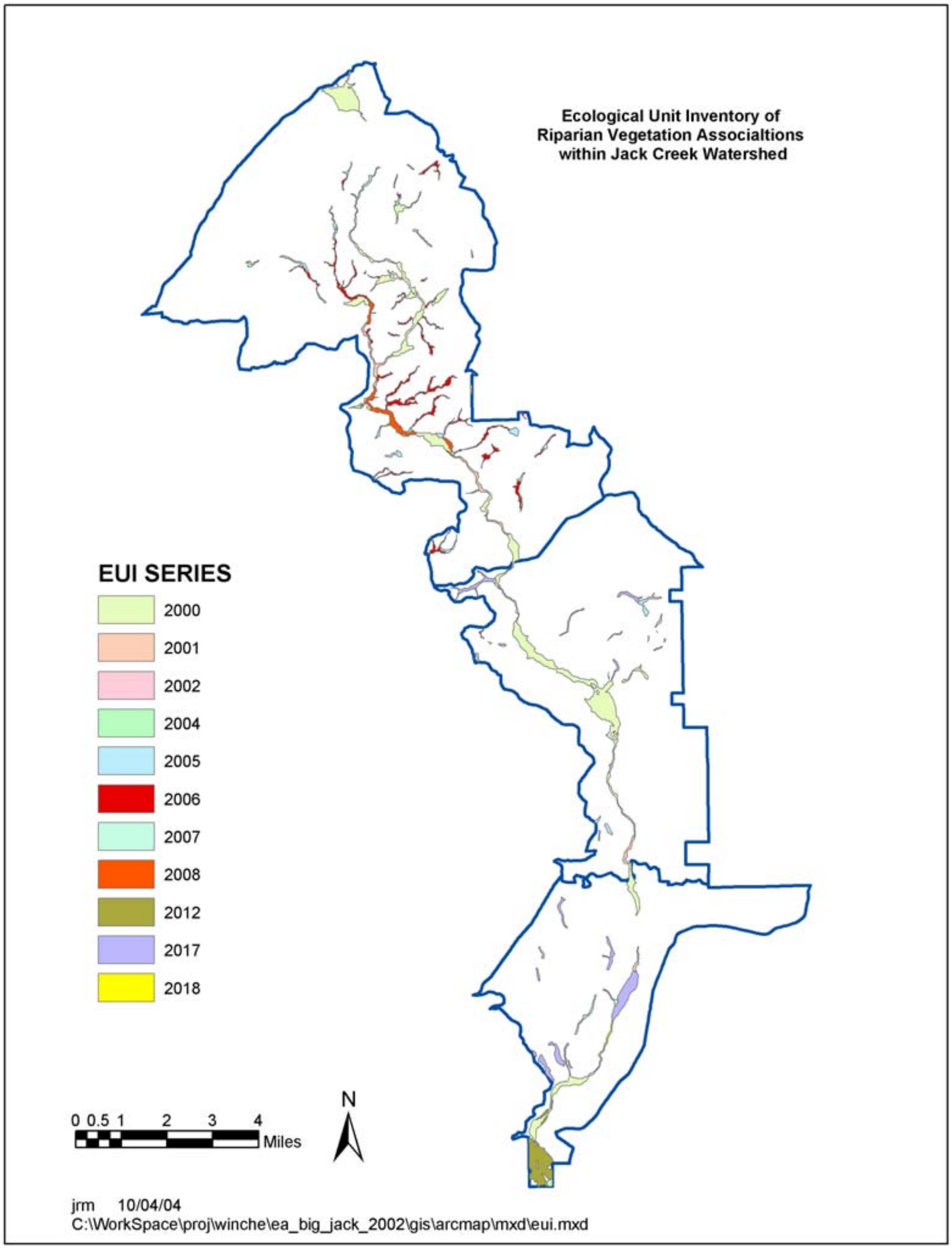
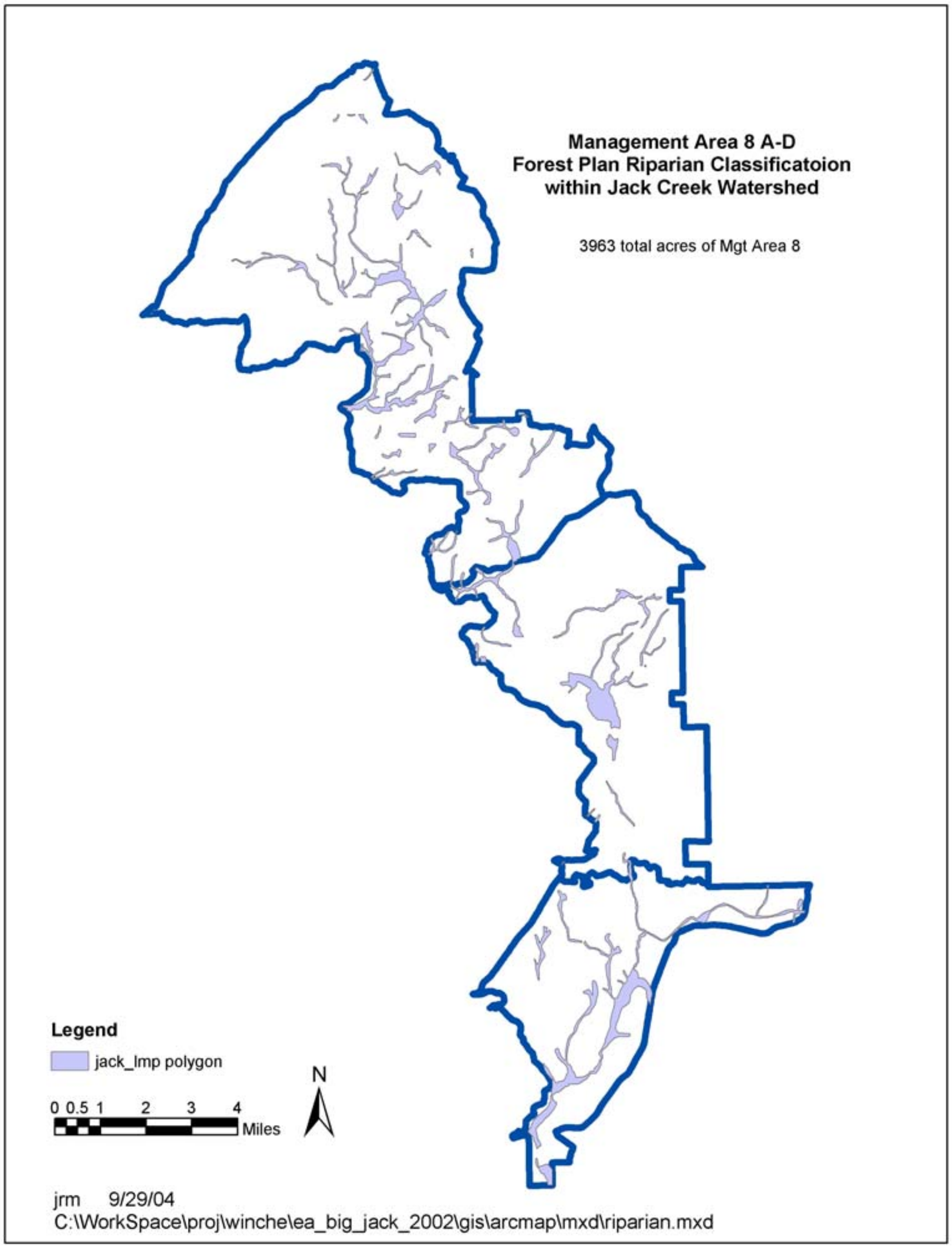
[2] USDA Forest Service. May, 2001. Ecological Unit Inventory of the Winema National Forest Area, Portion of Klamath County, Oregon. Interim Report #3. Winema National Forest. Klamath Falls, Oregon.
[3] USDA Forest Service. Chemult Ranger District 2002. Soil Disturbance Assessment Report. Big Jack Timber Sale. Winema National Forest. Klamath Falls, Oregon and USDA Forest Service. June, 1995. Soils Report, Sou'wester Analysis Record. Chemult Ranger District. Winema National Forest. Klamath Falls, Oregon
[4] Soil puddling is a physical change in soil properties due to shearing forces that destroy soil structure and reduce porosity.
[5] Dorr, James, Fremont-Winema National Forest Soil Scientist. September, 2004. Personal communication with Terry Simpson. Chemult Ranger District, Winema National Forest.


Ecological Unit Inventory of
Riparian Vegetation Associaltions
within Jack Creek Watershed
EUI SERIES
2000
2001
2002
2004
2005
2006
2007
2008
2012
2017
2018
0 0.5 1 2 3 4
Miles
N
jrm 10/04/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\eui.mxd

Soil pedestals are apparent in many of the seeps, bogs, willow wetlands and other perennially wet areas where cattle congregate. This lumpy appearance is caused by cattle breaking down the vegetation and puddling/compacting the soil. The end result is less water holding capacity. The system becomes drier during the dry times of year than would have resulted if puddling hadn't occurred.

There are miles of well-defined cattle trails apparent in the riparian system within the cattle allotment portion of the watershed. These were likely formed at times when soils were wet. The trails are channelizing surface flow, which increases flow velocity and dries out the system quicker. Historically flows would spread out across the meadow slowing runoff and increasing water percolation into the soil column. Compacted cattle trails also act as barriers to impede/redirect subsurface flows in the riparian system. The extensive network of trails contributes to loss of water retention capabilities and lowered water tables in the riparian system.


Management Area 8 A-D
Forest Plan Riparian Classificatoion
within Jack Creek Watershed
3963 total acres of Mgt Area 8
Legend
jack_lmp polygon
0 0.5 1 2 3 4
Miles
N
jrm 9/29/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\riparian.mxd

Displacement/Mixing

The watershed's dominant soils have very low clay and organic matter contents. Clay and organic matter serve as cementing agents that bind individual soil particles together into larger aggregates. With the absence of such agents, these soils are easily displaced, especially when dry. This displacement becomes more pronounced as the ground slope increases. Dry ravel erosion can occur on slopes over 40% as a natural process, or on road cutbanks/fills and other areas where management activities have disturbed the soil on steeper slopes.

Occasionally, high velocity, high discharge flows occur from rain on snow or summertime thunderstorm events. These climatic events create flows that scour streambeds and tear out road crossings. Such an event occurred in spring, 1964. The extent of damage within the watershed is poorly documented. However, the magnitude of damage in the Davis Flat-Yellowjacket Spring portions of the main channel was apparent in a photo series that showed severe downcutting. A series of rock/log check dams were constructed in this area sometime between 1964 and 1971 to slow velocity and catch sediment in an effort to help the stream aggrade and reconnect with its floodplain. These structures appeared to have aggravated the downcutting downstream of the dams. In 2002, the structures in Davis Flat were modified to mimic the fuzzy dam function that a beaver dam would have. All but the furthest downstream dam appear to be functioning as expected in the short term. There is evidence that the downcut sections are slowly filling.

Vehicle traffic and skidding trees frequently mixes the top several inches of soil. This is commonly called displacement and is the most commonly found form of erosion in areas of human disturbance. Removal of forest litter and complete removal of the A horizon in the top couple inches of the soil profile essentially set soil formation (the nutrient and moisture status of the A horizon) back to "ground zero" on ash and pumice soils because underlying strata are relatively undeveloped parent material. Until these soils recover an organic layer, they will be continually unstable and limiting to redevelopment of the A horizon. Without an organic layer, soil moisture and temperature is directly modified, thus limiting various chemical, physical and biological soil-forming processes. The absence of an organic layer also limits diversity and quantities of soil organisms, further limiting the soil forming processes. Topographic relief directly influences the building of the A horizons, particularly on convex slope positions where erosion is common and deposition is most limiting. Time is the final limiting factor for recovering disrupted A horizons.

Some degree of displacement from harvest activities has occurred on all of the ponderosa community within the watershed and approximately 50% of the lodgepole community. The vast majority of the ponderosa community was harvested during the World War II era. The next significant logging period occurred in the lodgepole community in the late 1970's- mid 1980's. Evidence of mechanized operations are apparent from both eras.

Soil displacement is most commonly found on skid routes or secondary trails where harvest equipment turned on too tight a radius. Displacement is most apparent in past harvest units that were raked and burned prior to replanting.

Historical Conditions and Trends

<u>What were the historical conditions and trends of the dominant soil types and landforms?</u>

Erosion is part of the natural process. There were likely large scale, low intensity fires on a much more frequent basis that reduced ground cover. Wind erosion was likely a stronger disturbance factor than under the present conditions.

Natural and Human Causes of Change

What are the natural and human causes of change between the historical and current conditions? What are the influences and relationships between the soil conditions and other ecosystem processes?

Harvest activities, grazing, and road construction have influenced the natural erosion rates. These activities can directly contribute to displacement, puddling, and compaction. They can indirectly affect historic erosion processes by damaging protective vegetative layers which can lead to lost soil function and lowered site productivity by reducing water infiltration, root penetration, aeration and moisture storage.

Most of the watershed has been surveyed for detrimental soil conditions. The techniques used were developed for soils that share few physical and chemical similarities with soils found in this area. In particular, pumice particle size and density within the watershed are highly variable, which results in inconsistent and inaccurate measurements of compaction.

Stand exams measure site productivity (using tree growth measurements). This has been measured extensively across the Chemult Ranger District, including the watershed area, since the 1980's. Site productivity has improved in all plant communities.[6] Stocking curves have been adjusted to accommodate the increased productivity.[7] There are areas where below normal tree growth rates are documented, which are most often the result of planting ponderosa pine in cold air drainages and/or in areas where thermal cover has been removed, allowing cold air to settle in basins.

Suppression of fires has increased the organic component of soils. There have been no large scale and/or severe fires in the watershed since the turn of the century. As a result, the duff layer has been slowly decomposing, releasing nutrients back into the soil rather than volatilizing into the air from burning. Compaction and displacement does not appear to be negatively affecting site productivity. It may be the organic input from fire suppression is positively offsetting effects of compaction or displacement.

Issues

- Soil compaction is apparent from natural and human causes while site productivity in general is increasing across the watershed.
- Compaction measuring techniques being used were not developed for pumice soil and result in inaccurate and inconsistent measurements.
- Management activities on wet soil conditions are causing puddling and reducing water holding capacity.
- Headcut structures are aggravating channel downcutting.

Recommendations

- Finish the Ecological Unit Inventory management and limitations section.
- Continue to monitor soil conditions at the basic level for productivity, erosion rates and water holding capacity.
- Develop a protocol to measure compaction and puddling that is specific, accurate and consistent for pumice soils in this watershed.

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[6] Personal Communication with Bill Hopkins, Region 6, Area IV Forest Service Plant Ecologist.
[7] Cochran, P. H., et al. 1994. Suggested stocking levels for forested stands in northeastern Oregon and southeastern Washington. USDA Forest Service, Pacific Northwest Region. PNW-RN-513.

- Determine conclusively the effects of compaction and puddling on site productivity and make adjustments in forest standards accordingly.
- Check soil moisture conditions each year prior to turnout. Manage livestock to minimize damage to wet soils. Not all soils will dry at the same time. The perennially wet ecological units are 2006, 2008, 2017, and 2018. They are likely to have very limited time periods if any, when they are dry enough to graze. The 2001, 2002, 2004, and 2005 ecological units are likely to be wet for the July 1 turnout date in some years and should be checked prior to turnout. The 2000, 2007 and 2012 units are most likely to be dry for the July 1 turnout date. A pasture rotation system would provide the optimum opportunity to facilitate proper timing of turnout under these varied soil moisture regimes.

Erosion Processes

Dominant Erosion Processes

What erosion processes are dominant within the watershed? Where have they occurred or are they likely to occur?

Soils Characteristics

The eruption of Mt. Mazama over 7,700 years ago deposited a thick layer of pumice over this area, to depths of 40 inches or more. The pumice from these pyroclastic flows and fall deposits, although highly porous, do hold water and reduce the amount that migrates into streams and wetlands. In low precipitation years, most of the annual precipitation is probably held in the pumice deposits, leading to little recharge of ground water and lower stream flow. Ash and pumice derived soils are coarse-textured, non-structured, and non-cohesive. They have low fertility, low bulk density, and are (mostly) excessively drained. Soil temperature regimes are cold, and growing seasons are short. Killing frosts may occur any month of the year.

The Lapine series (Group A soil type) consists of coarse textured, ashy soils that are excessively drained and greater than 60 inches deep. These soils developed in air-laid volcanic ash and pumice that mantles a lava plateau. The Shanahan and Shukash series (Group B types) are somewhat excessively drained and greater than 60 inches deep. These soils developed in air-laid volcanic ash and pumice over wind deposited soils and colluvium (unconsolidated, unsorted material deposited by mass movement and by local unconcentrated runoff) or residuum (unconsolidated, weathered material from the breakdown of bedrock in place) from andesite or basalt. They consist of 18-40 inches of coarse-textured ashy soil material over medium-textured soil material with 5 to 60 percent hard rock fragments to depths of 60 inches or more. See the Soils map.

Soils derived from pumice and ash may become water repellent when dry. Fungal mycelia may also cause soil hydrophobia, resulting in soil erosion through rapid runoff and overland flow. Low clay and organic matter content causes very low aggregate stability. When dry, these soils are easily displaced by mechanical equipment operations. Most of the limited amounts of nutrients are found in the upper eight inches of the soil, so displacement can reduce site quality drastically.

These soils often support sparse ground vegetation as a result of their insulative qualities. Due to lack of heat penetration and storage, and the soil's inability to re-radiate heat during the night, surface air temperatures can be very cold. Frost heaving often occurs when soils are wet to the surface and air temperatures drop below freezing. Summer surface temperatures have been recorded in excess of 160 ° F in openings. Both temperature extremes can be lethal to seedlings.

Disturbance Factors

The major soils disturbance factors include compaction and displacement from mechanized equipment primarily in roads and harvest units, and stream bank erosion. Erosion from road concentrated storm runoff and snowmelt, and erosion exacerbated by compaction of soils also contribute to a lesser extent. The dominant soil types are susceptible to wind erosion. However, there have been no recent major fires to create large open tracts of bare soil that would be susceptible to wind erosion.

Current Conditions and Trends

What are the current conditions and trends of the dominant erosion processes prevalent in the watershed?

Past Harvest Activities

Soil assessments for the lower portion of Jack Creek and the Three Buttes area were reviewed to determine conditions and trends. There are three types of soil damage documented; displacement and erosion, compaction and puddling, and unknown.

Displacement/erosion is the most common and persistent disturbance type.[8] It is most commonly found in areas of past harvest activities. The greatest amounts of displacement/erosion are found in past harvest units where harvest activities were followed up by intensive site preparation. Refer to the Soils section for discussion regarding factors influencing erosion processes.

Compaction/puddling is less common than displacement, but like displacement, is most often associated with areas of heavy equipment use like roads and main skid trails. Soils with higher components of ash fines are more likely to be compacted. Soils composed of 25% or more small cobbly material do not show compaction even with heavy equipment use.

There are areas where A horizons are thinner than the low end of the range of thickness for a particular soil type, and where there is little to no evidence of equipment. There are also areas showing compaction that have not had any sign of human disturbance (such as vehicles or cattle). There may have been hot fires that degraded soils. Heavy duff layers lower pH and make soils too acidic to break down organic material necessary for soil development. There is also some indication that "hardpans" can form from chemical leaching processes. These hardpans can create subsurface layers that function like compacted soils affecting root growth and penetration.

Roads

The road density in the analysis area is approximately 6.4 miles per section.[9] The roads range from main system routes to rustic. There are still remnants of grades, crossings, and spurs associated with railroad logging that occurred in the watershed. In some areas, roads were constructed within the stream channel and floodplain. Regardless of whether roads or grades are being used or are in closed status, their presence on the landscape still affects soil resources and water flow.

Nearly all of the roads in the area are in soil types A and B, with road gradients in the 0%-2% range. Storm runoff from these roads is minimal and infiltration rates are generally high enough to eliminate overland flow, except in the most extreme cases, Storm runoff down road surfaces or in roadside

[8] USDA Forest Service. Chemult Ranger District 2002. Soil Disturbance Assessment Report. Big Jack timber Sale. Winema National Forest. Klamath Falls, Oregon. USDA Forest Service, Chemult Ranger District. 2002. Three Buttes Project File, Soils Section. Winema National Forest. Klamath Falls, Oregon.

[9] USDA Forest Service. Chemult Ranger District. 1994. Assessment of the Jack and Mosquito Creek Watersheds. Draft. Winema National Forest. Klamath Falls, Oregon.

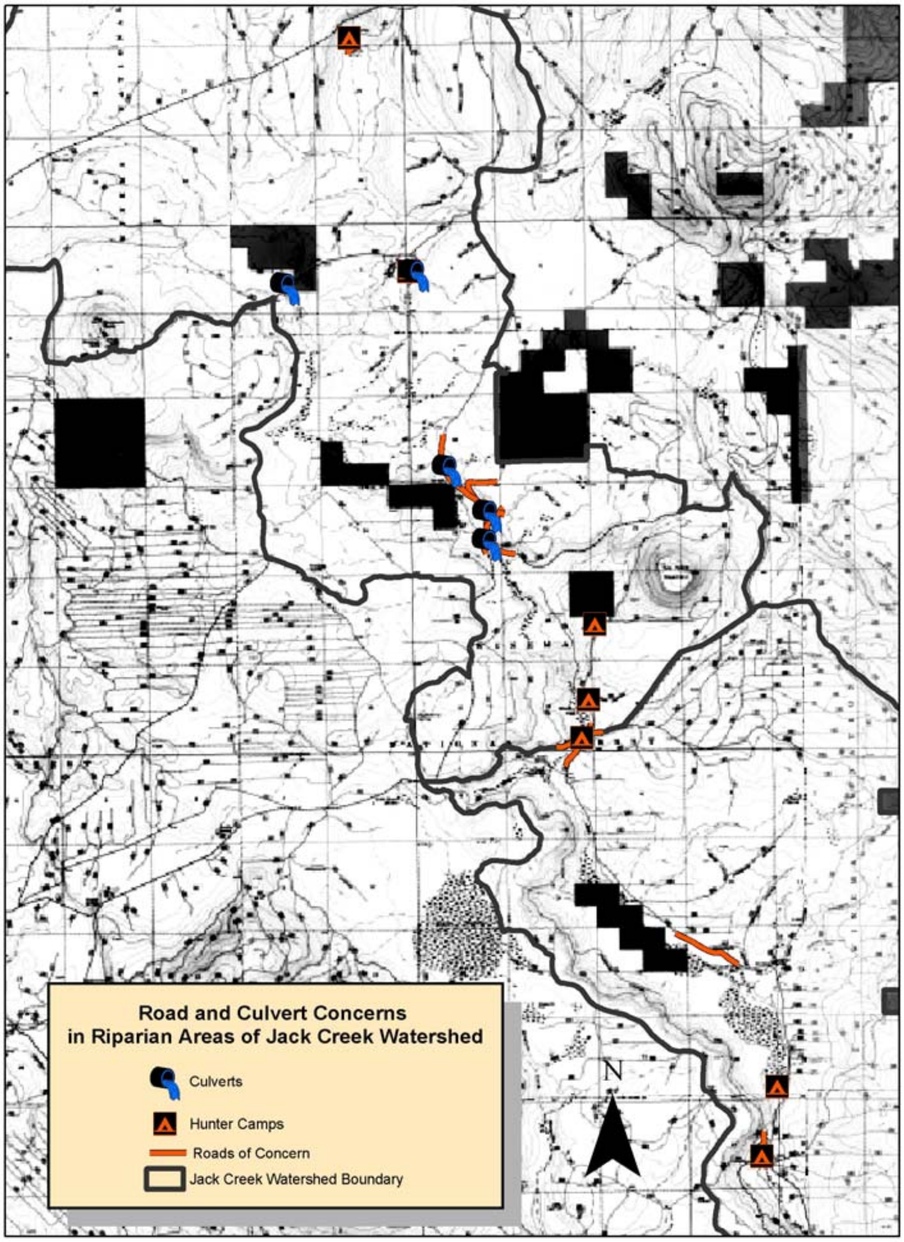
ditches may occur during rapid snowmelt or intense summer thunderstorms, on short pitches of road with grades in the 5% -10% range. Significant erosion damage is rarely a result.

There are several erosion processes associated with roads. Storm runoff concentrates in road ditches and on road surfaces. Road fills and culverts contrict stream channels at crossings. Water becomes ponded around culverts, which then receive heavy use by livestock. The livestock trample and graze down vegetation leaving exposed soils at the culvert crossings.

There are seven forest roads that cross the main stem of Jack Creek. Three are bridges and the rest culvert crossings. The 9418 Road crossing and the 8821 crossing each have culverts that are washing out and may be in danger of complete failure relatively soon. Other crossings appear to be functioning properly. There are approximately fifteen culvert crossings on tributaries to the mainstem. All are showing some signs of washout, crushed sections or debris plugs. The two tributary culvert crossings on the 8821 immediately north of where the 8821 crosses the main stem are also in imminent danger of taking out the 8821 Road.

The vast majority of roads cross perpendicular to the riparian system. However, there are several locations where hunters and campers have created user-defined roads in meadow systems. These areas include lower Rake's Meadow, Jack Creek Corral, lower and upper Bullfrog meadow, Yellowjacket Spring, Davis Flat, Big Camp, Cabin Spring, Johnson Guard station, east Johnson meadow and Wilshire meadow. These roads tend to run the length of the meadows causing channelized flow and increased erosion. Vehicular compaction also decreases water absorption and retention capabilities.

Roads concentrating runoff flows and directing sediment down into the creek are not prevalent in the watershed. One notable exception occurs in the vicinity of where the 8821 Road crosses Jack Creek. That section of the 8821 from the creek crossing north approximately one and a half miles, along with the junctions of the 8829, 8821-320, 8821-340 and 8829-010 roads, are gullying and creating a sediment fan in the creek downstream of the crossing at the 8821 Road. Portions of these roads are currently dangerous to vehicle traffic due to washout. To a lesser degree, the 8827/88 junction and nearby 88-450 spur are also washing down into the creek at the Davis Flat Bridge.


Road and Culvert Concerns
in Riparian Areas of Jack Creek Watershed
Culverts
Hunter Camps
Roads of Concern
Jack Creek Watershed Boundary
N

Grazing

Soil types in the riparian system are susceptible to puddling caused by livestock trampling when wet. Puddling destroys soil structure and reduces its water holding capacity. There are miles of cattle trails in meadows channelizing overland flow within the cattle allotment. Soils are pedestalled around springs used for watering livestock. These types of damage are drying out the riparian system.

See discussion in Soils, Hydrology, and Grazing portion of Human Uses section for more information relevant to grazing and erosion processes.

Historical Erosion Processes

What were the historical erosion processes within the watershed? Where have they occurred?

The primary erosion process prior to the aggressive management of the timber and grazing resources was stream bank erosion. The rate of erosion was likely slower and less extensive than today. Stream vegetation is assumed to have been more continuous, with deep-rooted species such as willow more common. Aggressively eroding streambanks, although present, are assumed to have been short discontinuous sections, with little overall effect on the system as a whole.

The meadows were well vegetated, with native grass species supplying a well-formed root mass, protecting the soil from the erosive forces of major storm events. The only grazing pressure came from deer. There were no wild horses, cows, or elk present.

Erosion rates were associated with the natural disturbances of fire and drought. The overall impacts of these events are assumed to be less frequent and less intense than the modern disturbances of timber harvest, grazing, and road construction.

Natural and Human Causes of Change

What are the natural and human causes of changes between historical and current erosion processes in the watershed? What are the influences and relationships between erosion processes and other ecosystem processes?

The rates of erosion processes have increased. Grazing, logging, and associated road systems have served to reduce stabilizing vegetation along stream banks and in riparian systems, in some cases concentrating runoff flows. This has allowed the erosion process to accelerate. Continued disturbance events from regular use of the land have slowed or delayed the natural recovery of the drainage system.

Accelerated channelization and compaction in meadows and other riparian habitat locally lowers the water table or accelerates the seasonal lowering, in many cases resulting in vegetation changes over the extent of the affected meadow. This may include changes in grass species, a narrowing of the meadow due to conifer encroachment, or in the extreme case, the slow conversion of the entire site to forest or dry site brush type.

Issues

- Displacement reduces productivity. It is the most common and persistent type of erosion.
- Several riparian crossings are failing, resulting in road damage and increased sediment loads in riparian habitat.
- Roads are concentrating runoff and directing sediment down into the creek in two areas.
- Livestock use is damaging wet soils and reducing water holding capacity.

Recommendations

Roads

- Fix the drainage problems on that section of the 8821 road from the creek crossing north approximately one and a half miles, along with the 8829, 8821-320, 8821-340 and 8829-010 roads near to where they enter the 8821 Road.
- Fix the drainage problems at 8827/88 junction and nearby 88-450 spur to the culvert at the Davis Flat Bridge.
- Fix the stretch of 8827 in the Bullfrog Springs vicinity. The road remains soft and rutted well into summer season. Permit water flows to pass under road through use of permeable fill or culver arrays.
- Replace the four failing crossings along the 8821 and the 9418 crossing on the main stem of Jack Creek with crossings that will allow water to pass in as least restricted and natural a manner as is feasible.
- Close roads to reduce road density wherever possible.
- Maintain culverts on a regular basis.
- Chemult Ranger District project plans are being developed to block roads into meadows at the meadows mentioned. Camping areas in nearby uplands are being developed to accommodate hunters and campers. Similar actions should be taken if any other roads appear in meadows. District signs, handouts and personal communication with hunter and campers about impacts of driving in meadows may also be useful.

Harvest Activities

Regional and Forest level standards say land management activities should be designed to not cumulatively exceed 20 percent detrimental soil condition on an activity area. These conditions include compaction, piling, burning and displacement, as well as erosion, which is commonly a natural process but can be accelerated by management activities.

- Use Best Management Practices specific to each soil type and proposed activity to meet these standards.
- Mitigate by taking proactive measures that minimize disturbance such as use of existing skid trails and landings, use of low ground pressure equipment and limited equipment entries.
- Subsoiling to reduce compaction should not be used where it can cause root damage.

Grazing

Cattle traffic compacts wet soils and reduces soils' permeability, which leads to less water being absorbed and lowered water tables during the dry season.

- Protect wet soils. Do not graze areas that rarely dry out (e.g. 2006, 2008, 2017, 2018 ecological units).
- Allow cattle turnout on seasonally wet riparian systems only after soils are sufficiently dry and resistant to puddling.

Hydrology and Stream Channels

Dominant Hydrologic Characteristics

What are the dominant hydrologic characteristics and other notable hydrologic features and processes in the watershed?

Flow Regimes

There are no stream gages to measure peak flows and low flows in the system. Observations of district folks are noted to characterize flow periods. The Chemult Weather Station located approximately 10 miles west of the watershed, is the closest long term station available to indicate annual precipitation amounts. Snow pack is the dominant precipitation affecting high and low flows. The watershed gets approximately 25 inches of precipitation annually, of which two thirds is snow[10]. Typically peak overland flows occur in May and June as the snow pack melts. Peak flows may vary greatly from one year to the next.

Most of the upper two thirds of the riparian system, including the intermittent and ephemeral reaches, have flowing water to the extent of the riparian vegetation during a good spring runoff. Rarely do the lower reaches of Jack Creek, including the mainstem, flow all the way to the Klamath Marsh, even during peak flow periods. Peak flow periods may last a couple weeks to a few months, depending on snowpack and the rate at which it melts off. The system starts drying after snowmelt runoff in spring. Although there is some recovery during fall rains, most of the precipitation that comes into the system is in the form of snow. Low flow periods are typically in March-April just prior to the spring snowmelt. Low flows are dependent on both the annual snowpack, as well as snowpack from one year to the next. A series of low snowpack years will produce low flows for several years to come, even after average annual snowpack conditions return. This suggests some level of ground water recharge occurs, and that water table levels have a significant affect on this system during the dry time of year.

Flows in the perennial reach located at the top of the watershed are supported by numerous small seeps all along the main channel. There are also many small seeps along the intermittent and ephemeral reaches of Jack Creek. Many of these seeps go dry or show reduced flow during August and September.

Stream Morphology

The riparian system consists of channelized flow primarily along the mainstem of the creek and overland flow in the tributaries. There are approximately 5 miles of class III stream (Winema Forest Plan), 26 miles of channelized intermittent class IV stream, and 78 miles of non channelized ephemeral flow. The class III reach fits into Infish Category I streams. The class IV and ephemeral reaches fit into Infish category IV seasonally flowing or intermittent streams. Channels have very high to extreme sensitivity to disturbance. E channels have good recovery potential while F channels have very poor recovery potential. All have low sediment supply potential due to the highly porous nature of pumice, very high to moderate streambank erosion potential, and high to very high controlling influence from streambank vegetation.

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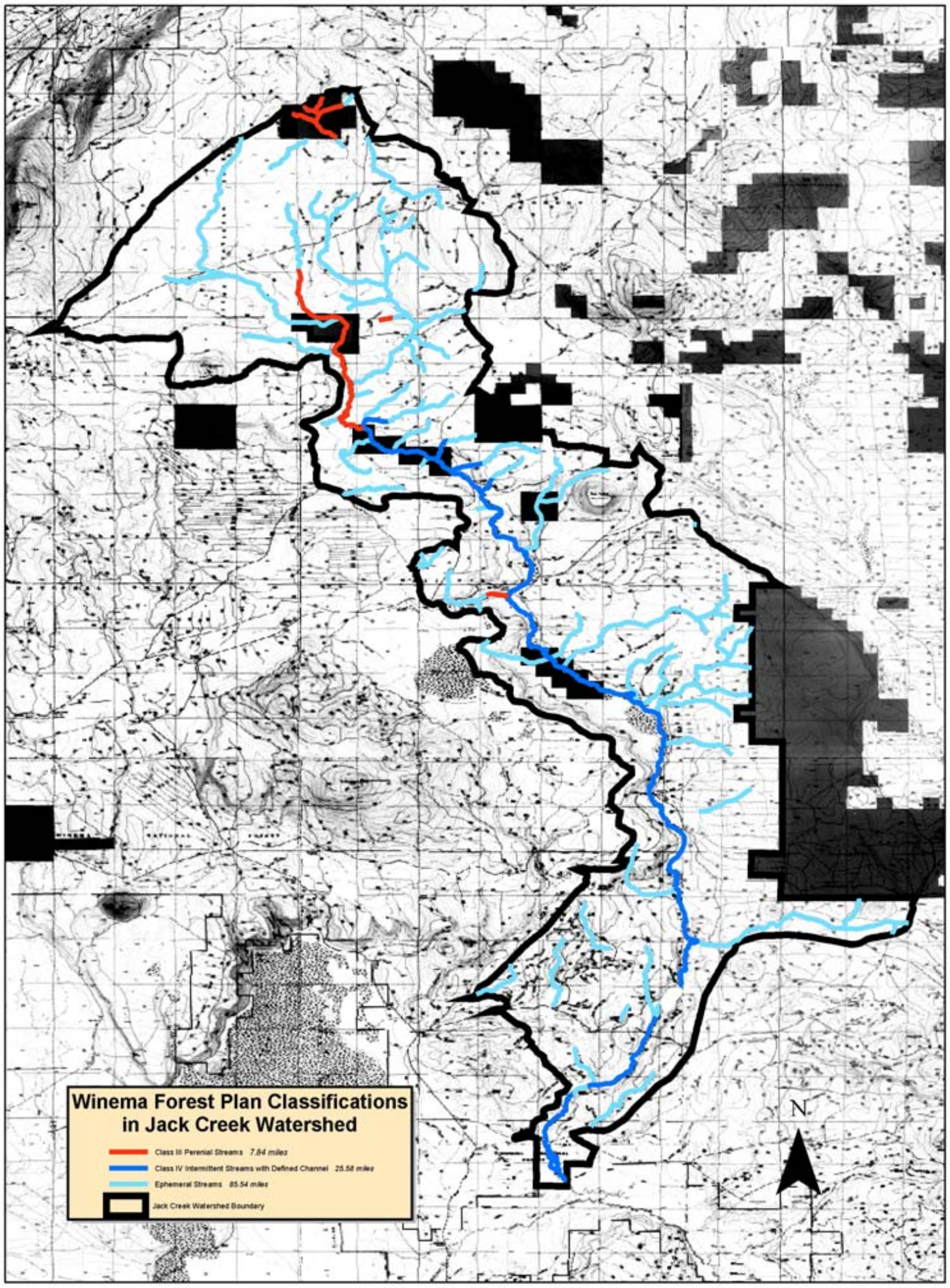
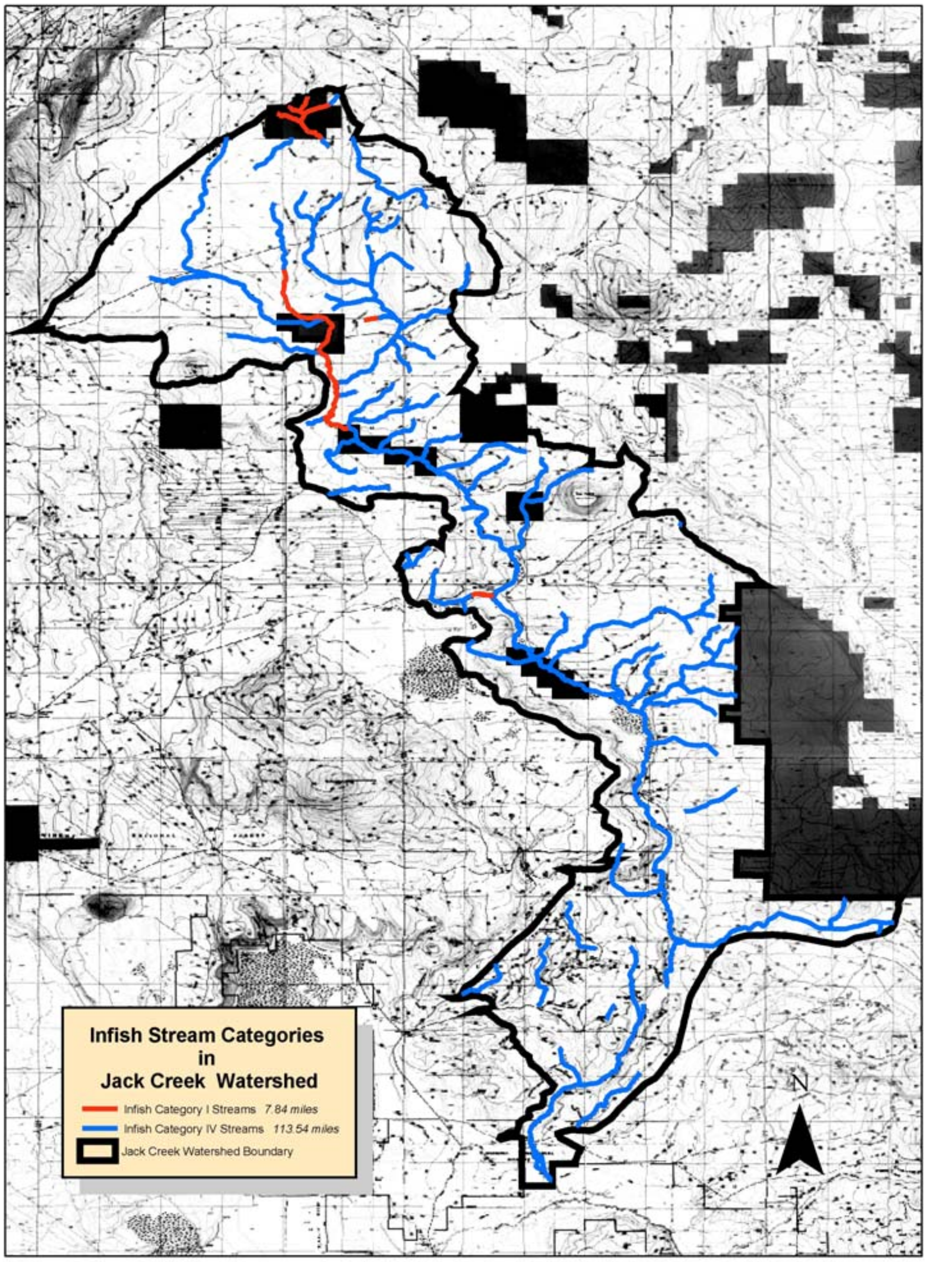
[10] USDA Forest Service, Winema National Forest. May, 2001. Ecological Unit Inventroy of the Winema National Forest. Pg. 260.


Winema Forest Plan Classifications
in Jack Creek Watershed
Class III Perenial Streams 7.84 miles
Class IV Intermittent Streams with Defined Channel 25.58 miles
Ephemeral Streams 85.54 miles
Jack Creek Watershed Boundary
N



Infish Stream Categories
in
Jack Creek Watershed
Infish Category I Streams 7.84 miles
Infish Category IV Streams 113.54 miles
Jack Creek Watershed Boundary
N

Forest Service personnel have completed multiple assessments of Rosgen stream channel type within the watershed. Not all of the assessment results were verified in the field, and there are discrepancies between the results of these projects. Channels in Jack Creek have been described as being Rosgen Types A, B, C, E, F, and G. Based on field observations by qualified personnel, the majority of Jack Creek may be classified as an E or C channel, with numerous short sections, which may classify as a B channel, at least in the sense of having higher gradient, lower sinuosity, and a larger substrate assemblage than the more typical E and C channels. The common E and C channels are sometimes found in a degraded condition (increased entrenchment, reduced sinuosity, and unstable banks). E and C channels in this altered condition could be considered F channels.

Comment: This sentence needs some love

Stream Type	General Description	Landform/Soils/Features
B Channel	Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plain and profile. Stable banks.	Moderate relief, colluvial deposition and/or residual soils. Moderate entrenchment and width-to-depth ratio. Narrow, gently sloping valleys.
C Channel	Low gradient, meandering, point bar, riffle/pool, alluvial channels with broad, well-defined floodplains.	Broad valleys with terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channel. Riffle-pool bed morphology.
E Channel	Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.	Broad valley/meadows. Alluvial materials with floodplain. Highly sinuous with stable, well vegetated banks. Riffle-pool morphology with very low width/depth ratio.
F Channel	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.	Entrenched in highly weathered material. Gentle gradients, with a high width-to-depth ratio. Meandering, laterally unstable with high bank erosion rates. Riffle-pool morphology.

The majority of Jack Creek and its tributaries are low gradient systems (<2%) with occasional short reaches of higher gradient (>2%). These higher gradient reaches are often dominated by boulder and bedrock sized basaltic substrate while the lower gradient reaches are mostly characterized by sand/silt substrate. In 2003, a Region 6 Level II survey was completed on nine reaches of Jack Creek with the first reach beginning at the crossing of the 8821 road and the last reach being above the Moffit Place private property. These nine reaches consisted of the entire perennial section of Jack Creek. Results of Wolman Pebble Counts indicate that these nine reaches consisted entirely of fines (<6mm), however, these results do not account for several short stretches within the survey area that have cobbles and boulders as the dominant substrate. These sites are very limited in extent and the survey was not designed to take this into account. According to this survey, gradient ranged from a low of .09% along reach 4 to a high of 1.7% along reach 9. Reach 9 was the only reach that showed a gradient of greater than 1%. Sinuosity along these 9 reaches ranged from 1.07 to 1.74.

Despite its small size (0.9 cfs on August 20th 2003) Jack Creek's mainstem is characterized by wide valley widths. In the level II survey, valley widths ranged from 50 ft. to 2000 ft. with a median of 300 ft. wide. These ranges are also characteristic of reaches outside of the level II survey. Due to the wide valley widths with valley bottoms dominated by wetland and meadow vegetation, allochthonous inputs in many reaches are limited to leaf fall from willow, bog birch, grasses, and sedges.[11] When valley widths are narrow, lodgepole is often colonized across the width of the meadow. Along these sections allochthonous inputs sometimes consist of large amounts of large wood. This large wood component likely has an influence on the geomorphology of these areas. With recent heavy die off of the large tree components along riparian areas, the significance of these inputs may be greater now than at any time in the historic past.

Current Conditions and Trends

What are the current conditions and trends of the dominant hydrologic characteristics and features present in the watershed?

Interior Columbia Basin Ecosystem Management Plan (ICBEMP) analysis looked at aquatic integrity in a cluster group that includes Jack Creek. In this analysis an aquatic system that exhibits high integrity has a mosaic of well-connected, high quality water and habitats that support a diverse assemblage of native and desired non-native species, the full expression of life histories and dispersal mechanisms, and the genetic diversity necessary for long-term persistence and adaptation in a variable environment. The aquatic integrity was rated as 52% low, 44% moderate, and 4% high integrity.

A hydrologic system with high integrity is considered a network of streams, along with their ground water ecosystems, within the broader landscape, where the upland, floodplain, and riparian areas have resilient vegetation; where capture, storage and release of water limits the effects of sedimentation and erosion; and where infiltration, percolation, and nutrient cycling provide for diverse and productive aquatic and terrestrial environments. Due to a lack of consistent data on stream characteristics such as width, depth, etc., measures of hydrologic integrity were based on disturbance sensitivity and recovery potential of watersheds, plus the amount and type of past disturbance. The hydrologic integrity was rated as 39% low, 41% moderate, and 20% high integrity for the cluster that includes Jack Creek.

Several surveys of various types completed since 2002 have suggested a downward trend in channel condition. An Ochoco Bottom Line survey was completed along three reaches of the lower end of Jack Creek from its crossing with the Silver Lake Road up to just north of Rakes Meadow. Part of the bottom line survey consists of determining the extent of unstable banks within the survey area. For the three reaches surveyed, 36.53%, 29.6%, and 26.1% of stream banks were considered unstable respectively.

In September of 2002, a survey of channel condition was completed for 13,851 feet of the main-stem of Jack Creek beginning at the north end of the Jamison private property and heading north to the southern boundary of the Moffit private property. This survey looked at bank stability from the perspective of percent of channel length altered from its natural geomorphic shape. In this determination altered condition did not have to be actively sloughing. Altered morphology from sloughing that had occurred in the past counted as “altered morphology” just the same as altered morphology caused by sloughing that was actively occurring at the time the survey was completed as long as that site still showed altered morphology as a response to disturbance. This was done to account for the cumulative effect of streambank damage over time. Channel recovery rates are much slower than the rates at which channel degradation occurs. If continued microsite disturbance occurs at a frequency and scale that is beyond the recovery rates of that stream then stream channel conditions will not only remain in a degraded condition but will continue on a downward trend. Using these criteria, 10,562 feet of channel were considered to display “altered condition.” This

[11] Allochthonous inputs: pertaining to organic stream inputs that were formed outside the stream channel (inputs arrived from riparian or upland areas).

figure constituted 76% of the stream channel surveyed. Much of this channel damage was considered an effect of heavy grazing by cattle. In order to get an idea of how much grazing pressure was occurring, measurements of stubble height were taken adjacent to the channel at each site. Each site had five randomly placed measurements of stubble height and an average of the five was recorded as the stubble height for that site. Stubble height was used because the Antelope Cattle Allotment EA contains stubble height standards beyond which cows will be removed from the adjacent range. 63 sites had stubble height measurements taken and of these 41 or 65% exceeded (were 4 in. or shorter) stubble height standards listed in the EA.

Headcutting and downcutting occur at various sites throughout the watershed. Stream channels in many locations are suffering from abnormally wide and shallow morphology. Alteration of the channel morphology contributes to the headcutting and downcutting problem. The headcutting and downcutting has in turn led to a lowering of water tables and a subsequent drying of meadows and increased lodgepole encroachment. The significance of these trends varies dramatically depending on the exact nature of the stream at each site (adjacent meadow type, parent geologic material, flow patterns, influence from wild and domestic ungulates). The type of changes occurring suggests a shift from a Rosgen C or E channel type to a Rosgen F type. This shift in channel type has additional repercussions. When narrow, deep, sinuous channels become widened in the manner that is prevalent on Jack Creek, the stream slowly loses its sinuosity and its ability to process sediment efficiently. As this shift occurs the sediment regime is drastically altered, often shifting channel reaches from depositional in nature to transport or source reaches. A negative trend in willow abundance and distribution is occurring throughout the length of Jack Creek. This loss of a healthy willow community may have left stream banks more susceptible to the trampling damage that is exacerbating the shift in channel types.

Some of the headcuts in the watershed have been subject to enhancement projects such as the placement of logs or rocks in a manner meant to stop the headcut progression. These attempts all appear to be a failure as headcutting at these sites continues to progress upstream.

Historical Hydrologic Characteristics

<u>What were the historical hydrologic characteristics and features?</u>

Although very little direct documentation of historic conditions has occurred in the watershed many inferences can be made based on similar histories in surrounding watersheds, and current trends. Considering the type of channels most prevalent (Rosgen type E and C), historical morphology likely consisted of narrow, deep channels with a high sinuosity, low entrenchment and low levels of unstable banks.

Willows were more abundant and likely of a larger size than what is typically found today. Currently, willows are in poor condition along the entire length of the main channel. Some tributaries still maintain healthy populations. The difference between the mainstem and tributaries is that all of the mainstem has been subjected to heavy pressure by livestock. Some of the tributaries, due to their locations outside the allotment, along with other access issues, don't receive such heavy pressure. Tributaries with little influence from livestock tend to be choked with dense patches of willow and this was likely the historical condition found throughout much of the watershed. Large dense patches of willow likely had a significant influence on the stability of stream banks.

Fire played a much different role in the watershed historically. Before fire suppression ponderosa pine was a more common upland forest type and frequent low intensity fires were likely the norm. It is assumed that the meadows also burned on a relatively frequent basis. Charred pieces of wood can be found throughout the meadow systems of Jack Creek. Fire may have locally and periodically reduced riparian shrub abundance and also could have prevented riparian lodgepole establishment. This would have altered the nature of allochthonous inputs to the stream channels.

Due to the former presence of beaver, wetland area was likely more substantial than what is found today. Currently, most wetlands are associated with springs and seeps. Historically, under the influence of beaver, wetlands would have been more widespread than at present time and their locations would have reflected different site-specific conditions. Due to the progression of beaver impoundments from open water habitat towards meadow conditions, the type of wetlands within the watershed varied both temporally and spatially. Increased diversity in aquatic invertebrate assemblages would have coincided with increased diversity of wetland types. With a greater extent of wetland habitat, riparian area and habitats suitable for riparian hardwoods would also be more extensive.

Natural and Human Causes of Change

What are the natural and human causes of change between historical and current hydrologic conditions? What are the influences and relationships between hydrologic processes and other ecosystem processes?

Grazing

Grazing has reduced willow abundance and health, and has altered meadow vegetation composition, reducing the stability of stream banks. Livestock and native ungulate traffic occurs in many areas with reduced resistance to trampling (due to altered vegetative communities), resulting in sloughing banks and a widened channel. Impacts to channel geomorphology have been greatest where channels cut through dry and moist meadow types.

Fire

Fire regimes have been significantly altered from historic conditions both through suppression activities and through structural and compositional alteration of vegetation communities. Fires were more frequent historically. This shift has altered riparian communities in addition to upland communities. Riparian vegetation and upland vegetation can both influence structure and function of stream channels through providing erosive resistance and woody inputs.

Beaver

During the booming fur trade of the 19th century beaver were heavily trapped throughout North America. Early trapping expeditions came through the Klamath Basin but few beaver were found. It is not known whether the Jack Creek locality was among the areas explored. Recent surveys of Jack and Sellers Creeks show that beaver were active throughout the watersheds, with occupation as recently as 30 years ago. It is not known exactly why beaver are no longer found within the area. Government removal programs were active at the time of the disappearance and some locals believe this program was active on Jack Creek. Habitat alterations have significantly reduced willow abundance, eliminating populations in some areas. It could be a combination of both trapping and poor habitat conditions that resulted in the total disappearance of beaver. See Appendix A, Beaver Survey Report.

The absence of beaver has resulted in shifts in hydrologic, geomorphic, and vegetative conditions. Beaver influence these conditions through construction of dams, lodges, holes, and runs; extensive foraging; and structural use of riparian vegetation. The alteration of these structural habitat parameters can in turn have a significant effect on biogeochemical cycling patterns (eg. materials transport, carbon and nitrogen cycling, oxidation/reduction reactions, etc.), and the biotic community that uses these habitats (Naiman et al. 1988). Aquatic invertebrate communities in pond habitats are significantly different than those of flowing stream habitats. The presence of pond complexes is associated with increased aquatic invertebrate diversity. Additionally, the formation of ponds causes sediments to aggrade and water tables to rise. As this occurs riparian area is increased and the area suitable for riparian hardwood establishment increases.

Roads

The Jack Creek Watershed is heavily roaded and the pumice roadbeds are susceptible to erosion. High flow events can quickly cause gullies to form, and at that point surface flows become concentrated in these gullies increasing erosive force. Fall of 2003 through spring of 2004 saw several heavy rain events and gully erosion problems occurred throughout the watershed. A particularly heavily influenced area is the 8821 road from where it crosses the creek to about 1.5 miles north of this point. Sediments from some of these eroding areas are being deposited on flats with upland vegetation, leaving alluvial fans of pumice, burying vegetation up to a foot deep. Other gullies have been observed depositing their pumice loads directly into stream channels. One Jack Creek tributary east of the Jamison private property has had its native substrate buried by recent pumice flows for approximately the first 200 ft. below its crossing of the 8821 road.

1964 Flood

A heavy flood event occurred in May of 1964. Reports of this event discuss an abundance of road erosion, channel downcutting and blowouts. Much of the entrenchment seen today is considered a remnant of this storm event. The majority of the erosion and downcutting apparently occurred in the southern portions of the watershed. If today's entrenched conditions in the southern portions of the watershed are a result of this event then it was likely degraded conditions that allowed this event to so drastically alter channel conditions. Channel development in Jack Creek has occurred over thousands of years. The '64 flood event has been compared to a hundred year event. If this is the case then numerous floods of this magnitude have occurred since the explosion of Mt. Mazama and the development of the Jack Creek stream channel. If channels and water tables were significantly higher before this flood, then the stream either had enough resistance to avoid large downcuts and blowouts, or it had enough resilience in the face of these disturbances to continue to efficiently process sediment loads, aggrading channels and restoring stability of stream banks after these high flow events.

Issues

- Riparian hardwoods are declining; there is a vegetation shift in some riparian areas.
- Stream bank morphology is altered from its natural state along much of Jack Creek, its tributaries, and Sellers Creek. Channels are wider and shallower than is natural.
- Stream banks are vulnerable to continued trampling disturbance.
- Channel resistance to flooding disturbance is limited.
- Downcutting of channels and headcut formation and progression are prevelant.
- Water tables are lower than historic levels.
- Sediment loads are abnormally high due to channel erosion and inputs from road systems.
- Absence of beaver has resulted in reduced wetland habitats thereby altering hydrologic functions, geomorphic conditions, vegetative assemblages, biogeochemical cycling processes, and biotic communities.

Recommendations

Roads

- Identify areas where erosion from roads is adding unwanted sediment to stream channels. Modify, eliminate, or close roads that are adding to this problem.

- Identify culverts that limit natural stream processes (sediment flow, channel migration, passage of native dace and lamprey) and make necessary changes to allow these processes to occur.

Grazing

- Alter grazing management strategies to be more sensitive to channel conditions. Explore options such as flash grazing, shortened or different grazing seasons, rest rotation management, and reduced numbers to determine if these alternative strategies could allow improved conditions.
- Healthy plant communities are the best tool to prevent streambank damage. Adequate stubble heights help to insure long term plant health by maintaining sufficient plant leaf mass and undamaged root structure to sufficiently recover during non-grazed periods. In the long term, desired native species composition should be maintained that has inherent capability to work in balance with natural processes and minimize disturbance factors. Set utilization standards to maintain adequate stubble heights and appropriate vegetative cover.
- Explore methods for keeping cows from kegging up along the perennial section of Jack Creek during the late part of the season (mid August-late September). Fence sensitive areas prone to deterioration under the influence of grazing.

Riparian Hardwoods

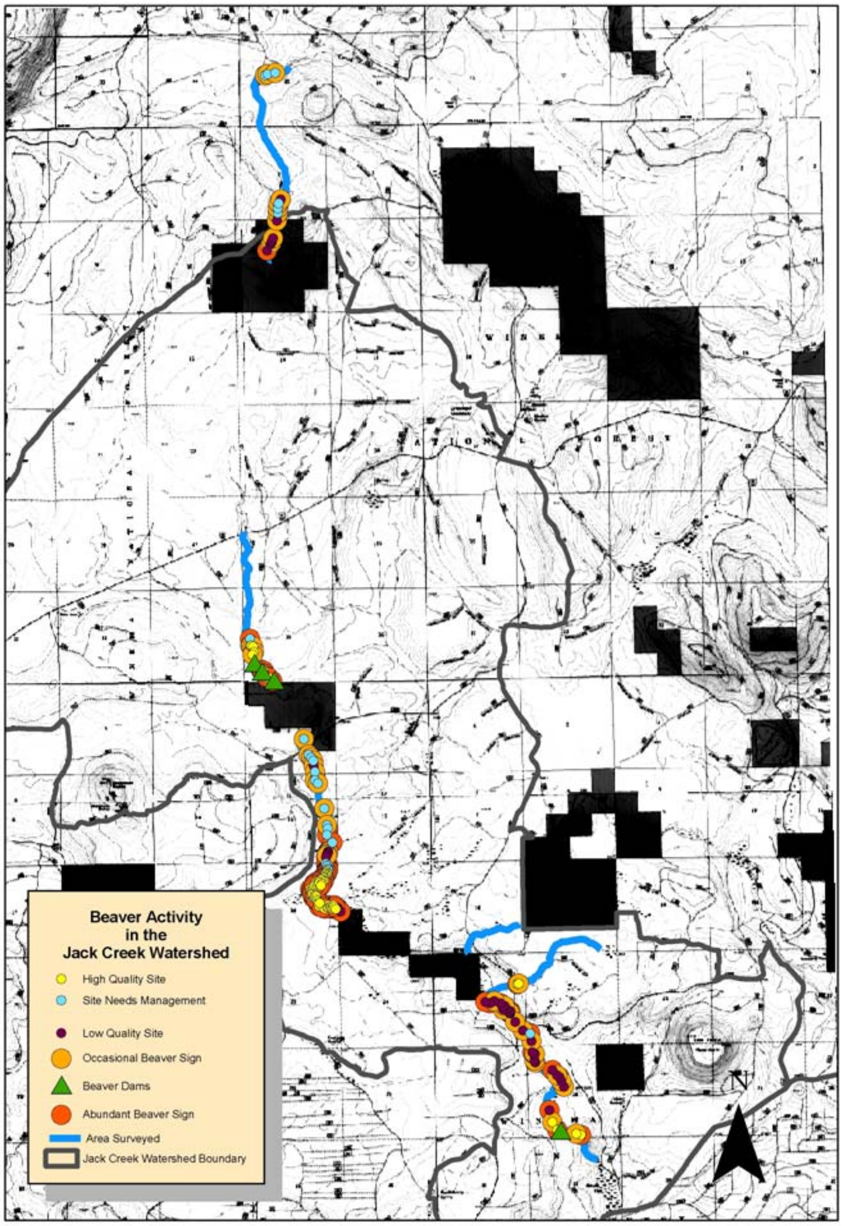
- Set up program for improvement of existing willow condition and expansion of willow populations throughout Jack Creek, its tributaries, and Sellers Creek.
- Fence especially sensitive populations. Possibly fence, from livestock and native ungulates, small individual patches in order to ensure flowering response occurs on a regular basis. These small fences could be moved to different patches every few years. Flowering response at these sites should be monitored closely.
- An active planting program should be started that concentrates its efforts in locations where the willow population has been completely eliminated. In areas where willow populations still exist, but in poor condition, more passive options should be explored before resorting to planting. Passive restoration will ensure that willow establishment consists of local plants established in natural manners and locations. When plantings are used, the cuttings should come from plants as local to the planting site as possible. Site selection should include consideration of site specifics such as surrounding plant community, local water tables, and juxtaposition in relation to the channel. Before active plantings begin, a survey of the various species of *Salix* in the project area should be performed. This survey should include mapping of distributions, and a characterization of habitat preferences for each species encountered.

Headcut Repair

- Remove nonfunctional artificial structures that utilize non-native materials (large rocks in meadow systems).
- Fence livestock away from headcuts allowing deep-rooted vegetation to reestablish.
- After eliminating perturbations that exacerbate headcuts, explore options for assisting vegetation establishment including the establishment of willow populations if water table conditions make it feasible.
- Explore options for aggrading sediments and raising water tables. This could include the use of “fuzzy dams,” or possibly beaver.

Beaver

- Reintroduce beaver into both Jack Creek and Sellers Creek. Initially concentrate reintroduction efforts in areas with relatively extensive and healthy willow populations. Continue reintroduction efforts into additional areas as riparian hardwood communities become robust enough to withstand extensive, long-term use by beaver.
- Coordinate beaver reintroduction effort with willow improvement projects. Concentrate willow improvement projects in areas that beaver formerly occupied.
- Determine if beaver will utilize bog birch as a food source and construction material.
- Establish beaver monitoring plan: determine beaver influence on stream channels and vegetative condition.
- Monitor natural migrations and establishment patterns of colonies.
- Explore options for using beaver as stream restoration tools especially in regards to reversing downcutting and headcutting problems.


Beaver Activity
in the
Jack Creek Watershed
High Quality Site
Site Needs Management
Low Quality Site
Occasional Beaver Sign
Beaver Dams
Abundant Beaver Sign
Area Surveyed
Jack Creek Watershed Boundary
N

Water Quality

Beneficial Uses

What beneficial uses dependent on aquatic resources occur in the watershed?

Beneficial uses for the Klamath Basin as whole, according to the Oregon Department of Environmental Quality water quality standards that can be applied to Jack Creek include: livestock watering, fish and aquatic life, wildlife and hunting, and aesthetic quality. Oregon State specified beneficial uses for the Klamath Basin also include public domestic water supply, private domestic water supply, industrial water supply, irrigation, fishing, boating, and water contact recreation, none of which apply to Jack Creek or its tributaries. (Table 180A, Sec 340-41-0180, Oregon DEQ state water quality standards)

Current Conditions and Trends of Beneficial Uses

What are the current conditions and trends of beneficial uses and associated water quality parameters?

Water quality parameters summarized include temperature, quantity, particulate matter, and chemistry.

Temperature

Jack Creek has a low velocity flow, is a relatively small stream, meanders through forested, meadow and wetland systems, and is at a relatively high elevation with a harsh winter. These factors help explain why this creek (in its perennial section) is prone to large daily and yearly fluctuations in temperature.

The creek is frozen from approximately November to mid-March. Weekly average temperatures peak in late July and early August at around 15-20° C. As with most small streams, water temperatures fluctuate a lot between daily minimum and maximum temperatures, but Jack Creek shows this in extreme. Stream temperatures fluctuated 10-15° C on a regular basis between daytime high and low temperatures, and 20° C shifts are not uncommon at surface temperatures. This high degree of shift can be partially attributed to the high amounts of tannins (dark sphagnum particles) in the water column, giving the water a tea color, and contribute greatly to daily shifts in temperature.

Quantity

Water flow quantities have been very influenced by drought the last few years. Even in recent years of high snowfall, the water level recovery is not sustained, probably due to the needs of groundwater recharge, especially in this pumice landscape.

Localized effects on water flow include channel incision that reduces effective floodplain. This is covered more thoroughly in the Hydrology section. The presence of more ungulates than the native species has an impact on the quantity of water available. For example, a cow drinks 15 to 20 gallons of water a day, (Engle, 2002) and the cattle allotment on the district coincides with the perennial reaches of Jack Creek. Jack Creek and its tributaries provide the only sustained water to the 356 cow-calf pairs on the allotment that are on the allotment for about 100 days each year.

Sediment

Contributors to sediment loads in this system are streambank erosion due to the combined effects of a fluctuating water table, livestock grazing in the riparian zone, and the paucity of riparian hardwoods that stabilize streambanks. Timber harvest and excessive or ill-built or unmaintained roads also contribute to sediment loading by destabilizing soils and causing erosion. Sediments diminish deep hiding areas for fish and frogs and smother aquatic plants that provide cover and forage.

Chemistry

This water chemistry discussion will address pollutants such as phosphorous, nitrogen and bacteria, as well as oxygenation. To help address these important aspects of water quality, there has been a series of water quality test within the Jack Creek watershed. A table of all the results are included in Appendix B. Tests have been done to detect levels of total phosphorous concentration, dissolved orthophosphate, total Kjeldahl (organic plus inorganic) nitrogen, ammonia nitrogen, dissolved nitrite plus nitratephosphorous, dissolved oxygen, and total and fecal coliform.

Excessive amounts of phosphorous and nitrogen added to an aquatic system interact to create snowballing negative effects on water quality and organisms dependent on water. Algae growth is increased which then results in depleting oxygen available in the aquatic system. Adequate dissolved oxygen is necessary in maintaining healthy populations of aquatic life, especially amphibians. Dissolved oxygen is further suppressed as the water temperature rises from loss of vegetative cover. Additionally, levels of disease-causing organisms can increase as a direct result of the nitrogen and phosphorous entering the system.

Coliform bacteria originate as organisms in soil or vegetation and in the intestinal tract of warm-blooded animals (fecal coliform). This group of bacteria has long been an indicator of the contamination of water and possible presence of intestinal parasites and pathogens. Fecal coliform are a group of bacteria that are associated only with the fecal material of warm-blooded animals such as wildlife, livestock, and humans with the most common member being *Eschericia coli (E. coli).* The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of some animal(s). High quantities of fecal contamination are an indicator that a potential health risk exists for individuals exposed to this water. In addition, decay of this material depletes the water of oxygen.

Fecal coliform entering the water, can multiply quickly when conditions are favorable for growth, especially high water temperatures. Counts can be highly variable depending on rain events, which may initially wash more fecal material into the water system, and temperature.

If fecal coliform numbers are high (over 200 colonies per 100 ml of water sample) in the stream, there is a greater chance that pathogenic organisms are also present. Diseases and illnesses such as typhoid fever, hepatitis, gastroenteritis, and dysentery can be contracted in waters with high fecal coliform counts.

The Oregon State Department of Environmental Quality has standards for Oregon waterways, including Jack Creek. Many of the Jack Creek water samples have exceeded the state water quality standards for coliform bacteria.

The following standards come from the Oregon state water quality standards (OAR Chapter 340, Division 41), Oregon Department of Environmental Quality:

- “Bacteria: Organisms of the coliform group commonly associated with fecal sources” in freshwaters shall not have “a 30-day log mean of 126 *E. coli* organisms per 100 ml, based on a minimum of five samples”, or “no single sample may exceed 406 *E. coli* organisms per 100 ml.” The standards address animal waste thusly: “Runoff contaminated with domesticated animal wastes must be minimized and treated to the maximum extent practicable before it is allowed to enter waters of the State.” (Sec. 340-041-0009) The Biocriteria standards state, “Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.” (Sec. 340-041-0011)

In the last three years there have been eight samples representing six sites that have exceeded the one time standard (406 organisms per 100 ml) of fecal coliform. There are 18 main sample points with 4 in the sheep allotment (lower Jack) and 14 in the perennial reach of Jack that coincide with the cattle allotment. All of the samples that exceeded the one time *E. coli* state standard were in the cattle allotment. There are several sites that may exceed the threshold of 5 samples in 30 days of *E. coli* levels of 126.

Other sample points for water quality are included in Appendix B that are outside the Jack Creek subwatershed, but illustrate the contrast between sample points in the cattle allotment versus outside.

It is reasonable to link some if not most of the *E. coli* presence to the cattle present there, that are drawn to the riparian areas for water and shade. They would tend to defecate where they spend the most time eating and resting.[12] To add credence to this assumption, water samples were taken outside the cattle allotment in Jack Creek subwatershed, and even though these water sources were downstream of the other sample points, they were consistently lower in coliform counts, and none of them exceeded the state water quality threshold of >406 colonies per 100 ml.

Poor water quality directly affects the "beneficial users" of the water in Jack Creek. Livestock that depend on the water as their only source of drinking water can become ill or die if pathogens are present in sufficient numbers. Oregon spotted frogs, and other amphibians (Western toads, Long-toed salamanders, Pacific chorus frogs) are especially susceptible to pollutants and poor water quality since they spend so much time in the water, and absorb chemicals through their skin. Therefore amphibians are considered an indicator of aquatic health, and *Ranids*, to which Oregon spotted frogs belong, are more sensitive to poor water quality than other amphibian species. The local endemic dace and lamprey species could also be affected by poor water quality. Speckled dace require permanent, unpolluted water.

Historical Water Quality Characteristics - Natural and Human Causes of Change

<u>What were the historical water quality characteristics of the watershed? What are the natural and human causes of change between historical and current water quality conditions?</u>

Water quality parameters are highly interactive with each other, as well as other factors such as land use and modification. Management practices in general may affect water chemistry, temperature, and sediment loading. Within the Jack Creek subwatershed, domestic livestock grazing, logging activities, dispersed camping, and road maintenance are the management practices of concern.

Water temperature was presumably lower historically due to higher levels of instream shade, greater water quantities, and narrower, deeper channel morphologies. Water temperatures during the summer have probably increased due to channel widening, less flow due to channel incision, and a reduction in shade in areas where there is damage to overhanging banks and where hardwoods were more abundant, but now their growth is retarded or they are absent due to browsing/grazing, and/or lower water tables.

Sediments were no doubt more stable historically in both the uplands and the riparian zone in the absence of numerous roads, timber activity, and livestock grazing and with beavers present. Sediment loads are generally higher currently as result of factors such as streambank erosion due to combined effects of a fluctuating water table, livestock grazing in the riparian zone, and the removal of riparian hardwoods. These factors expose raw stream banks to erosion by streamflow, increasing scour that further contributes to the degradation of the banks and sedimentation in depositional zones.

If large storm events occur, channel widening and downcutting could be accelerated. Continued drought conditions would also exacerbate the water table lowering and encroachment of conifers, and contribute to greater water quality threats.

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[12] "A single cow excretes between 30 and 49 pounds of urine and between 29 and 70 pounds of feces per day" containing billions of fecal coliform bacteria and fecal streptococcus bacteria. (Carter, 2002)

Headcuts, lowering of the water table, loss of riparian hardwoods and drying out of meadows are extreme results of these types of erosional processes, which are evident in several areas on Jack Creek and its tributaries. High sediment yields and changing channel form from stable to unstable banks has increased water temperature and decreased hiding cover in the form of healthy undercut banks and deep pools for dace, lamprey, spotted frogs and other aquatic organisms living in Jack Creek.

Contributing factors to the overall decrease in water quality of Jack Creek includes several years of sparse precipitation, coupled with cattle grazing regimes, runoff associated with roads and past timber harvest activities, and the absence of beavers in the system.

Water quantity was also more plentiful and overall water quality was better historically when beaver were present. Beaver play an important role in low gradient streams, both functionally and biologically. Structures built by beaver are often constructed in a series and typically create lower gradient pond habitats in flowing systems, often extending the floodplain for long periods, even decades. Each beaver dam in the series has some storage capacity, so impoundments collectively reduce peak discharge during high flow events (Parker, 1985 IN 1994, Assessment of Jack and Mosquito creek watersheds). Reducing the channel gradient decreases water velocity, dissipates water energy and allows sediment to settle to the pond bottom or on to the floodplain. The improvement in water quality can be significant, with sedimentation below the dam being reduced by as much as 90%, though different sites can have varying amounts of sedimentation reduction. Beaver dams, "a continuously renewed, erosionally resistant substrate", effectively resist erosional effects up to a threshold as long as they are maintained by the beaver (Ibid.).

Beaver dams greatly increase the hydraulic retention of the system, allowing for a slow discharge of water throughout the driest parts of the year, by markedly increasing the duration and area of contact between the ground surface and standing water, which in turn allows a higher rate of infiltration to deeper layers underground than occurs from precipitation.

Issues

- Water quality is often poor in Jack Creek in cattle allotment.
- Streambanks are very vulnerable to disturbance.

Recommendations

- Meet or exceed state water quality, or thresholds for frogs, whichever is higher. Monitor.
- Grazing needs to be tightly managed and controlled to allow for revegetation, healing of raw banks and changes in the stream profile, and improvement of water quality (especially in the cattle allotment). Specific recommendations include adhering to the stipulations of the permit with adaptive management based on consistent monitoring; adding upland water sources and fencing off degrading or susceptible stream sections and springs; possibly adopting a rotational grazing system; modifying livestock numbers or length of seasons during drought years (or managing for "worst year" scenarios).
- Reintroduce beaver into the system using beavers that would otherwise be trapped and killed. Prioritize areas of reintroduction: places that the water table should be raised, or the water velocity slowed down, and are a distance from culverts that might be blocked by beaver activity.

Vegetation

Patterns of Plant Communities and Seral Stages

What are the array and landscape patterns of plant communities and seral stages in the watershed? What processes caused these patterns?

Vegetation types

The following plant associations occur in the Jack Creek watershed and can be grouped into three plant community types. The CLG311, CLS211, CLS212 represent the lodgepole community, the CPS211, CPS212, CPS215, and CWS112 represent the ponderosa community and the CLM211, MD, MM, and MW represent the riparian community

Lodgepole basin plant communities dominate the northern half of the Jack Creek watershed. These are characterized by cold air drainage basins and extremes in soil temperatures. Cold air kills the ponderosa pine buds preventing its establishment in these areas. Soil temperatures range from below freezing any day of the year to in excess of 140 degrees Fahrenheit at the soil surface during the summer. These two factors control the distribution of the tree vegetation, with lodgepole pine dominant in the cold air pockets and ponderosa pine on elevated landforms. Lodgepole pine tends to be linear in its distribution on the landscape, following riparian areas and drainages. Large blocks are apparent where the entire basin is a cold air pocket.

Moving south through the watershed, lodgepole pine dominates the wetter soil types, with ponderosa pine communities on the slightly elevated areas. Ponderosa pine communities dominate the southern end of the watershed, except in the wetter soil types that are lower in elevation and susceptible to cold air pockets.

The ponderosa pine communities dominate the higher elevations of the watershed. The elevational difference between cold air drainages and wet soil types regulating lodgepole pine distribution, and the expression of ponderosa pine may only be a few feet, but it is significant. Ponderosa pine communities are linear in the north and middle of the watershed, but develop on to large blocks in the south end due to more favorable temperature conditions.

There are nine ecological units (3,273 acres) that describe the riparian vegetation. The current vegetation, potential natural community, and historic climax plant community are described for each unit in the Ecological Unit Inventory.[13]

- Ecological unit 2000 is the most common riparian unit (1,484 acres). These were historically moist meadows and are tending toward lodgepole pine with grass understory. This unit currently contains predominantly hairgrass/sedge moist meadows. Approximately 30% of these meadows are showing lodgepole encroachment. Riparian hardwoods are not a significant component of this unit.
- Ecological unit 2001 is rare (149 acres). These are the flat, forested riparians of ponderosa pine and lodgepole pine with spirea/sedge understories. This unit was historically lodgepole/spirea/sedge. The drying trend is pushing the vegetation toward ponderosa/snowberry.
- Ecological unit 2002 is also very rare (14 acres). These are slope forested riparians with vegetation and trends similar to the 2001 unit.

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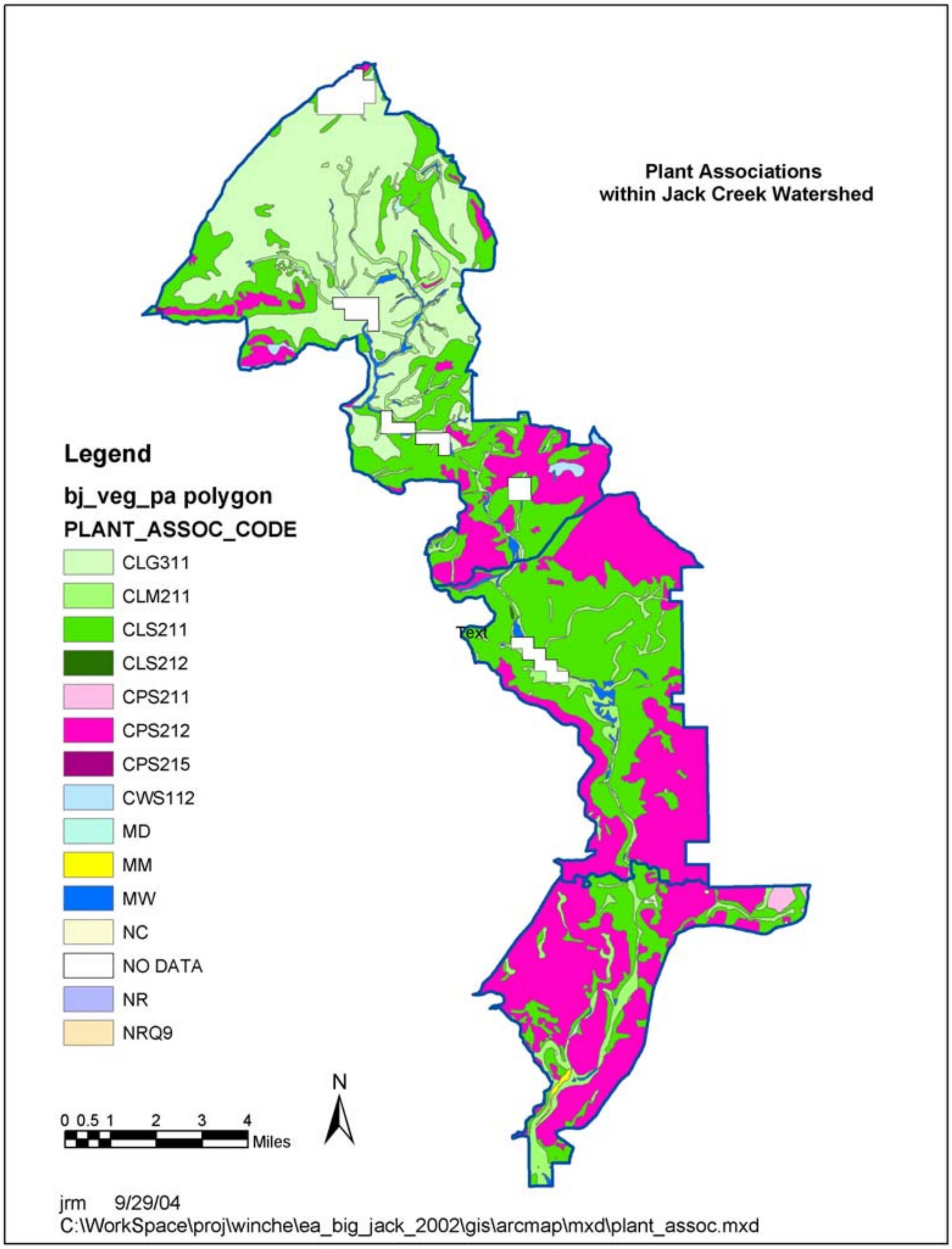
[13] USDA Forest Service. May 2001. Ecological Unit Inventory of the Winema National Forest Area, Portion of Klamath County, Oregon. Interim Report #3. Winema National Forest. Klamth Falls, Oregon.

- Ecological unit 2004 (156 acres) is moist and dry meadows with bluegrass/hairgrass understories. These were historically moist meadows. The drying trend is pushing them toward lodgepole with grass understories. Riparian hardwoods are not a significant component of this unit.
- Ecological unit 2005 (166 acres) is forested riparians of lodgepole/riparian hardwoods/sedge. These units were historically spirea-blueberry/widefruit sedge communities. This unit is tending toward lodgepole pine/blueberry/sedge.
- Ecological unit 2006 is also a common unit (488 acres). This unit is swampy. The historic, current and potential vegetation is lodgepole pine/ willow/bog blueberry/wet sedges.
- Ecological unit 2008 is willow wetlands (142 acres). The historic, current and potential vegetation is willow/ /wet sedges.
- Ecological unit 2012 (247 acres) is the flat forested riparians of aspen, ponderosa pine and lodgepole pine with bearberry//currant understories. This unit was historically lodgepole/spirea/sedge. The drying trend is pushing the vegetation toward ponderosa/snowberry. These were historically lodgepole pine with bearberry and are now drying toward ponderosa.
- Ecological unit 2017 (360 acres) is forested riparians of lodgepole/willow/wet sedge. It has historically been this type and is likely to continue if willows are managed to minimize browsing and encourage flowering reproduction.
- Ecological unit 2018 (12 acres) is also willow wetlands. It is dominated by willows/bog birch/widefruit sedge/bluegrass communities.


Plant Associations
within Jack Creek Watershed
Legend
bj_veg_pa polygon
PLANT_ASSOC_CODE
CLG311
CLM211
CLS211
CLS212
CPS211
CPS212
CPS215
CWS112
MD
MM
MW
NC
NO DATA
NR
NRQ9
Text
N
0 0.5 1 2 3 4
Miles
jrm 9/29/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\plant_assoc.mxd

Seral stages/Structural classes

Seral stages are mostly in the early to middle range. Structural classes of the tree vegetation are presented in the table showing the biophysical environments and the percentage of the watershed in the Early, Middle, Late Multi-storied and Late single-storied classes. The historic and current percentages are represented and the departure from historic estimates is displayed as the difference.

Biophysical Environment	Early			Middle			Late Multi-Storied			Late Single-Storied		
	H%	C%	%D	H%	C%	%D	H%	C%	%D	H%	C%	%D
Hot, Dry *PIPO* Plant Community	8-18	41	+23	0-14	42	+28	4-6	17	+11	70-90	0	-70
Cold, *PICO* Plant Community	33-56	60	+4	0-37	40	+3	2-5	0	-2	5-16	0	-5

Processes

Temperature, soil, and water regimes control the plant community distribution, with fire, insects, wind, and human activities serving as the disturbance factors modifying the landscape pattern over short time (100 years or so) periods. Human activities such as fire suppression and timber harvest moved the seral stages and structural classes to the early and middle ranges by allowing in-growth of lodgepole pine in ponderosa pine communities and removing the larger trees for timber. Recent outbreaks of mountain pine beetle and lodgepole needle miner changed the seral stages and structural classes of lodgepole across thousands of acres. Under water regimes, the periodic nature of drought must be a factor considered, as this disturbance covers entire regions with its influence on vegetation distribution. See also the hydrology section for discussion on hydrologic regime influence on riparian habitats.

Current Conditions and Trends

<u>What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed?</u>

There has been a reduction in large-tree dominated stands, with corresponding increase in poles and seedling/sapling dominated stands and increased fragmentation. The large ponderosa pine tree component within the watershed has been reduced due to harvest and competition. Structural size diversity within stands is being lost. Seral composition is shifting to favor lodgepole pine.

All stands in the area are crowded with small trees competing with large trees for nutrients, water, and growing space. The general forest health of the Jack Creek area shows that most not receiving some sort of vegetation management in the past 15-20 years are showing signs of decline, low vigor, recent tree mortality, and are at moderate to high risk of beetle attack. There are fewer large tree dominated ponderosa pine stands than desired and more pole-size and seedling/sapling dominated stands than desired.

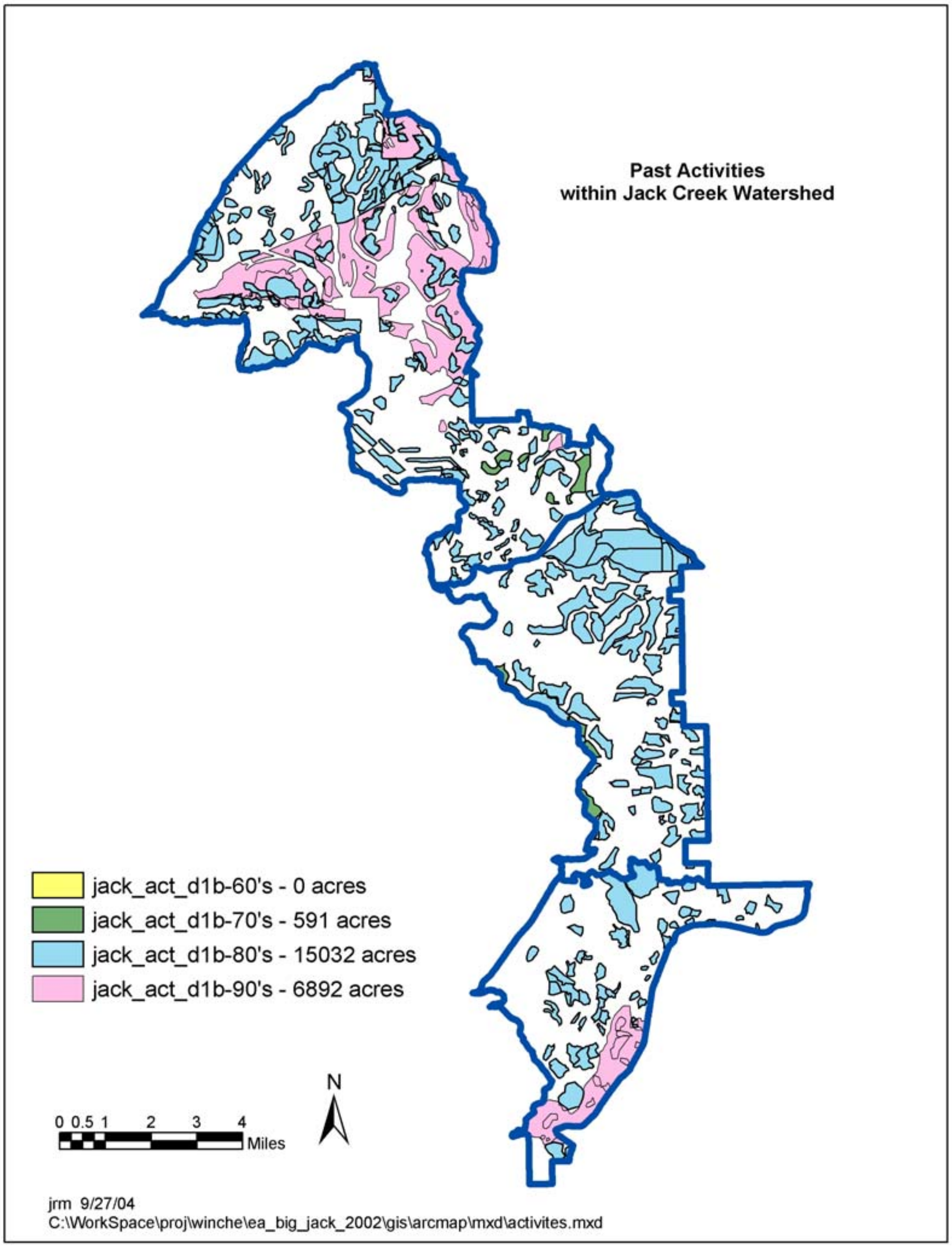
The ability to maintain current old-growth structure in overstocked condition in the short term and grow old-growth structure in the long term is compromised with overstocked conditions.[14] A balance should be maintained where stocking remains high enough to develop structural decadence that is a

[14] Overstocking is defined as a point at which a given plant series (i.e. ponderosa pine, mixed conifer, ponderosa/sugar pine, and lodgepole pine) has exceeded carrying capacity for the site and tree mortality has begun due to competition for the site's resources (i.e. water, and nutrients).

necessary part of old-growth habitat, but yet is not so high that mortality collapses the stand prematurely.

Logging in the Jack Creek watershed began in the 1930's. The entire ponderosa community had varying amounts of the large overstory trees logged. Approximately 39% (22,800 acres) of the watershed has past harvest activities from the 1960's to the present. Activities are displayed by decade. There are approximately 300 acres of units in the 1960's, 591 acres in the 1970's, 15,032 in the 1980's and 6,900 acres in the 1990's. Activities in the lodgepole units from the 60's, 70's and 80's were clearcuts and are now approximately 15'-20' tall. About 25% of these plantations have been thinned. The past activities in the lodgepole in the northern portion of the watershed are salvage units that removed beetle killed trees. Harvests in the ponderosa units were overstory removal prescriptions leaving units stocked with natural regeneration and varying amounts of middle- aged ponderosa. About 95% of these ponderosa units have been thinned.

Lodgepole pine encroachment and drying are a common trend driving community development in the riparian system. Willows are in serious decline as evidenced by the preponderance of willow carcasses. Systems appear to be drying out and willows are being heavily browsed. Very little flowering is occurring. Lodgepole pines are overtopping the willows in many areas. These factors are likely contributing toward this decline. Aspen is also disappearing from the system, likely from similar factors.

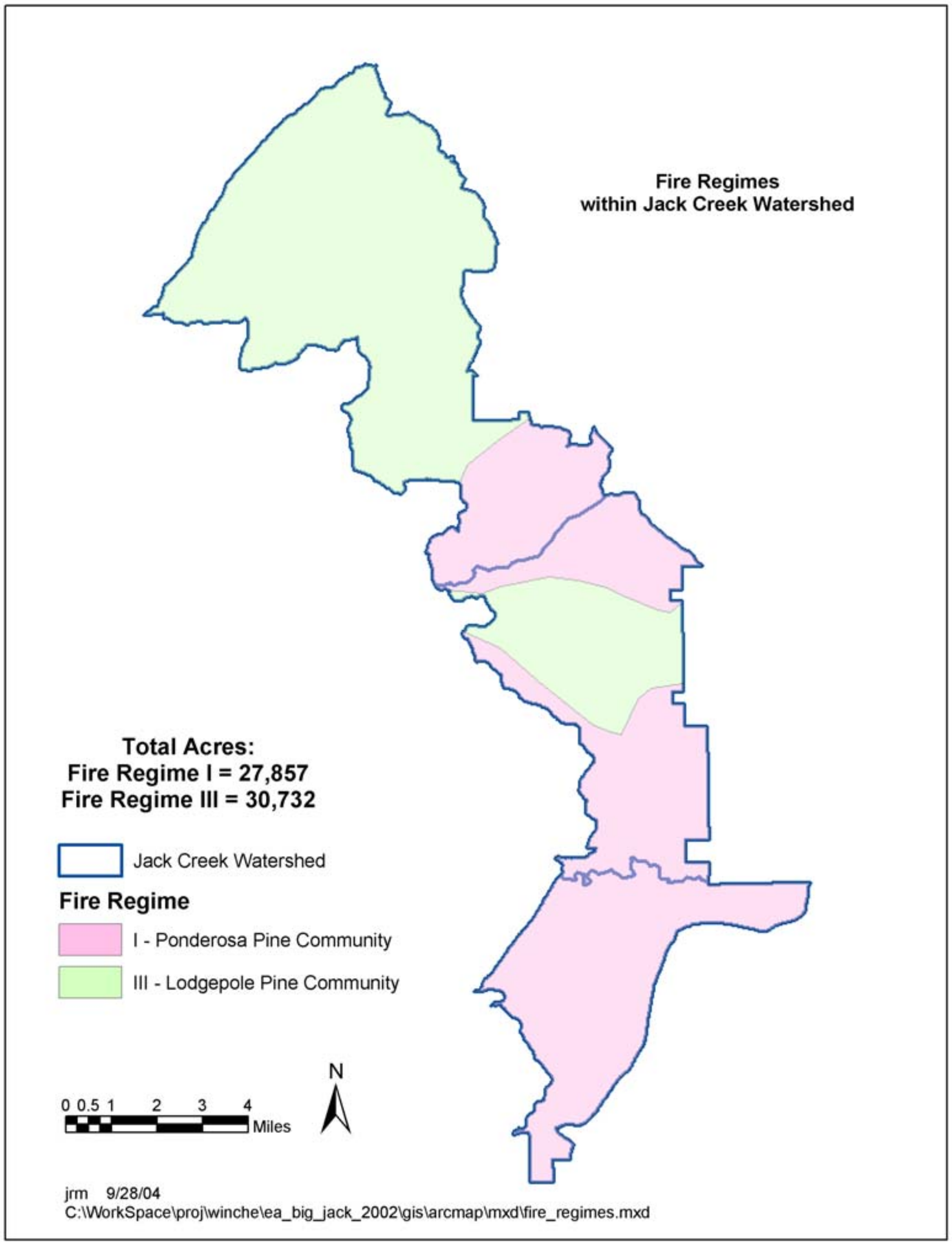

Past Activities
within Jack Creek Watershed
jack_act_d1b-60's - 0 acres
jack_act_d1b-70's - 591 acres
jack_act_d1b-80's - 15032 acres
jack_act_d1b-90's - 6892 acres
N
0 0.5 1 2 3 4
Miles
jrm 9/27/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\activites.mxd

Fire Regimes and Condition Classes

There are two fire regimes in the watershed. The ponderosa communities are Fire Regime I and the lodgepole communities Fire Regime III. There are about 27,850 acres in Fire Regime I and 30,730 acres in Fire Regime III.

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). The five natural (historical) fire regimes are classified based on the average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. These five regimes include:

- I – 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75% of the dominant overstory vegetation replaced)
- II – 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced)
- III – 35-100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced)
- IV – 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced)
- V - 200+ year frequency and high (stand replacement) severity

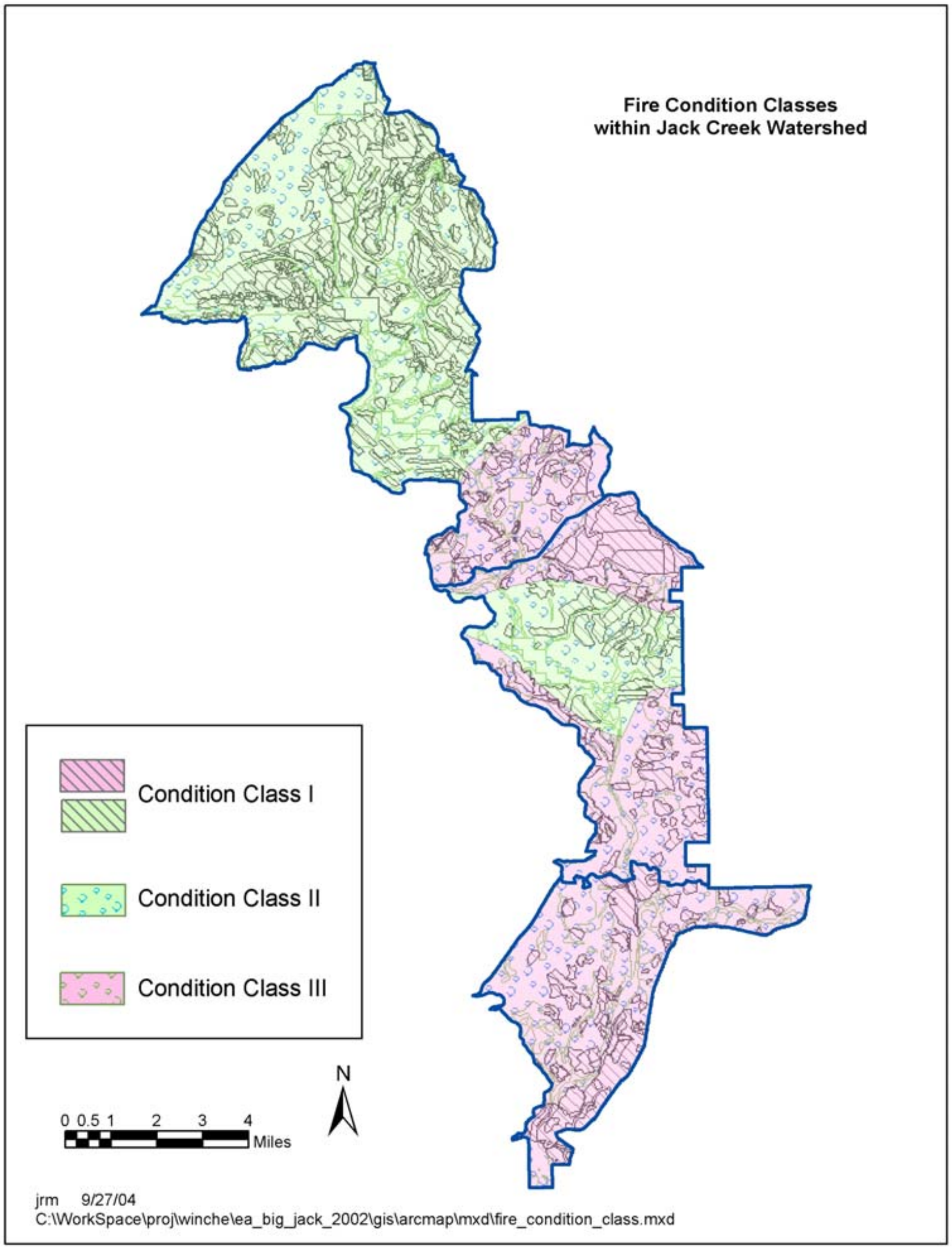

Fire Regimes
within Jack Creek Watershed
Total Acres:
Fire Regime I = 27,857
Fire Regime III = 30,732
Jack Creek Watershed
Fire Regime
I - Ponderosa Pine Community
III - Lodgepole Pine Community
N
0 0.5 1 2 3 4
Miles
jrm 9/28/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\fire_regimes.mxd

There are 3 condition classes (FRCC) associated with fire risk ratings. The three classes are based on low (FRCC I), moderate (FRCC 2), and high (FRCC 3) departures from the central tendency of the natural (historical) regime (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al. 2002). Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside the range. Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural (historical) fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural (historical) fire regime such as invasive species (e.g. weeds, insects and diseases), "high-graded" forest composition and structure (e.g. large trees removed in a frequent surface fire regime), or repeated annual grazing that maintains grassy fuels across relatively large areas at levels that will not carry a surface fire.

Determination of amount of departure is based on comparison of a composite measure of fire regime attributes (vegetation characteristics; fuel composition; fire frequency, severity and pattern) to the central tendency of the natural (historical) fire regime. The amount of departure is then classified to determine the fire regime condition class.

There are two condition classes for the lodgepole regime. Past harvest units are in Condition Class I, and unharvested units are in condition Class II. There are also two condition classes for the ponderosa regime. Past harvest units are in Condition Class I, and unharvested units are in condition Class III. Approximately 62% of the watershed is in either Condition Class II (lodgepole pine communities) or Class III (ponderosa pine communities).

Fire Regime Condition Class I	Within the natural historical range of variability of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances. The risk to loss of key ecosystem components is low.
Fire Regime Condition Class II	Moderate departure from the natural historical regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances. The risk to loss of key ecosystem components is moderate.
Fire Regime condition Class III	High departure from the natural historical regime of vegetation characteristics, fuel composition, fire frequency severity and pattern, and other associated disturbances. The risk to loss of key ecosystem components is high.


Fire Condition Classes
within Jack Creek Watershed
Condition Class I
Condition Class II
Condition Class III
N
0 0.5 1 2 3 4
Miles
jrm 9/27/04
C:\WorkSpace\proj\winche\ea_big_jack_2002\gis\arcmap\mxd\fire_condition_class.mxd

Fire Risk

A fire risk rating was done for the watershed using stand information and field verification. The ponderosa pine communities have experienced a shift from low fire risk to high fire risk. The historic fire regime of frequent low intensity stand maintenance fires has shifted to large stand replacement fires. Fire suppression for nearly a century and unmanaged growth of stands have resulted in development of surface fuel accumulations and overstocked, fire intolerant understories that act as ladder fuels to carry fire to large overstory ponderosa. These shifts in structure and composition promote more extreme fire behavior.

Stands with a high risk rating have fuel profiles that, when burned, can produce high levels of tree mortality. The risk is produced by stands capable of supporting both surface and aerial (in tree crowns) fire spread. As the fuel's ability to support aerial fire spread is reduced, so is the fire risk.

A stand's ability to support aerial fire spread (crown fires) is based on several factors: the flammability of ground and surface fuel and the fire intensity created by this fuel; the availability of fuel above the surface that can be ignited by the surface fire and once ignited can provide adequate fuel to support fire spread above the surface fire; and the continuity of the aerial fuels at various levels of the tree canopies.

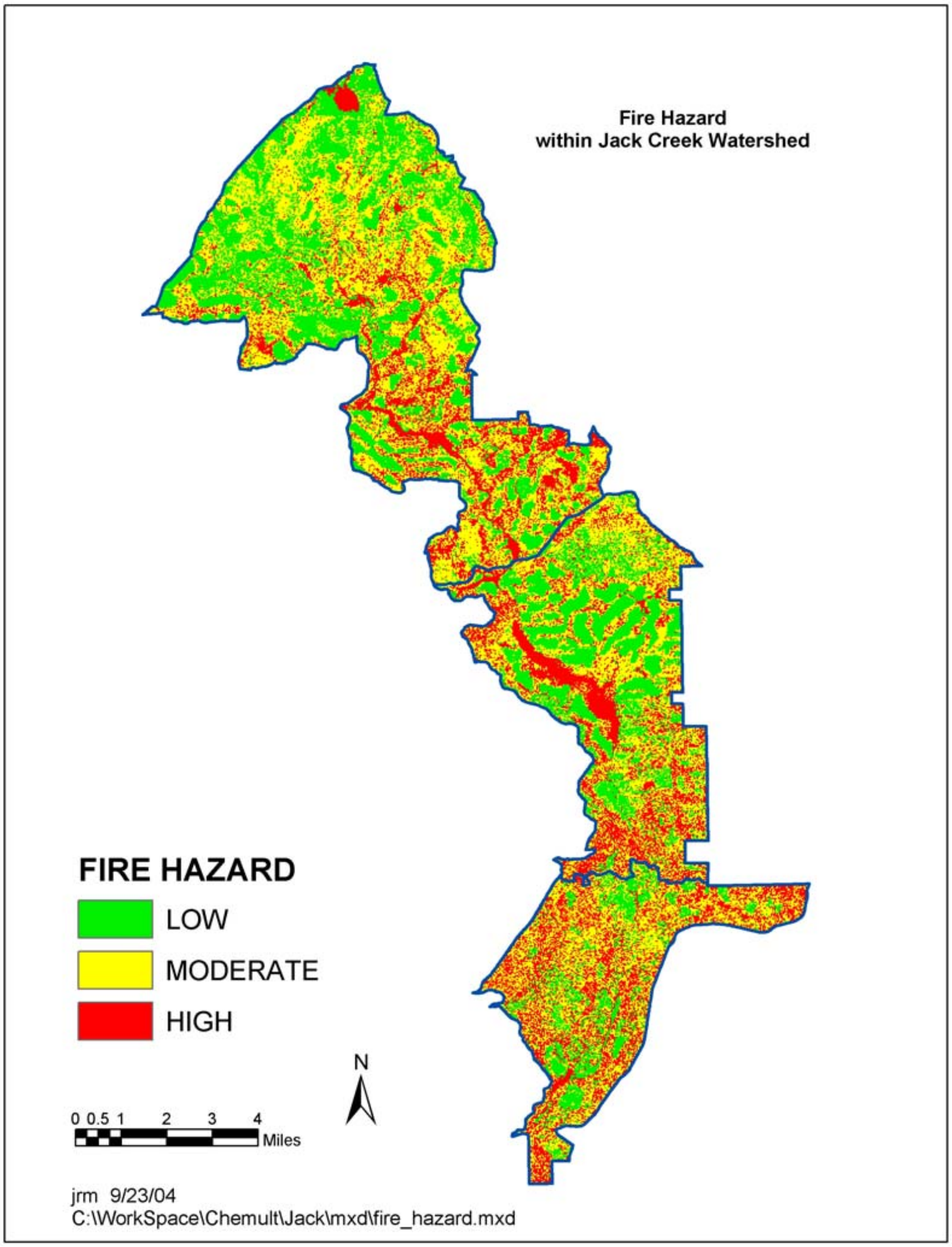
Stand canopy closure; number of trees per acre; height, quantity and age of understory shrubs; and ground and surface fuel loading were criteria used to determine fire risk ratings. Fire risk ratings are based on fire behavior and the environmental effects produced by the fire. Fire behavior predictions are based on outputs from a computer program predicting fire behavior based on the fuel model, fuel moistures, slope, and weather conditions. The program predicts fire-spread rates, flame lengths, maximum spotting distance and other parameters that help fire managers determine fire risk. The program does not predict crown fire potential or spread rates. Expert knowledge of fire behavior and fuel complexes must be utilized to determine crown fire potential.

The presence of ponderosa pine trees and a high shrub density creates extreme fire behavior. Ponderosa pine creates a very flammable litter layer of long needles and small diameter branches (this material is considered ground fuel). Shrubs are considered surface fuel. Due to their height above the ground and generally small diameter of foliage they can produce intense fires.

The predicted fire intensity level of fires burning in ponderosa pine and shrubs is capable of igniting all vegetation from ground level to 27 feet (where crown fires burn). This intensity level can easily ignite the lower tree limbs and allow fires to move into tree crowns independently of the surface fire.

Stands dominated by encroaching lodgepole pines contain dead and down material that would produce fires with low to moderate rates of spread and moderate to high intensities. The fire intensities would cause most of the tree crowns in these stands to ignite. The tree canopies are very close together and capable of sustaining fire spread through the tree crowns once torching occurs. The slow rates of decomposition in this area would allow the stands to maintain a high fire risk rating until they burn.

Although the surface fuel loadings are not as heavy in stands dominated by ponderosa pines, the fire spread rates are higher due to the presence of ponderosa pine litter (needles). The litter produced by ponderosa pine contains a much higher amount of fine fuel and is not dense like that of lodgepole pine. This lack of compaction allows much more oxygen to be present between fuel particles to support the flaming stage of combustion.


Fire Hazard
within Jack Creek Watershed
FIRE HAZARD
LOW
MODERATE
HIGH
N
0 0.5 1 2 3 4
Miles
jrm 9/23/04
C:\WorkSpace\Chemult\Jack\mxd\fire_hazard.mxd

Historical Patterns of Plant Communities and Seral Stages

<u>What were the historical array and landscape patterns of plant communities and seral stages in the watershed?</u>

As in the current time period, lodgepole basin plant communities dominated the northern half of the Jack Creek watershed. The two factors of cold air and soil conditions (temperature and moisture) controlled the distribution of the tree vegetation, with lodgepole pine dominant in the cold air pockets and ponderosa pine on elevated landforms. Lodgepole pine tended to be linear in its distribution on the landscape, following riparian areas and drainages. Large blocks were apparent where the entire basin was a cold air pocket. The major difference between current and historic is there were more communities with larger diameter lodgepole pine and the lodgepole pine was not encroaching into the riparian areas and the ponderosa pine communities.

Periodic fire controlled the tree structure with fires occurring between thirty and fifty years. Fire disturbance controlled the lodgepole pine structure by burning areas of lodgepole pine with high tree densities during favorable conditions (wind driven fire events). This resulted in low density, open-grown stands that might survive the fire events and not be killed by mountain pine beetle outbreaks. In areas that developed high densities ands were not killed by fire, mountain pine beetle outbreaks would kill the trees when the tree diameters and climatic conditions were ready for beetle epidemics. Fire would probably follow after the areas were fallen and weather conditions were favorable.

Moving south through the watershed, lodgepole pine dominated the wetter soil types, with ponderosa pine communities on the slightly elevated areas. Ponderosa pine communities dominated the southern end of the watershed, except in the wetter soil types that were lower in elevation and susceptible to cold air pockets.

The ponderosa pine communities dominated the higher elevations of the watershed for the reasons stated in the current condition section. Ponderosa pine communities were linear in the north and middle of the watershed, but developed into large blocks in the south end due to more favorable temperature conditions and periodic fire. Lightning was the major cause for fire, but anthropomorphic fire should not be ruled out, as humans have lived in the area for about 10,000 years, and they knew how to use fire as a tool.

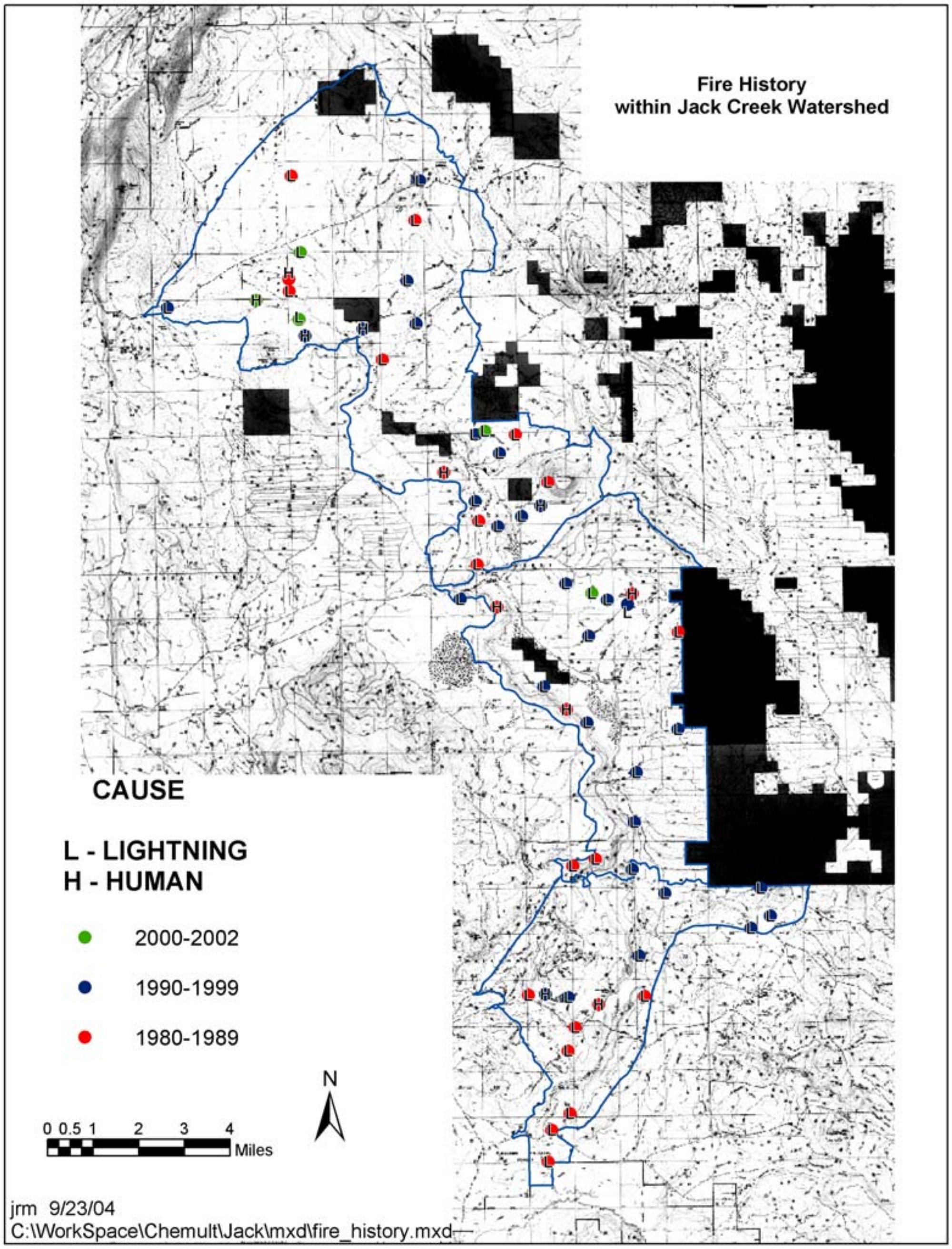
Seral stages/Structural classes

Seral stages for lodgepole pine were mostly in the early to middle ranges, with few areas in late stages. Structural classes followed this same pattern. Ponderosa pine is another story with most of the ponderosa pine communities in late to old seral stages and structural classes, and few areas in the early to middle stages/classes. Structural classes of the tree vegetation are presented above in the table showing the biophysical environments and the percentage of the watershed in the Early, Middle, Late Multi-storied and Late single-storied classes. The historic and current percentages are represented and the departure from historic estimates is displayed as the difference.

Processes

Temperature, soil, and water regimes controlled the plant community distribution, with fire, insects, wind, and human activities serving as the disturbance factors modifying the landscape pattern over short time (100 years or so) periods. The human activity of burning moved the seral stages and structural classes to the early and middle ranges in small areas of the ponderosa pine communities. Outbreaks of mountain pine beetles, and lodgepole needle miners changed the seral stages and structural classes of lodgepole across thousands of acres.

There have been 90 fires since 1970. Nineteen human-caused fires burned 243 acres. Seventy-one fires were lightning-caused and burned 15 acres.


Fire History
within Jack Creek Watershed
CAUSE
L - LIGHTNING
H - HUMAN
2000-2002
1990-1999
1980-1989
N
0 0.5 1 2 3 4
Miles
jrm 9/23/04
C:\WorkSpace\Chemult\Jack\mxd\fire_history.mxd

Natural and Human Causes of Change

<u>What are the natural and human causes of change between historical and current vegetative conditions?</u>

Historic

- Drought – effects on the availability and timing of water in the watershed
- Fire – low intensity periodic fires
- Humans – possibly fire use for game forage and hunting
- Insects – mountain pine beetle outbreaks when tree structure and climate favorable
- Wind – occasional random large-scale impact on watershed

Current

- Drought – effects on the availability and timing of water in the watershed
- Fire – suppression resulting in infrequent, high intensity fires
- Humans – fire suppression changing stand structure and seral stages distribution. Logging with road impacts on water flow. Removing large trees thereby changing habitat structure and distribution. Shifting seral stage and structural class areas to early and middle from late and old across the landscape.
- Insects – mountain pine beetle outbreaks when tree structure and climate favorable
- Wind– occasional random large-scale impact on watershed - 1962 Columbus Day storm - 1996 Sou'wester blow.
- Disturbances changed from local area, short interval to broad area, longer interval, such as mountain pine beetle, fire, human

Influences and Relationships

<u>What are the influences and relationships between vegetation and seral patterns and other ecosystem processes in the watershed?</u>

Changes in seral stages/structural classes:

- Wildlife
  - Habitat linkages and corridors changed
  - Structure changed to favor early to middle guilds and species
  - Forage in areas due to lack of fire and out of other areas due to canopy changes
  - Plant species composition changed due to structure or process change.
- Water
  - More trees on landscape may have influence on water availability and timing
  - Roads acting as small dams to retain/change water patterns
  - Higher tree density may have effect on snow retention in watershed
- Fire
  - Higher fire intensity
  - Changes in fire-dependent processes
  - More volatile understory vegetation
  - Increased risk of stand replacing fires for both lodgepole and ponderosa pine communities

Issues

- There appears to be a drying trend causing a shift in plant community structure in much of the riparian system.
- The willow and aspen components are in serious decline from the system drying, lodgepole encroaching, and browsing.
- There has been a reduction in the large tree dominated lodgepole and ponderosa communities with a corresponding increase in poles/seedlings/ saplings.
- The majority of unharvested stands are overstocked and showing signs of decline. These stands are at moderate to high risk of beetle attack.
- Approximately 62% of the watershed shows a moderate to high departure from the natural historical regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and associated disturbances. The risk of loss of key ecosystem components is moderate in the lodgepole communities and high in the ponderosa communities.

Recommendations

- Develop a willow restoration strategy on ecological units with a significant historic willow component.
- Clean out encroaching lodgepole pine from aspen stands.
- Thin understories of overstocked stands to reduce fire risk and promote stand health.
- Thin plantations to encourage good growth.

Species and Habitat

Canada Lynx

What is the relative abundance and distribution of Canada lynx that are important in the watershed? What is the distribution and character of their habitats?

The lynx is one of the three species of wild North American cats. The lynx primarily occupies territory in Canada and Alaska. The southern populations of the cat are much more disjunct and of fewer number. Lynx prefer boreal forests with high populations of its primary prey, snowshoe hares. The snowshoe has a profound affect on where the lynx may live and how high its population numbers can reach. When snowshoe populations are at a low, lynx populations also dramatically drop until the hare numbers rise again. The lynx diet would also include squirrels, grouse and caribou. Lynx survive best in areas with more than three feet of snow. The deep snows restrict other competitors, such as bobcats and coyotes from entering lynx habitat (Ruggiero et al 1994).

"In the Cascade Range, subalpine fir forests are the primary vegetation that may contribute to lynx habitat (IN, Ruediger, et al. 2000). Lodgepole pine is frequently present as a seral species in this forest association. Cool, moist Douglas-fir, grand fir, Pacific Silver fir, or western larch forests, where they are interspersed with subalpine fir forests, constitute secondary vegetation that may also contribute to lynx habitat."

"On the east side of the Cascade Mountains, subalpine fir plant associations are generally present above 1,220 m (4,000 feet) (Williams and Lillybridge 1983, Lillybridge et al. 1995). These vegetation types generally occur in areas with heavy winter snowfalls" (IN, Ruediger, et al. 2000).

What are the current habitat conditions and trends for Canada lynx?

The Winema National Forest is deemed to be outside the range of lynx. It is not thought to be within historical and/or occupied lynx habitat (USFS, September 4, 1998). Regional habitat definitions were incorporated into a GIS lynx habitat model developed in 1999 to determine lynx habitat on the Forest. The model showed the Winema National Forest habitat only occurs in very small patches that are widely scattered across the higher elevations of the forest. Small widely scattered patches would not support a lynx.

Three years (1999-2001) of survey effort was completed on the very best blocks of habitat identified from the Winema GIS model, mostly within this subwatershed. There were no lynx detections. The current presence of a resident lynx population cannot be substantiated.

The project area does support lynx's primary prey, the snowshoe hare, as well as cottontail rabbits and other secondary prey such as chipmunks, pine squirrels, ground squirrels and grouse. This subwatershed is within an active cattle and sheep allotment. There is no indication that lynx currently disperse through this area. The Forest has some of the components of lynx habitat, but not in sufficient quantities to sustain viable populations. Obstacles to dispersing lynx include highways, roads, utility corridors, land development such as campgrounds, resorts, and ski areas, conversion of shrublands to grasslands, non-native plant invasion, and grazing competition with hares from livestock. (Ruediger, et al, pages 32-35).

Although the subwatershed does not fit the boreal forest habitat descriptions above, lynx behavior studies show this species is highly linked to their preferred prey species, snowshoe hare. In the Jack Creek subwatershed, especially in the north, forest conditions currently favor high populations of snowshoe hare. In this area, there are many acres of dense lodgepole pine stands in early seral stages post pine beetle epidemic. The heights of the vast majority of these trees extend above the deep snowpack, providing snowshoe hares cover and forage during the winter. The possibility exists that conditions currently are favorable for Canada lynx for at least dispersal. However, this area may likely not be large enough to support lynx or able to provide a good link to suitable habitat in a reasonable distance.

<u>What was the historical relative abundance and distribution of Canada lynx and the condition and distribution of their habitats in the watershed?</u>

Historically the lynx inhabited most of the northern and western states, including this area and southward into northern California. There are multiple records of bounties paid for lynx around the turn of the century in Klamath County and a confirmed sighting of Canada lynx in 1899 by Fort Klamath near the Winema Forest boundary. There are two high reliability sightings within the recent years, but they have not yet been confirmed.

<u>What are the natural and human causes of change between historical and current species distribution and habitat quality for Canada lynx in the watershed? What are the influences and relationships of lynx and their habitats with other ecosystem processes in the watershed?</u>

The two main global causes of the decline of Canada lynx populations and range shrinkage are habitat fragmentation and competition. Fragmentation consists of forested habitat changes with increased openings, as well as the proliferation of roads and highways. Species competing for the same food include coyotes and raptors. Aggressive competitors include cougars and bobcats. All species of these competitors have become more widespread and abundant within the southern distribution of the lynx in the last 50 years ago. (Buskirk, et al. IN Ruggiero et. al. 1999)

The Jack Creek area has not been immune from these changes, although the prey species of lynx in the area may be at an historic high. The area may be too small or too segregated from other habitat for lynx to live in the area, or even use it as dispersal habitat. The two main global causes of the decline of Canada lynx populations and range shrinkage are habitat fragmentation and competition. Fragmentation consists of forested habitat changes with increased openings, as well as the proliferation of roads and highways. Species competing for the same food include coyotes and raptors. Aggressive competitors include cougars and bobcats. All species of these competitors have become more widespread and abundant within the southern distribution of the lynx in the last 50 years ago. (Buskirk, et al. IN Ruggiero et. al. 1999)

The Jack Creek area has not been immune from these changes, although the prey species of lynx in the area may be at an historic high. The area may be too small or too segregated from other habitat for lynx to live in the area, or even use it as dispersal habitat.

Lynx Reference Condition

Low density of roads, minimal human habitation and activity, adequate adjacent habitat, fewer competitors, good prey base (especially snowshoe hare).

Pacific Fisher

<u>What is the relative abundance and distribution of Pacific fisher that are important in the watershed? What is the distribution and character of their habitats?</u>

The Jack Creek area is probably too high in elevation with too deep a snow depth to support fishers. Surveys to detect forest carnivores were conducted in the winter using snow tracking in 1992, and using baited camera set-ups in 1999, 2000, and 2001 at all times of year in the project area. Fishers were not positively detected in either type of survey, however, martens, which we know occur here, were only detected with the snow tracking and not with the camera.

In the spring of 1999, a radio-collared fisher from the Rogue River National Forest, traveled over the Cascade crest briefly through the northwest corner of the Chemult district and north to the Deschutes National Forest. This was male less than a year old, and although he was repeatedly relocated near

Big Marsh in mixed conifer on the Deschutes, he also made several forays back and forth to the headwaters of the Umpqua on the west side of the crest. The next fall, his radio collar failed, and he could no longer be tracked. Another fisher was found dead near the southwest of the Chemult district on Sand Ridge.

Oregon Spotted Frog

What is the relative abundance and distribution of Oregon Spotted Frog that are important in the watershed? What is the distribution and character of their habitats?

Status

In 1989 the spotted frog was petitioned and listing with a positive 90 day finding by the USDI-FWS. In 1993 the species listing was deemed warranted but precluded by higher priority actions of the USDI-FWS, and so remains a candidate species for listing, with a priority of 2.

In 1997, genetic analysis concluded the spotted frog complex consisted of at least two species, the Oregon spotted frog (*R. pretiosa*) and the Columbia spotted frog (*R. luteiventris*). Columbia spotted frogs range from southeast Alaska through British Columbia, into western Washington and Oregon, northern Idaho, western Montana and Wyoming, and isolated populations occur in Utah and Nevada. Historically, the Oregon spotted frog ranged from British Columbia to the Pit River drainage in northeastern California. Currently, the Oregon spotted frog is found from extreme southwestern British Columbia south through the Puget/Willamette Valley Trough, and in the Cascades Range from south-central Washington at least to the Klamath Basin in Oregon. Only 15 of 59 historic localities, where the species' previous existence can be verified are occupied.

Currently, 35 Oregon spotted frog locations are known in Washington (1 historic, 5 new) and Oregon (12 historic, 17 new). Oregon spotted frogs have not been documented in recent surveys in California. In British Columbia, Oregon spotted frogs have been rediscovered at an historic site, and found at three new sites in 1996 and 1997.

Several Oregon spotted frog populations have been monitored in the recent past, and the Jack Creek population is not the only one to show a decline. Even the large population at Sunriver, Oregon and the largest known population at Conboy Wildlife Refuge in southern Washington are exhibiting a marked decline in the last half decade of monitoring. Conboy counted over 7,000 egg masses in 1998, and about 1,500 egg masses in 2001 and 2002.

Jack Creek population in relation to other populations

A population of Oregon spotted frogs was discovered and verified in three miles of the perennial section of Jack Creek in 1996. This is the only extant population of this Pacific Northwest endemic on the Chemult Ranger District. Other Oregon spotted frog populations in the Klamath Basin include several in the Klamath Marsh and Williamson River, approximately 20 miles downstream which are the closest within the watershed to the Jack Creek population, several populations along the west side of Upper Klamath Lake, Wood River Wetlands, and Buck Lake. Outside the Klamath basin, the nearest Oregon spotted frog population is in Big Marsh in the Deschutes watershed to the north, 20 air miles away. Spotted frogs utilize aquatic habitat more so than other ranids (true frogs). There is no current aquatic connection between Jack Creek frog habitat and any other occupied spotted frog habitat.

What are the current habitat conditions and trends for Oregon Spotted Frogs?

Local Habitat description

Jack Creek is fed by a system of perennial springs that characterize the area. The creek runs intermittently along its entire length, but contains areas with persistent water. Sedge (*Carex* spp.)

complexes dominate the adjacent meadows, but a remnant shrub component and some encroaching lodgepole pine are present. The habitat that spotted frogs occupy in Jack Creek consists of linear low gradient perennial section of stream that flows through a series of montane meadows, with various sized marshy areas of floodplain bordering the creek. Most other spotted frog sites, especially in the Klamath Basin, tend to be associated with multiple channels or man-made canals that occur in open marshland. Deep pools occur within the Jack Creek stream channel are havens for adult frogs in the summer. The floodplain and nearby springs that remain connected to the summer habitat provide breeding habitat and a pathway for tadpoles. Several breeding areas occur on late successional bogs, close to the spring sources. Most of these bog breeding sites, and the largest of the sites are on private land. Little is known about overwintering sites for this species as a whole; biologists thought this species sought out highly oxygenated water sources such as springs. A graduate project focusing on the Jack Creek Oregon spotted frog population (full description included in the appendix) was successful in fitting transmitters on several dozen frogs in 2003 during the late summer and tracking their locations into the fall, in an effort to ascertain their overwintering locations. It was not possible to track all the frogs to their overwintering destination for several reasons including: the batteries in the transmitters did not always last long enough, frogs slipped their transmitter belts, frogs died, and an attempt was made to remove the transmitters for frog health before access was no longer possible due to winter weather and prior to the batteries discharging. Overwintering sites were determined for about 8 Jack Creek frogs in 7 microhabitats during this study. The microhabitats are described below:

1) Associated with willow roots in bank of main channel
2) Three horizontal feet from main channel, underground in collapsed old beaver "run"
3) Two frogs were in main channel of about 4 feet depth, with flowing water. It is unknown whether they were resting on bottom in woody debris or under mud at bottom
4) One was similar to above but in 2.5 feet of water which was flowing more slowly. Unknown whether in fine willow roots at bottom or under mud
5) In marshy supersaturated peat, at least one foot below surface of water in peat, off channel, but this marshy area connecting main channel and a side channel
6) In main channel, under undercut bank, associated with old willow clump in mid water column
7) Barely covered with very wet mud on bank of main channel (not sure whether this was the overwintering site, or a transitional site between summer and winter habitat)

Unique Population Characteristics

The Jack Creek population has some unique characteristics: it is the highest known remaining population at 5,440 feet. The relatively low water temperatures at least partly related to relatively high elevation, seems to suppress growth and development rates compared with other sites. The system has no introduced bullfrogs or non-native fish species nor any non-native plants that pose a threat to the frogs. Cattle grazing influences the habitat. The Jack Creek habitat is fairly linear with a stream course and associated floodplain, versus wetland or marsh per se. The stream system is not altered much by man-made structures such as canals, diversions or weirs in the occupied habitat itself, although there are some diversions between the Jack Creek population and the next closest known population.

Population Estimates and Trends

From 1997 to 2002, monitoring in the form of a mark recapture program was conducted on the entire occupied habitat of Jack Creek including the private lands, to estimate approximate population size.

From 1999 to 2003, spring egg mass surveys were done to determine the number of adult breeding females.

As a result of monitoring, the population was found to be declining throughout that time. Egg mass counts are thought to be a more accurate reflection of population size (albeit just the number of breeding adult females) than mark-recapture estimates, according to several frog biologists (personal communication). Numbers of adult breeding females were estimated to be over 330 during the first 2 years, then dropped to half (167) in 2001, then to 60 egg masses in 2002, half of which were partly dead, and 71 egg masses in 2003. The egg mass counts were discontinued since 2003, because access to the private property where most of the breeding habitat occurs, was denied to the crew.

The mark-recapture program was replaced in 2003 and 2004 with a graduate thesis project centering more on preferences by spotted frogs to grazed and ungrazed microhabitats. Opportunistic mark-recapture surveys were repeated in 2004 excluding the private lands. The mark recapture results have not been analyzed as yet, and will only be able to be compared with the data from the same partial section of Jack Creek (minus the private portions), from previous years.

<u>What was the historical relative abundance and distribution of Oregon Spotted Frog and the condition and distribution of their habitats in the watershed?</u>

The most recent historic occupancy of beaver in Jack Creek is under investigation, but it is thought that the results of beaver activity, created much of the habitat occupied seasonally by frogs. Old beaver activity is apparent throughout the frog occupied riparian area evidenced by old willow and lodgepole stumps with gnaw marks by beavers. Multiple pools, old oxbows and collapsed beaver runs are further evidence of former beaver activity. Beaver were probably highly responsible for extending the still water habitat so important for spotted frogs.

<u>What are the natural and human causes of change between historical and current species distribution and habitat quality for Oregon Spotted Frog in the watershed?</u>

The species may be absent from as much as 90 percent of its former range. Range-wide threats to Oregon spotted frog populations include habitat loss, habitat alteration, drought, fire suppression, changing water quality, chemical contaminants, exotic predators, effects of livestock, and epizootics.

In the distant past, there was considerably more suitable habitat and fewer threats to the Oregon spotted frog as a whole. Loss of habitat is certainly a major contributor to the virtual disappearance of this species on the west side of the Oregon Cascades, coupled with the almost ubiquitous presence of non-native predators and competitors such as introduced bullfrogs and non-native fish.

Introduced fish species within the historic spotted frog range that may contributed to losses of frog populations include small mouth bass, largemouth bass, pumpkinseed, yellow perch, bluegill, brown bullhead, black crappie, warmouth, brook trout, rainbow trout, and fathead minnow. Oregon spotted frogs, which are palatable to fish, did not evolve with these introduced species and may not have the mechanisms to avoid predatory fish that prey on the tadpoles of native amphibians. At least one introduced predator has been documented in 20 of 24 surveyed sites in the 1990's.

Bullfrogs have been introduced in to the Pacific Northwest from eastern North America. Bullfrogs eat native frogs and can outcompete or displace them from their habitat.

Hydrologic alterations have occurred at 75% of the Oregon spotted frog sites surveyed in the Deschutes and Klamath Basins, ranging from minor changes (e.g., local ditching around springs) to substantial alterations (e.g., major modifications of historic flow patterns) (Hayes et al. 1997, Pearl 1997, 1999). Inundation of large marshes and construction of reservoirs has further fragmented Oregon spotted frog habitat. Abrupt water level alterations associated with human regulated water bodies can negatively impact Oregon spotted frogs. Reductions can concentrate predators and frogs, expose egg masses to desiccation or freezing, while flooding during critical periods can result in loss of shallow wetlands needed for egg laying and development.

Hayes (Hayes, et al. 1997) identified 38% of the Oregon spotted frog sites as having a moderate to high risk from drought (i.e., the potential for water level reduction that could reduce or eliminate suitable habitat). Sites with the highest risk frequently depended on surface flow and were located in areas with low annual precipitation. Sites in Oregon with the highest risk from drought are the Klamath and Deschutes Basins (Hayes et al 1997).

Historically, wildfires played an important role in maintaining Klamath Basin ecosystems (Agee 1996). However, decades of fire suppression have created situations where wildfires can dramatically alter an ecosystem as compared to functioning more in a maintenance capacity. Wildfires can change watershed hydrology, species composition (plant and animal), and habitat structure. Habitat succession, exacerbated by fire suppression, may negatively impact Oregon spotted frog populations, particularly where marsh-to-meadow changes occur.

Water acidity (low pH) can inhibit fertilization and embryonic development in amphibians, reduce their growth and survival through physiological alterations, and produce developmental anomalies (Hayes and Jennings 1986, Boyer and Grue 1995). A low pH may enhance the effects of other factors, such as activating heavy metals in sediments. An elevated pH, acting singly or in combination with other factors such as low dissolved oxygen, high water temperatures, and elevated un-ionized ammonia levels, may have detrimental effects on developing frog embryos (Boyer and Grue 1995).

Amphibian populations may be negatively impacted by poor water quality. Studies comparing responses of amphibians to other aquatic species have demonstrated that amphibians are as sensitive, and often more sensitive, than other species when exposed to aquatic contaminants (Boyer and Grue 1995). Immature amphibians absorb contaminants during respiration through the skin and gills. They may also ingest contaminated prey. Pesticides, herbicides, heavy metals, nitrates and nitrites, and other contaminants introduced into the aquatic environment from urban and agricultural areas are known to negatively affect various life stages of a wide range of amphibian species, including ranid frogs (Hayes and Jennings 1986, Boyer and Grue 1995, Hecnar 1995, Environment Canada 1998, Northern Prairie Wildlife Research Center 1998).

Additionally, acidification of water can inhibit fertilization and embryonic development, reduce growth, decrease survival, and produce developmental anomalies (Hayes and Jennings 1986, Boyer and Grue 1995, Northern Prairie Wildlife Research Center 1997).

Poor water quality and water contamination have probably played a role in the decline of Oregon spotted frogs, although data specific to this species is limited. Eutrophic (nutrient-rich) conditions, characterized by blooms of algae that can produce a high pH and low dissolved oxygen, have increased in Upper Klamath Lake and may have contributed to the absence of Oregon spotted frogs there. In 2002 and 2003, algal blooms, poor water quality, and low dissolved oxygen added to the impacts of drought conditions that affected Oregon spotted frogs' reproduction on the frogs of Jack Creek.

The effects of livestock vary with the site, livestock numbers, and the intensity of grazing. Livestock can cause mortality or displacement of Oregon spotted frogs by trampling adults, juveniles, or egg masses. Livestock graze and trample emergent and riparian vegetation, puddle soil in riparian and upland areas, and introduce urine and feces to water sources (Hayes 1997, Hayes 1998a, 61 FR 25813). The resulting increases in temperature and sediment production, alterations to stream morphology, effects on prey organisms, and changes in water quality have the potential to negatively affect Oregon spotted frogs.

Fourteen of twenty-eight (50 percent) Oregon spotted frog sites surveyed were directly or indirectly influenced by livestock grazing (Hayes 1997, Hayes et al. 1997, Pearl 1999). Too many cattle at several Oregon spotted frog localities in Oregon have caused severe habitat modification. Large numbers of cattle at a site may negatively affect Oregon spotted frog habitat, particularly at springs that possibly are used as overwintering sites (Hayes 1997). Preliminary results from exclosure studies at two sites in Oregon show significant improvement in vegetation where cattle are excluded. However, livestock grazing may, in some instances (e.g., Dempsey Creek in Washington), benefit the Oregon spotted frog by maintaining openings in the vegetation in highly disturbed wetland communities (Hayes et al. 1997, McAllister and Leonard 1997).

Cattle numbers, distribution, and time of grazing were not adjusted for drought conditions in Oregon spotted frog habitat from 2000 through 2004. Cattle congregated in the Oregon spotted frog habitat because nearly every other water source in the allotment went dry. Trampling by cattle and alterations in water quality, bank structure, and loss of protective vegetation compounded the impacts of the reductions of available habitat due to drought conditions on Oregon spotted frog reproduction.

Severe erosion caused by livestock or other anthropogenic means contribute to downcutting segments of creek, exposing raw banks, reducing the sinuosity, increasing flow velocities, lowering local water tables, and making terraces out of former flood plains. Although riparian areas and meadows adjacent to downcut streams will become saturated during the snow melt season in normal precipitation years, the damaged channels will cause a drop in the water table adjacent to the channel much faster than normal, and may affect the life cycle of riparian vegetation, and the suitability for breeding for the Oregon spotted frog.

Drought conditions can occur on multiple year cycles, seasonally, and locally in the Klamath Basin. Drought conditions can occur on a local scale because the area hydrology and elevational differences can strongly affect local conditions. Local drought conditions can negatively impact Oregon spotted frogs in all life cycles, particularly in isolated populations occupying fragmented habitat. Seasonal drought affects populations to a greater extent by increasing the likelihood of egg mass desiccation and exposure to freezing, concentrating post-metamorphs and elevating predation risk, and increasing the impacts of epizootic events (Turner 1960, Licht 1974 and 1975, Kephart and Arnold 1982, Hayes 1998, Kiesecker and Blaustein 1997). Multiple year droughts carry impacts similar to seasonal droughts, but may expose populations to negative long-term impacts including decreased population numbers, potential losses in population heterozygosity, exacerbation of impacts from catastrophic events, and potential extirpation (which is more serious in isolated populations and metapopulations with remote chances of being recolonized).

Hayes (Hayes, et al, 1997) identified 38% of the Oregon spotted frog sites as having a moderate to high risk from drought (i.e., the potential for water level reduction that could reduce or eliminate suitable habitat). Sites with the highest risk frequently depended on surface flow and were located in areas with low annual precipitation. Sites in Oregon with the highest risk from drought are the Klamath and Deschutes Basins (Hayes et al. 1997).

Extreme temperature fluctuations most seriously impact populations by causing mortality during embryonic development. Although extreme temperature fluctuations are a natural phenomenon in the Klamath Basin, impacts can be exacerbated when populations become fragmented and connectivity is minimal or absent. Since extreme temperature fluctuations are uncontrollable, some reproductive years will have low recruitment. Intuitively, conservation of breeding adults should be a high priority, particularly if non-annually breeding populations are identified.

Naturally occurring events, such as disease, can strongly impact populations already stressed by other factors (e.g., drought or low food availability). Most Oregon spotted frog populations are small, and small populations that are already stressed by other factors, such as drought or low food availability, are more vulnerable to random, naturally occurring events. Amphibians are affected by a variety of diseases (Berger 1999), and some diseases are known to negatively affect declining amphibian species. Blaustein et al. (1994) suggested fungal pathogens from the *Saprolegnia* genus caused the decline of some amphibians in the Pacific Northwest. Amphibians exhibiting communal oviposition are thought to be more susceptible to pathogenic infections, such as *Saprolegnia* (Kiesecker and Blaustein 1997). However, information on specific effects of disease and parasitism in Oregon spotted frogs is lacking. Several dead fungal infected egg masses from the Jack Creek breeding habitat were collected and submitted for pathological analysis and results are pending.

Historically, some sites may have exchanged individuals through dispersal or emigration. Currently, connectivity among sites appears to be minimal. Therefore, geographic isolation is a major threat to most Oregon spotted frog populations. Natural recolonization was deemed to be unlikely in 82% of Oregon spotted frog sites due to their high degree of isolation. Current isolation of Jack Creek populations from the nearest populations is due to the spatially intermittent nature of the channel, with flows often submerging under the porous pumice, below the frog habitat (south and downstream of the Jamison property.) There also may have been other suitable habitat closer to the Jack Creek in the past before diversions (such as on Round Meadow and Seller's Marsh) or during wetter times with more groundwater that made other channel and meadow systems suitable habitat.

Genetic isolation could be a threat to some populations of Oregon spotted frog. DNA was analyzed from 20 of the known populations in Oregon and Washington. Analyses indicate that *Rana pretiosa* is subdivided into four main groups, with the Klamath basin group being the most distinct. Overall results indicate that low movement and/or substantial genetic drift occurs among populations. Perhaps the connection between Jack Creek population and its neighbors was better established with higher numbers of individuals within the populations.

In its 2003 candidate and listing priority assignment, USFWS deemed the Oregon spotted frog's listing priority as number 2 for the following reasons: the high magnitude of threat due to small populations with patchy and isolated distributions, and a wide range of threats to both individuals and their habitats, with some populations more vulnerable than others, and a loss of any populations will significantly reduce the range and genetic diversity of the species. Habitat restoration and management actions have not prevented a decline in the reproductive rates in some populations. The listing priority also points out that some habitat restorations are being initiated for some populations, especially on public lands.

In summary, the threats most pertinent to the Jack Creek population of Oregon spotted frog are: water quality deterioration, drought conditions, mechanical alterations of the riparian habitat due to livestock grazing, isolation geographically and genetically, vulnerability to pathogens due to limited amount of habitat, especially during drought years coupled with water quality and other stressors, conversion of marsh and meadow habitats to later successional stages as a result of fire suppression and lowering of water tables as well as absence of beavers to create new suitable habitat.

<u>What are the influences and relationships of Oregon Spotted Frog and their habitats with other ecosystem processes in the watershed?</u>

Oregon spotted frogs are preyed on in this system mostly by common garter snakes, but also by sandhill cranes, and great blue herons, and potentially by ducks, belted kingfishers, coyotes, red-tailed hawks, great gray owls, ravens, gray jays, Steller's jays and Clark's nutcrackers.

Spotted frogs appear to utilize prey associated with aquatic habitats more so than other ranid species. Tadpoles feed on algae, rotting vegetation and detritus. Juveniles and adults are highly opportunistic and eat a wide variety of insects as well as different mollusks, crustaceans and spiders.

Spotted Frog Reference Condition

The desired condition for frog habitat in Jack Creek is:

- Water quality meets or exceeds state water quality, or thresholds for frogs, whichever is higher.
- Stream banks are stable along Jack Creek.
- All occupied habitat (breeding, summer and overwintering) is protected from direct livestock damage.
- Habitat is improved or expanded by periodic inundations by beaver. Historically, higher populations of beavers in the area contributed to increased water retention and flooding, and likely supported larger populations of riparian communities (i.e. Hardwoods) compared to the current conditions.
- Summer, winter and breeding habitats are protected from human caused negative effects.

Spotted Frog Issues

- Spotted frogs in this watershed are showing marked declines from 1998 to present. Populations of several other wildlife species may be at risk.
- Water quality is often poor in Jack Creek in cattle allotment coinciding with the Oregon spotted frog habitat.

Spotted Frog Recommendations

- The perennial reaches of Jack Creek should be assigned a stronghold designation for protection of Oregon spotted frogs, (and Klamath speckled dace and lamprey?) as per the Framework for aquatic and riparian habitat management of the ICBEMP. The key processes that should be protected and monitored that are likely to influence the persistence of populations include water quality, Oregon Spotted Frog breeding sites, and overwintering areas.
- Adjacent private land with the largest Oregon spotted frog breeding sites, should be sought for public ownership (Moffit and Jamison). Other private lands with the potential for suitable habitat with some restoration activities should be sought for public ownership (O'Connor Meadow and Seller's Marsh).
- Grazing should be tightly controlled to allow for re-vegetation, healing of raw banks and changes in the stream profile, and improvement of water quality (especially in the cattle allotment). Specific recommendations include adhering to the stipulations of the permit with adaptive management based on consistent monitoring, adding upland water sources and fencing off degrading or susceptible stream sections and springs, possibly adopting a rotational grazing system, modifying numbers or length of seasons during drought years (or managing for "worst year" scenarios).
- Reintroduce beaver into the system using beavers that would otherwise be trapped and killed. Prioritize areas of reintroduction: places that the water table should be raised, or the water velocity slowed down, and are a distance from culverts that might be blocked by beaver activity.

Great Gray Owls

<u>What is the relative abundance and distribution of great gray owls that are important in the watershed? What is the distribution and character of their habitats? What are the current habitat conditions and trends for great gray owls?</u>

Most of the district's great gray owl habitat occurs within the Jack Creek watershed analysis area. Great gray owls inhabit mature to old-growth coniferous forest adjacent to openings, in this case mature lodgepole or lodgepole-ponderosa mixed stands adjacent to meadows that support abundant small rodents, especially voles and pocket gophers. Prime foraging meadows are grassy, wet at least in the spring but not completely inundated, and have numerous perches. Great gray owls cannot build their own nest, so therefore depend upon pre-existing nests including those built by red-tailed hawks, northern goshawks, stick nests made by squirrels, mistletoe clumps or natural or artificial nest platforms. Most of the larger meadow systems in this analysis area have had verified presence of great gray owls. There are several (exact number not known) artificial nest platforms that were erected near meadows for great gray owls in this analysis area, in the past. Some of these platforms are monitored by interested public annually to determine reproductive success. Some may be acting as sinks for reproduction if they deteriorate to the point that they are not able to support a nest.

The most recent systematic surveys for Great Gray owl presence and distribution was conducted in Jack Creek subwatershed in 2001 in all potential habitat of meadows and riparian stringers with adjacent mature coniferous trees. Occupancy was verified in at least nine separate territories. Few actual nests were located despite a great deal of effort.

There is limited, yet some site-specific information on reproductive success of great gray owls on the Winema National Forest. Sixteen great gray owl territories were monitored on the Chemult and Chiloquin in 1999, with two of those occurring in the Jack Creek subwatershed, but were not occupied in that year. The results of the monitoring of the 16 nests showed 8 territories unoccupied, one taken over by a red-tailed hawk, and 7 with nest attempts. Two nest attempts failed, and five produced young. There were 1.29 fledglings produced per nest attempt. Fledglings per successful nest on the Winema NF that year was 1.8, lower than other areas (2.3 in NE Oregon, 2.7-3.0 in Idaho and Wyoming, 2.8 in Manitoba), although the percent of nests that produced any young successfully on the Winema is typical of other areas. (Gerhardt, 1999) It is not known whether the figures from the other areas are from more than one season. Variability in reproductive success between years can be large for most owl species.

<u>What was the historical relative abundance and distribution of great gray owls and the condition and distribution of their habitats in the watershed?</u>

In the past, great gray owl habitat may have been more extensive in the Jack Creek area, between pine beetle epidemics and recovery of lodgepole to mature stands. Meadows were larger in the past with higher water tables, and periodic fire that maintained meadow systems. This compares with the current shrinkage of meadow areas with encroaching conifers due to fire suppression and less groundwater due to downcutting of channels, absence of beavers and several years of drought.

The extremely sandy, well-drained upland soils do not provide sufficient forage for the preferred prey species, voles and gophers, and do not provide suitable foraging habitat for this raptor.[15] Currently there are fewer meadows that exhibit adequate moisture to maintain the proper foraging habitat for great gray owls than in the past.

<u>What are the natural and human causes of change between historical and current species distribution and habitat quality for great gray owls in the watershed? What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?</u>

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[15] Richard Gerhardt, who has been studying great gray owls locally for many years. Personal comm..

The last pine beetle epidemic most likely greatly decreased nesting opportunities for great gray owls significantly for decades. Nesting platforms were erected as a stopgap measure until conifers adjacent to suitable foraging habitats got large enough to provide nesting substrate for red-tailed hawks and Northern goshawks, on which great gray owls depend. Although there may be more trees of appropriate size in this area for raptor nests, the seven great gray owl nests in 1999 were all on artificial platforms, and none of the four natural nest structures were utilized by great gray owls (with one being usurped by a red-tailed hawk.) Therefore maintenance and erection of artificial platforms may be warranted in the short term.

The extremely sandy, well-drained upland soils do not provide sufficient forage for the preferred prey species, voles and gophers, for the great gray owls, and do not provide suitable foraging habitat for this raptor. Currently there are fewer meadows that exhibit adequate moisture to maintain the proper foraging habitat for great gray owls than in the past.

Great Gray Owl Reference Condition

Long-term management for great gray owls should include promoting and retaining large trees and snags near meadows and other riparian areas. Meadows should not be de-watered, causing a shift in prey base and unsuitability for great gray owl foraging. Beaver inundation could expand the suitable habitat for great gray owls.

Great Gray Owl Recommendations

- Manage for sustained northern goshawk habitat. Great gray owls will benefit from goshawk habitat and goshawks' tendency to build more than one nest.
- Reintroduce beaver.
- Restore historic moisture regimes in meadows that support vegetation for prey species.
- Monitor and either maintain platforms, or remove those beyond repair that could cause a biological sink.

Northern Goshawks

<u>What is the relative abundance and distribution of goshawks that are important in the watershed? What is the distribution and character of their habitats?</u>

The reproductive home range of goshawks requires three components: foraging area, nest area, and post-fledging family area. The foraging areas consist of a forest mosaic including large trees, snags, and down logs interspersed with openings, that support a wide range suitable prey, specially ground dwelling species. Heavy shrub layers are believed to inhibit foraging by goshawks.

Goshawks often use alternate nests in different years. Nests are typically built in one of the largest trees within dense patches of large old trees, with canopies either single or multi-layered, and often close to perennial water. Nest trees in Oregon can be Douglas fir, true fir, Ponderosa pine, lodgepole pine, aspen or western larch.

Post-fledging areas surround nest sites and consist of a mosaic of large mid-aged trees and snags with large down logs and small openings, with an herbaceous understory. Goshawks alter their diet seasonally preying on passerines, grouse, squirrel species and hares at various times of year.

<u>What are the current habitat conditions and trends for goshawks?</u>

There have been multiple sightings of northern goshawks in the Jack Creek subwatershed, but goshawk surveys in the area (in 1991, 1995, 1996, 1997, 1998, 1999, 2000, and 2001) have discovered only four nest sites.

The Forest has set aside numerous management areas for this species, and will continue to protect nest sites and post-fledging areas for newly located pairs according to the "eastside screens".

What was the historical relative abundance and distribution of goshawks and the condition and distribution of their habitats in the watershed? What are the natural and human causes of change between historical and current species distribution and habitat quality for goshawks in the watershed? What are the influences and relationships of goshawks and their habitats with other ecosystem processes in the watershed?

Range-wide, this species is thought to be declining mostly due to fragmentation of mature forest habitat. Fire exclusion has also developed brushy conditions less favorable to goshawk foraging. Both phenomena are apparent in the Jack Creek area.

Northern goshawks have probably always been present in the Jack Creek area, but not in large numbers, and most likely fluctuated according to local conditions.

Periods following pine beetle epidemics have probably been detrimental to local goshawks, since there is a long period of recovery from early seral stages to mature stands. There has been substantial snag recruitment over the last decade in this area. Natural succession of young forests in the area will gradually improve local goshawk habitat, unless a major conflagration occurs.

Fairly recent management guidelines were designed to improve habitat for this species such as designating goshawk management area, restricting disturbing activities near active nests seasonally, reducing general volumes of timber harvesting and providing additional snags in goshawk foraging areas. These management guidelines should help improve local goshawk populations. However, goshawk nest sites and even goshawk responses during active surveys have proven to be difficult to detect. There are probably many goshawk territories that go undetected and therefore not protected using the guidelines mentioned above.

Goshawk Reference Condition

Large unfragmented patches of mature stands of forest (all types), with dense canopy closure, low amounts of brush, high amounts of snags and down wood.

Goshawk Recommendations

- Maintain and promote large trees and snags with large down wood.
- Manage for large patches of unfragmented mature forest with dense canopy closure (>50%) with small openings. By managing for northern goshawks, great gray owls will also benefit from habitat and goshawks' tendency to build more than one nest.

Neotropical Birds

What is the relative abundance and distribution of neotropical birds that are important in the watershed? What is the distribution and character of their habitats?

Habitat relationships of forest songbirds occupying lodgepole pine forests of central Oregon pumice zone were studied on the Chemult District of the Winema National Forest, and on the Fremont National Forest from 1995 to 1999,[16] including in the northern section of the Jack Creek subwatershed. The most common species of birds detected on the Winema National Forest in lodgepole areas were mountain chickadee, yellow-rumped warbler, chipping sparrow, dark-eyed junco and American robin. Surveys were conducted in stands that had been treated and reference stands for comparison of species composition on both forests. Hermit thrushes, gray flycatchers and

[16] Arnett, E.B. B. Altman, W.P. Erickson, and K.A. Bettinger, 2000 Final Report, Weyerhaeuser Company, Springfield, OR.

red-breasted nuthatches were significantly more abundant in reference stands compared to treatment stands. Bird species that were found to be more abundant in treatment stands compared with reference stands included dark-eyed juncos, American robins, dusky flycatchers, hairy woodpeckers and Cassin's finches.

Nesting success in both salvage-logged and reference stands were determined for 21 species. Most of the nests monitored (81%) were from 6 species: mountain chickadee, yellow-rumped warbler, dark-eyed junco, chipping sparrow, American robin, and dusky flycatcher. Nest success ranged from 30% in juncos to 70% in yellow-rumped warblers. Among nesting guilds, nest success was lowest for ground nesters (28.8%), highest for cavity nesters (66.1%) and moderate for open-cup foliage nesters (55.3%). Nest success was similar between treated and untreated units for 5 of the 6 common species. The sixth species, the American robin, exhibited higher nesting success in the reference stands compared with in the treatment stands.

Avian density was studied in harvested and unharvested stands of lodgepole in 1992. Dusky flycatchers, yellow-rumped warblers, chipping sparrows and Brewers sparrows showed higher densities in harvested stands. Mountain chickadees and hermit thrushes showed higher densities in unharvested stands.[17]

<u>What are the current habitat conditions and trends for neotropical birds? What was the historical relative abundance and distribution?</u>

In general, dry forests east of the Cascades were formerly under a fire regime that controlled extensive understory development. Currently eastside stands, including those in this project area, have dense understories. These dense understories tend to favor red-breasted nuthatches, Cassin's vireos, American robins, and spotted towhees.[18]

The amount of open old growth ponderosa pine forest that has been maintained by frequent, low-severity fires has declined by approximately 85% from historical conditions to present across the Pacific Northwest, and the Klamath Plateau and the eastern slopes of the Cascade have less than 5% remaining. Species associated with this community, such as the white-headed woodpecker and flammulated owl, and those linked strongly with fire affected forests such as Lewis's woodpecker, northern three toed and black-backed woodpeckers, mountain and western bluebirds have likely declined in abundance.[19]

Historically, the percentage of mature Ponderosa pine stands was much higher and supported neotropical species associated with old growth.

<u>What are the natural and human causes of change between historical and current species distribution and habitat quality for neotropical birds in the watershed? What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?</u>

Most of the bird species listed in the table below are declining due to loss or degradation of old growth ecosystems. Unnaturally dense understories threaten the remaining old growth structure with high fuel loading, and potential loss of large trees and snags used by most of these species.

A strategy for achieving functioning ecosystems for landbirds was identified in *Conservation of Landbirds in the East-Slope Cascades of Eastern Oregon and Washington* (2000). In this document, focal species were identified that are highly associated with important attributes or conditions within

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[17] Forbes, Todd. Nov. 9, 1992. Avian Densities in Harvested and Unharvested Lodgepole Pine, Central Oregon. 14 pp.
[18] Oregon-Washington Partners in Flight. May, 2001. Landbird Conservation and Management Activities Associated with Restoration of Dry Forest Habitats.
[19]Johnson, D. H. and T.A. O'Neil. 2001. Wildlife-Habitat Relationships in Oregon and Washington, OSU Press, Corvallis.

each habitat type. The rationale for using focal species is to draw immediate attention to habitat attributes most in need of conservation or most important in a functioning ecosystem. By managing for a group of species representative of important components in a functioning ecosystem, many other species and elements of biodiversity also will be conserved.

The focal species, habitat types and structures identified as priorities in the East Cascades Strategy are consistent with species of concern and habitats identified in the ICBEMP and this analysis. The following East Cascades focal species and habitat types are present or were historically present in the Jack Creek subwatershed.

East-Slope Cascades Focal Landbird Species

Species	Habitat Attribute
white-headed woodpecker	PP old forest-large patches
pygmy nuthatch	PP large trees
chipping sparrow	PP or LP open canopy with regeneration patches
Lewis' woodpecker	PP burned old forest
brown creeper	large trees
Williamson's sapsucker	large snags
flammulated owl	grassy openings, dense thickets
hermit thrush	multi-layered, structural diverse
olive-sided flycatcher	fire edges and openings
black-backed woodpecker	LP mature/old growth
Clark's nutcracker	Mature/old growth

Refer to Appendix C for specific requirements for these focal species.

Deer and Elk

(analysis in progress, more information to be added)

What is the relative abundance and distribution of mule deer and elk? What is the distribution and character of their habitats? What are the current habitat conditions and trends for mule deer and elk?

Mule deer and elk are common in the Jack Creek watershed. Riparian areas are important for fawning and calving.

Recent research on mule deer populations on the Winema National Forest and surrounding area suggests forage production has dropped dramatically since 1953.[20] Several studies observed an inverse relationship between canopy closure and herbage production.[21] As canopy closure increases, herbage production decreases. Tree stand density and canopy closure has increased dramatically over

[20] Peek, James M., Jerry A. Korol, and Brian C. Dennis. A Review and Analysis of Habitat Relationships and Mule Deer Populations in South-Central Oregon. Department of Fish and Wildlife Resources, University of Idaho. May 1999. page 30

[21] Peek, page 29

much of the area. Research estimated that the 4700-5300 foot elevation band was growing about 92 pounds of forage per acre in 1988. The estimate for 1953 is about 204 pounds of forage per acre. This is a decline to <45% of that in 1953.

Deer and elk are important subsistence species for the Klamath Tribes who have hunting, fishing and gathering rights on the former Klamath Indian Reservation.

Yellow Rails

What is the relative abundance and distribution of yellow rails that are important in the watershed? What is the distribution and character of their habitats?

The best potential for yellow rail habitat in the project area, is the newly restored Round Meadow wetland. Surveys were conducted in 2004, but may have been conducted too late in the season to detect rails that were territorial earlier in the season, or the habitat could become occupied in the future.

Yellow rail habitat is considered to be shallow wetlands that are permeated with water year round. Nesting habitat is characterized by being a wet sedge meadow with standing water up to 30 cm deep. Rails are associated with cold water springs or seeps along a creek or a floodplain along a larger river.

There are about 235 to 285 pairs breeding in Oregon, which is geographically restricted to a small portion of the state and disjunct from the main population east of the Rocky Mountains. Yellow rails are a Region 6 USFS sensitive species.

Opportunistic surveys in the Jack Creek area have been conducted in the best potential habitat, and no yellow rails have yet been detected.

What are the current habitat conditions and trends for yellow rails? What was the historical relative abundance and distribution?

Yellow rails have been on a recent downward trend mostly due to habitat conversion, and in absence of beaver in historic sites. However, with restoration projects to improve wetlands, this trend may be slowly reversing. Yellow rails had nested at the then private Wood River (farther south in the Klamath Basin) in the past, and abandoned the site after it was ditched, diked and drained. After the Bureau of Land Management later acquired this land and restored the wetland, yellow rails recolonized the restored area.

Historically yellow rails nested in eastern California and southern Oregon. It was generally agreed that breeding populations of this species had been extirpated from the west. Recent surveys by Stern 1990 found five yellow rail eggs in a meadow north of Agency Lake (Wood River wetland), these eggs provided the first documentation of breeding yellow rails west of the Rocky mountains since the 1950's (Stern 1990). Yellow rails have also been found on Upper Klamath Marsh.

When water tables were higher in the past, and beavers were present in the system, the Jack Creek area probably sustained a population of yellow rails.

Loss of nesting habitat due to agricultural practices has occurred through the last century throughout the yellow rail’s range. Draining wetlands and lowering of the water tables in areas has caused the ground to be less saturated by water during long periods of time in the spring and summer (Stern 1990).

Locally, drying out of meadows, and lowered water tables have probably affected yellow rails in the Jack Creek area. Beavers would have created new habitats with shallow waters and prolonged saturated areas.

What are the natural and human causes of change between historical and current species distribution and habitat quality for yellow rails in the watershed? What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

Loss of nesting habitat due to agricultural practices has occurred through the last century throughout the yellow rail's range. Draining wetlands and lowering of the water tables in areas has caused the ground to be less saturated by water during long periods of time in the spring and summer (Stern 1990).

Locally, drying out of meadows, and lowered water tables have probably affected yellow rails in the Jack Creek area. Beavers would have created new habitats with shallow waters and prolonged saturated areas.

Fish

What is the relative abundance and distribution of fish that are important in the watershed? What is the distribution and character of their habitats? What are the current habitat conditions and trends for fish?

The only fish species present in Jack Creek are native Klamath speckled dace (*Rhinichthys osculus klamathensis*) and Miller Lake lamprey (*Lampetra minima)*. There are no records to indicate that Jack Creek was ever stocked with introduced species.

Speckled dace (Rhinichthys osculus)

Speckled dace is the only fish native to all western drainage systems from Canada south to Sonora, Mexico. In the western United States no native fish species is as widely distributed or occupies such a wide variety of habitats as the speckled dace. In Oregon, speckled dace is the most frequently occurring freshwater fish (Pfrender et al. 2001). The Klamath speckled dace (*R. o. klamathensi*s) is found in the Klamath River drainage. Although dace are generally found in small streams, thriving in shallow (<60 cm), rocky, riffles and runs, they can occupy an array of habitats: small springs, pools in intermittent streams, large rivers and deep lakes. Their numbers may actually increase in streams that have been channelized or have reduced flows because this can increase the amount of shallow riffle habitat that they prefer (Moyle 2002).

Dace are generally characterized as bottom browsers feeding on small invertebrates. Dace usually mature in their second summer with females producing 450-2000 eggs in a season. They can spawn throughout the summer, but most spawning occurs in June and July. Spawning activity is likely induced by rising water temperatures. In intermittent streams, spawning may be induced by high flow events (Moyle 2002). Dace adapted to warm water are tolerant of fairly high temperatures. In the laboratory, Klamath speckled dace can survive temperatures of 28-34^{o}C and dissolved oxygen levels as low as 1 mg/liter (Moyle 2002).

Pfrender et al. (2001) examined genetic diversity of speckled dace populations in Oregon. They differentiated three groupings of speckled dace populations within the Klamath basin. Two populations, Sycan and upper Williamson rivers, show a close association. A second grouping is formed from populations found in Antelope Creek (Lost River drainage), Jack Creek and Spencer Creek. This group is closely allied to the Sycan and Williamson rivers group. The third speckled dace group, from the furthest downstream population, Jenny Creek, is the most divergent population. Lorion et al. (2000) speculated that the current distribution of Miller Lake lamprey (*Lampetra minima*) is consistent with a historical connection of the upper Sycan and Williamson rivers. The close relationship between the dace populations in these two rivers provides further support.

Lamprey (Lampetra (Entosphenus) spp.)

The landlocked Pacific lamprey populations live in lakes and reservoirs and have been described as separate species. They are found in the Klamath River, Upper Klamath and Agency lakes and in the lower ends of the major tributaries where they migrate to spawn. In the upper Klamath drainage there are five named species: two nonparasitic forms *(Lampetra lethophaga* and *Lampetra folleti*) and three parasitic (predatory) forms: *Lampetra similes;* a nonanadromous form of *Lampetra tridentata;* and *Lampetra minima,* a species thought to be extinct. The dwarfed, parasitic Miller Lake lamprey, *L. minima*, was exterminated by chemical treatment of Miller Lake in 1958.

In 1992, an adult lamprey collected in the Williamson River above Klamath Marsh was identified as *L. minima.* In 1996, two small lamprey were collected from the lower reaches of Miller Creek. Concern for this species, once thought to be extinct, prompted consideration of emergency listing under the Federal Endangered Species Act (ESA). The immediate need to list was avoided when US Fish and Wildlife Service and Oregon State University researchers conducted subsequent surveys in 1996, 1997-1999. These surveys reconfirmed the species extinction in Miller Lake, but led to the discovery of several populations of *L. minima* in Miller Creek, the upper Williamson River drainage and the upper Sycan River drainage above Sycan Marsh (Lorion et al. 2000).

The Miller Lake lamprey, endemic to the Klamath Basin, is the world's smallest predatory lamprey, maturing at less than 4 inches. Its current distribution is from two small sub-drainages of the upper Klamath Basin; the upper Williamson and upper Sycan rivers. The upper Williamson River drainage contains four known populations (Miller Creek, Jack Creek, Klamath Marsh and the Williamson River above Klamath Marsh). Miller Creek is believed to be isolated from the Williamson River since the eruption of Mt. Mazama (Crater Lake) over 6,000 years ago. Jack Creek has limited, if any, connection to the Williamson River due to low surface flows. The upper Sycan River populations are found in Long Creek, the Sycan River above the Sycan Marsh and the Sycan Marsh itself.

Miller Lake lampreys occupy relatively cool, clear streams. Adult lamprey spawn in shallow redds in clean gravel and sand. Time to hatching is not known but is probably a few weeks. Larvae (ammocoetes) emerge at about 8mm and move into fine sediments. Ammocoetes have no eyes or teeth and are purely filter feeders, feeding on detritus and algae. Ammocoetes of different species are difficult to distinguish. The ammocoete phase lasts about 5 years, during which time the ammocoete grows to about 150 mm. Adult (predatory) lamprey live only a few months before spawning and dying.

A Conservation Plan for Miller Lake lamprey is currently being prepared by Oregon Department of Fish and Wildlife (ODFW *in draft* 2004). The Miller Lake lamprey is of considerable conservation concern due to:

- its relatively limited range in two small sub-drainages of the Klamath basin
- its continued absence in the ecologically unique setting of Miller Lake, the type locality
- its evolutionary distinctiveness as the smallest known predatory lamprey in the world.

Human Uses

Major Human Uses

<u>What are the major human uses, including tribal uses and treaty rights? Where do they generally occur in the watershed?</u>

Current human uses in the Jack Creek area can be categorized by timber production and firewood gathering, grazing, hunting and recreation, and tribal uses.

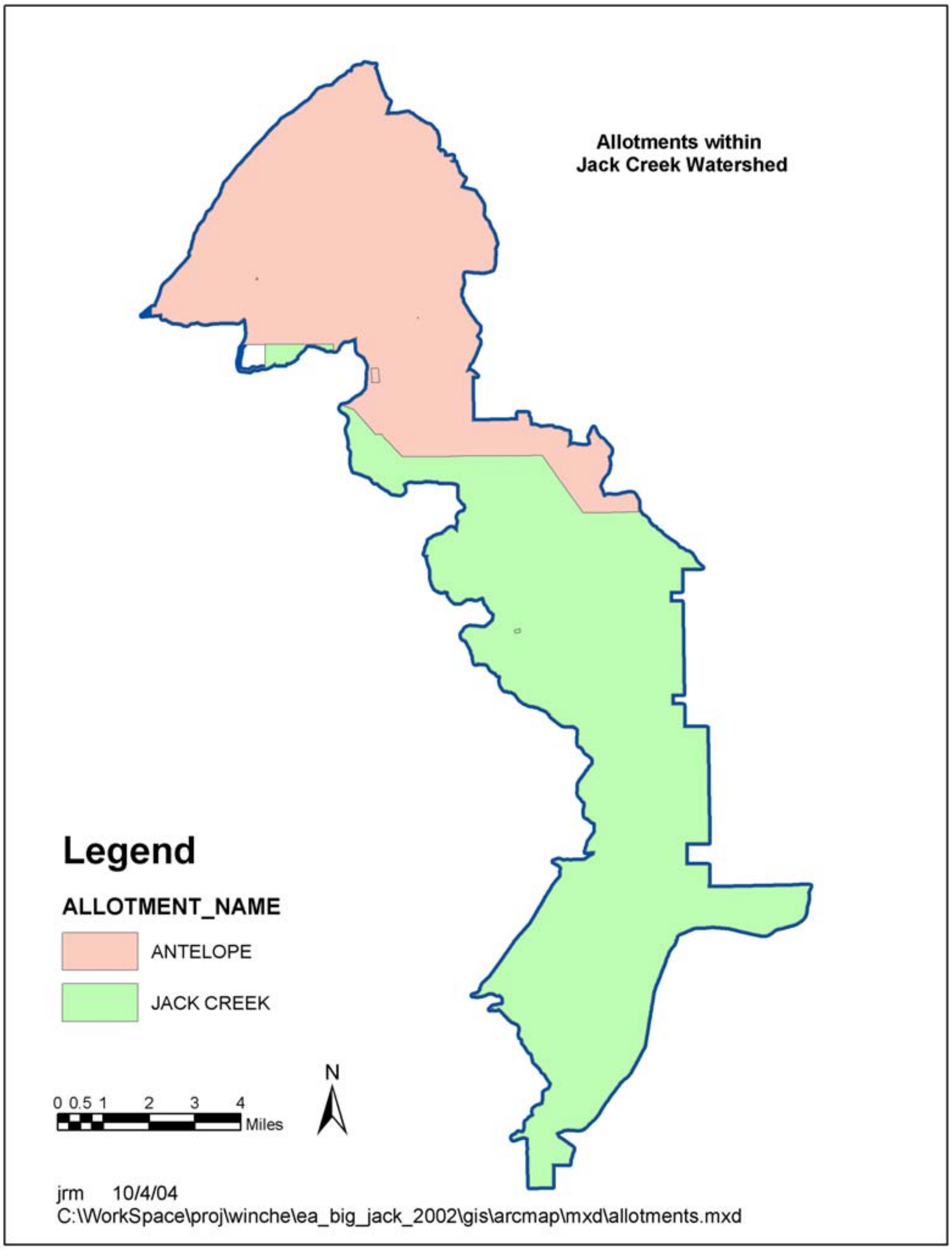
Timber Production and Firewood gathering

Timber production and firewood gathering has been sporadic since the early 1900's Timber production drastically increased around the 1940's during the second world war. Fairly large harvests in short time frames were conducted during this early period. The next significant period of harvest was between the late 1970'through the mid-1980's. A number of timber sale projects since the 1980's have harvested timber in the Jack Creek vicinity. The lodgepole pine in the northern end of the project area was the victim of pine beetle attacks in the mid-1980s and resulted in large-scale salvage projects to remove dead and utilize the material. The southern portion of the watershed has a greater percentage of ponderosa pine, and was not as affected by the outbreak of beetles.

Firewood cutting activities in the subwatershed was not very significant until the mid-1980's, when sources closer to major population centers were depleted. Prior to Forest Service administration, most firewood gathered was ponderosa pine. Since the early 1980's, the species collected is lodgepole pine on the Winema National Forest in response to concerns of the loss of this resource for cavity nesters and roosting perches for raptors. The Klamath Tribal members are allowed to collect firewood on former reservation lands. The southern 1/3 of the watershed was within the Reservation, and tribal woodcutters have been seen collecting firewood in the watershed. It is unclear how widespread the activity is since there are no records available and only anecdotal information concerning the activity. No free-use firewood areas have been setup in the Jack Creek watershed in the recent past, but several firewood salvage sales have operated in the northern half of the watershed. Here dead and downed lodgepole has been sold in an attempt to remove fire risk, and improve meadow habitats.

Grazing

There are two livestock allotments that take in all the Jack Creek watershed. The Antelope Cattle and Horse Allotment is in the north end of the watershed and the Jack Creek Sheep allotment is in the south end.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Jack Creek Watershed
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Recreation/Hunting

The major recreational use on the public lands of the Jack Creek area is dispersed recreation. There are no developed campgrounds within the planning area, though Indian Spring has picnic tables and a pit toilet. The vast majority of the dispersed recreation relates to hunting, then firewood gathering. Other minor activities probably include sightseeing, horseback riding, snowmobile riding and birdwatching. There are no developed and maintained trails in the watershed. Johnson Guard Station is the only standing structure in the watershed, and it does get used during hunting season as a campsite. The cabin is available to the public to camp in during bad weather, and eventually, it may be put on the Recreation Cabin Rental program along with a few others outside the watershed. Johnson Meadow Guard Station was scraped and painted recently as part of the Passport in Time project by volunteers. Walker Mountain Lookout is at the edge of the watershed, and lies on Deschutes National Forest lands. Its historic nature and expansive overview of the area attracts some visitors to the summit. The 1915 stone cabin has been restored in the last few years by Passport in Time Volunteers as has the garage and eventually the lookout tower itself. The road access to the lookout lies partially within the Jack Creek Watershed.

Dispersed campsites tend to cluster around water sources, making hotspots of places along the only perennial stretch of Jack Creek, and springsand riparians throughout the area. These areas have seen increased dumping of trash, disturbance of wildlife, soil damage, numbers of human-caused fires, presence of semi-permanent human-made structures, and potential degradation of water quality associated with human waste. Dispersed campsites include Bullfrog Spring, Cabin Spring, Davis Flat, Dempsey Spring, East Johnson, Huckleberry Spring, Jack CreekCorral, Yellowjacket Spring, and Wilshire Meadow. Other camping areas in the Jack Creek Watershed include Indian Spring, Kicking Horse Spring, and Johnson Meadow.

Tribal Uses

Traditional uses of the Klamath Tribes include subsistence plant gathering, hunting, firewood gathering, camping, and spiritual activities.

It is known that hunting and firewood gathering are presently taking place. These occur within the portion of the watershed that was part of the Klamath Indian Reservation. Here the tribal members are free to hunt and collect plants and wood without needing permits or being limited by State laws. This follows from their treaty that assured traditional gathering rights, and was supported by court judgments. (see hunting and timber sections below) It is unclear to what extent tribal camping, subsistence plant gathering or spiritual activities are taking place within the Jack Creek watershed. However, subsistence plants known to be used by the Klamath are not common in the watershed. Camping may be taking place, but no requests to the Chemult District for permitted sole use during traditional camping periods have been forthcoming from any tribal members as they have in other places nearby.

Current Conditions and Trends

What are the current conditions and trends of the relevant human uses in the watershed?

Timber Production/Firewood Gathering

Logging in the watershed has diminished since salvage of dead trees caused by the pine beetle epidemic. However, the recent trend to harvest and thin small timber will result in an increase in activity in the watershed. Many areas of plantations are in need of thinning, and natural stands are becoming choked with small to medium sized trees. A move to cutting smaller trees from around larger old growth trees has resulted in an increase in volume harvest recently in similar areas of the

Chemult Ranger District. It is likely that timber harvest will increase in the near future until stands can be stabilized at a density that will support key wildlife species and protect the larger trees from wildfire. At some point a leveling off of harvest will occur as a maintenance thinning program will take over. Fuelwood gathering will also increase as the need to remove dead, dying and down lodgepole has been recognized. This too will level off in the future to a maintenance level.

Grazing

The 1984 Allotment Management Plan and the 1995 Antelope Allotment Environmental Assessment set management standards for two cattle term grazing permits. The permits allow up to 365 cow/calf pairs. The livestock grazing season operates from July 1 to September 30 each year. The 1971 Allotment Management Plan sets management standards for the sheep term grazing permit. The permit allows up to 2,000 sheep from June 1 to September 30 each year.

Budget reductions and shifts in priorities have brought about several changes in the administration of the two allotments in the Jack Creek watershed in the past decade. Allotment management plans (1971 and 1984) are outdated. The number of people in the range program and amount of range dollars has decreased. Priorities for their limited time and range improvement dollars are given to other allotments with threatened and endangered fish issues. As a result, permit administration, monitoring and improvement projects on the Jack Creek sheep allotment and the Antelope cattle allotment have decreased. There has been a corresponding decrease in permittee responsibility to self-monitor. Allotment records indicate that annual operating plans included monitoring instructions and forms for permittees. Permittees were required to turn in written reports on stubble height measurements and movements on bi-weekly intervals during times of use. Current annual operating plan for the sheep allotment specify that allotment diary and grazing use records is not necessary. The cattle allotment annual operating plan does not specify if permittee monitoring is required, or what that requirement would be.

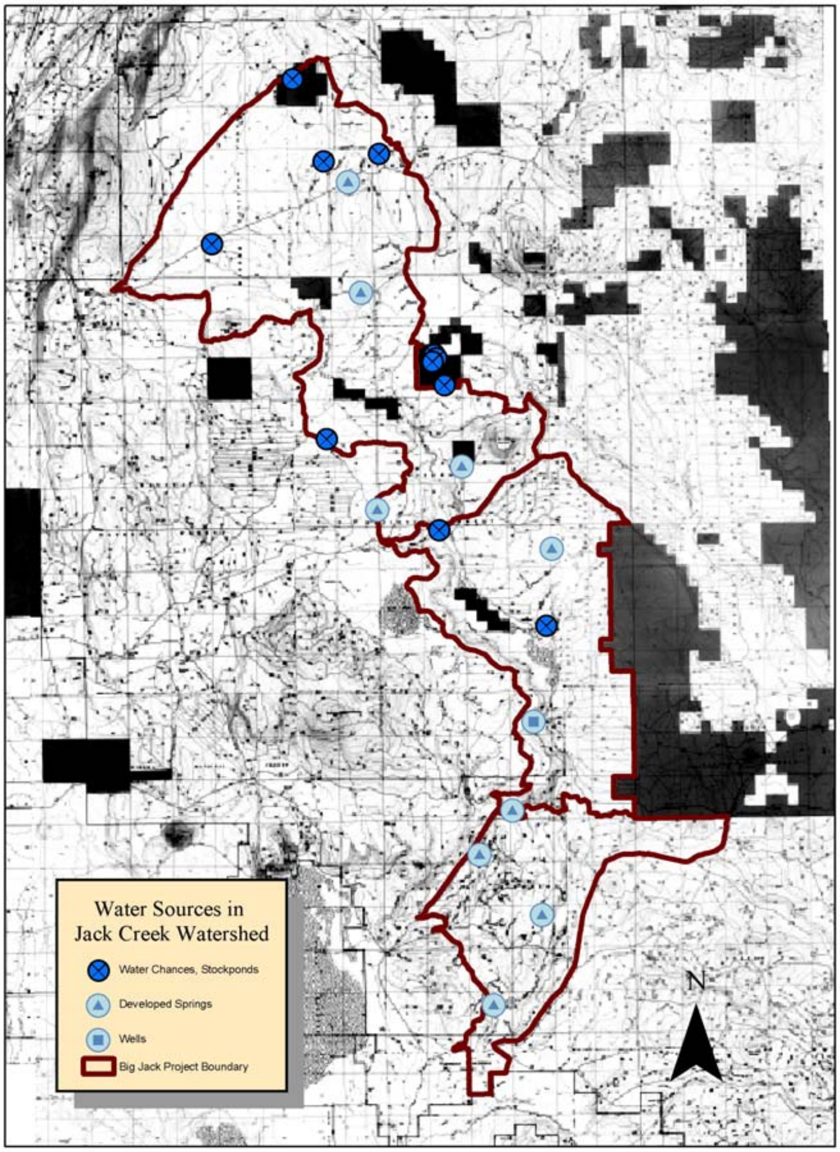
Cattle drink primarily out of natural waters. The cattle often rest and feed in close proximity to water sources. This leads to chronic overgrazed spots near certain water sources, increased bacterial contamination in the water, puddling damage on wet soil conditions around springs, and bank damage along the creek.

There are several water developments and headcut repairs in the Jack Creek Watershed. There are 19 water holes (ponds and pumper chances), ten improved springs, and one capped well. Currently there are no properly functioning spring exclosure fences or developed springs in the Antelope Allotment. The Huckleberry and Cleary spring developments in the sheep allotment are in need of repair. Most binwalls are washing out and in need of repair.

Water sources tend to dry up as the grazing season progresses. These can vary greatly from wet seasons to dry seasons as well. Natural waters are very limited during drought cycles. Water availability limits cattle distribution across the allotment.

Although upland plant communities were never highly productive forage areas, the high percentage of clearcuts (about 36%) and openings from natural mortality historically provided a significant amount of forage in the cattle allotment. Upland forage production has dropped dramatically from competition with tree seedlings, saplings and poles. Currently the cattle allotment is essentially completely dependent on riparian communities for forage production.

The cattle allotment is being managed as open pasture all season with salting and riding being important tools to manage cattle distribution. Heavy lodgepole regeneration in the uplands and meadows, as well as large amounts of dead, down lodgepole in and around meadows make it extremely difficult to effectively move cattle. There are chronic hotspots apparent that are overgrazed while other areas that show little use.


Water Sources in
Jack Creek Watershed
Water Chances, Stockponds
Developed Springs
Wells
Big Jack Project Boundary
N

Recreation and Hunting

Recreational activities are at a low level in the watershed. It is likely that these will remain at a low level into the future. There are no plans for trail construction, campground development, interpretive sites, or other amenities that would attract recreationists. The development of Johnson Meadow Guard Station as a recreation rental is the only proposal that is in the conceptual stage. This would add only a minor amount of recreation activity.

Hunting is likely to remain unchanged through the present and into the future. Changes in deer and elk populations and changes in allowable harvest of the animals by the State of Oregon are the greatest impact to hunting activity in the area. Dispersed camping in meadows and along water in Jack Creek area is a problem, but is being addressed with a plan to remove hunting camps out of the meadows, providing cleared camping areas on the upland edges of the meadows, closing roads into the meadows and removing trash and rock rings in the meadows. This should have a positive impact on the meadow and water health of the area, but should not impact the hunting volume in the watershed.

Tribal Uses

Tribal use within the watershed appears to be stable, though utilization numbers are very difficult to determine. Hunting and woodcutting are the primary activities in the area.

Major Historical Human Uses

<u>What are the major historical human uses in the watershed, including tribal and other cultural uses?</u>

Traditional Uses of Indigenous Peoples

Jack Creek lies within the traditional territory of the Klamath Indians of Southwest Oregon. Northern Paiute and Shoshone tribes were located immediately east of the Jack Creek Watershed in the Silver Lake area. It is possible that both groups utilized the watershed in the recent prehistoric era. Jack Creek is a tributary to the Upper Williamson River. The Williamson River, Klamath Marsh, Klamath Lake and Klamath River were very significant to the Klamath Tribes. Village sites were concentrated around the Klamath Marsh, lake and river as well as the meadows adjacent to the Upper Williamson River. The Marsh and meadows around the Upper Williamson River provided plant and animal foods and products that maintained the Klamath Indian way of life.

Subsistence

Klamath Marsh provided foods and products from wocus (pond lily), cattail, and tule that were essential to the Klamath. Wocus seeds were a major food source as was cattail root and tule sprouts. The tule, cattail and other marsh grasses, rushes, and reeds provided clothing, housing, bedding, mats, basketry and other items. The bird life on the marsh provided food as well as feathers and down used in clothing and bedding. Fish runs on the Klamath River, Williamson River and fishing in the lake provided food as well as products from fish bone and scales. Scales were used in forming glue that was used in hafting of arrowheads, spearheads, knives, scrapers and other items in antler or wood handles or shafts.

Upland habitats provided foods and products from trees, shrubs, and game. Wood was used in housing frames and canoes and paddles. Paddles were made of cedar, canoes were made of fir. Pine was used in housing. Ponderosa pine was preferred for twirling fire starter sticks. Juniper was used for bows, drums and basketry. Cedar was also used for basketry and fire starting blocks. Ponderosa and lodgepole pine cambium was harvested and eaten as a starvation food or a tasty treat depending on the informants asked. Yampa camas and arrowroot are found in riparian upland areas. Root crops such as bitterroot and biscuit root were collected in rocky scabflats within the forests. Berries collected in upland habitats included huckleberries, currants, chokecherries, and serviceberries.

Traditional berry grounds were in the uplands of the Cascades, specifically in the Huckleberry Mountain area southwest of Crater Lake National Park.

Few of these plants occur in the Jack Creek watershed. Bog huckleberries occur along the creek bottoms, but are not prodigious berry producers. Scattered yampa plants have been found in the Jack Creek watershed, but not in the densities needed to make collection economical. These are found in quantity on the Silver Lake and Chiloquin Ranger Districts where seasonally wet scab-flat openings and meadow stringers are common. Wocus is found in some pond areas along Jack Creek, but generally only scattered plants. Lily Camp at the south end of Bullfrog Meadow is one concentration area, but of small size. Camas and arrowroot do not occur in the Jack Creek watershed, and scab-flat habitat for bitterroot and biscuit root does not exist here. It is likely that the pumice depths in the project area have eliminated the habitat for many of these plants within the watershed. Several ponderosa pine trees have been found in the Jack Creek Watershed from which cambium had been removed. These trees exhibit scarring that is particular to this harvesting technique.

Animals that may have been used for food by the Klamath and Paiute peoples in the project area include deer, elk, and rabbit. Bear, cougar, bobcat, badger, raccoon, and marten may have been hunted and collected for food and/or furs in the watershed. Some waterfowl is also found, but not in any great number and not consistently in any one place. Round Meadow is one area where waterfowl would have been more common and may have been hunted. Jack Creek does not flow into the Williamson River except in extreme runoff years. The 7,000 year-old deep Mazama pumice deposits in the area absorb the water, leaving the upper stretch isolated from the rest of the watershed. Fish species in Jack Creek consist of speckled dace and lamprey eel. Both species are too small to make collection for eating feasible.

Religious/Spiritual Uses

The Klamath and Paiute peoples revered the landscapes and features of the landscapes as sacred items. Yamsay Mountain, Saddle Mountain, Crater Lake and other places were scenes of mythic events and creation stories. These places are today seen as integral to the maintenance of the traditional spirituality. They are visited by tribal individuals in reverence to the place they hold in the Klamath mythology. High places with views of these sacred peaks and places were often visited and rock cairns stacked during vision quests or simply out of reverence to the locations. There are no known such highly revered points within the Jack Creek watershed. However, there are a few rocky outcrops with expansive views that have prehistoric rock cairns placed on them.

Archaeological Evidence

Large village sites and lithic scatters are located around the edges of the Williamson River meadows. The lower reach of Jack Creek flows into privately owned pasture along the Williamson River. Several large lithic scatters have been found in the forest edge. Stone tools used for hunting and plant food processing were found in these sites. Further up Jack Creek, north of the Silver Lake Highway, prehistoric sites drop off rapidly. A few lithic scatters are found near Jack Creek in the central portion of the watershed, one of which was a basalt quarry site of cobbles in the creek bed. Here flaked stone tools were made from the hard tough rock for use in chopping, scraping, and hunting. Basalt flakes occasionally show up in other sites, and are likely from the reworking of tools that originated from this area. No obsidian source areas are located within the Jack Creek Watershed. In the northern portion of the watershed a few scatters are located near major meadows, but these are uncommon. Scattered individual stone tools and rock features are found in the area indicating some minor utilization in the prehistoric period. It may be that Jack Creek was utilized as a north to south travel corridor between the Klamath Marsh and the Deschutes River Basin. In early historic times, the Klamath Trail passed along the general route of Highway 97, through Chemult to the Lower Deschutes. This route is very dry along a long stretch and Jack Creek may have been an alternate route where water was more plentiful. However, it is clear that the majority of the Jack Creek Watershed was quite peripheral to the main activities of the Klamath and Paiute Tribes.

Historical Uses

The historical uses of the Jack Creek Watershed include the activities of the Klamath Tribes during the Reservation period and the activities of the non-tribal peoples. The historic period starts in this area in the late 1820s, though the Klamath and Paiute peoples continued to perform a traditional way of life for many years later until and after the signing of the treaty setting up the Klamath Indian Reservation.

Exploration

The earliest documented contacts with the Klamath and Paiute peoples of the Klamath Basin occurred in 1825. In that year, McKay and his group from the Hudson Bay Company trapped beaver in the upper reaches of the Klamath Basin. Contact with the Klamath was limited and not well documented. In 1826 Ogden, also from the Hudson Bay Company passed through the Chemult area, visiting the Klamath Marsh and Klamath Lake areas. Ogden documented his travels in a journal that includes some ethnographic notes on the tribes encountered. Ogden mentioned foods, housing, dress, and behavior of the Klamath at this earliest of contact periods.

In 1843, John C. Fremont passed through the Klamath Marsh area, recording the events in his journal. Fremont passed along the Williamson River above the Klamath Marsh and into the Sycan Marsh area. In doing so, he and his troop must have passed near the confluence of Jack Creek and the Williamson River. It was not specifically mentioned however.

Klamath Indian Reservation

In 1864 the Klamath, Modoc and Yahooskin Band of the Paiutes signed a treaty with the United States Government setting aside a tract of land in the heart of the Klamath traditional area as a reservation for the tribes. A further signing with additional Chiefs occurred in 1865, and a re-signing in 1869. Congress ratified the treaty in 1870 setting aside one million acres as the reservation. Boundaries of the Klamath Reservation were hotly contested from the beginning. The tribes understood a “peak to peak” description of the Reservation including lands from the Cascade crest, east to Winter Ridge, Deadhorse Rim, as far north as Little Cowhorn and Hager Mountain and south to Klamath Falls. Surveys by the government limited the size of the forest following Township and Range lines that had not been laid out by the 1864 treaty signing. Eventual some lands were added in an 1881 survey. In the late 1890s, a survey was undertaken to identify the approximate Peak to Peak description, but this survey was never ratified by Congress. The Reservation as ratified included some of the most important Klamath lands including the Klamath Marsh, the east half of Klamath Lake, the Williamson and the lower Sprague Rivers, several significant spiritual sites, and a large swath of large ponderosa pine. The Bureau of Indian Affairs managed the reservation until 1954 upon the termination of the Klamath Tribes. At that time the reservation was divided in to lands to be retained as government lands and those to be sold. In 1961 much of the land was added to the National Forest system, while the Klamath Marsh was made a unit of the National Wildlife Refuge system. A large swath of land on either side of Highway 97 south of Chemult was sold to Crown Zellerbach Corporation as a tree farm. The funds from the sale were meant to buy out the allotments privately held by tribal individuals.

Travel

Travel systems began with the Klamath Trail of antiquity. Ogden and Fremont followed this route into the Klamath country, and it was basically the only route into the area until 1867. This route lies west of the Jack Creek Watershed. In 1865, J.W. Perit Huntington improved the Klamath Trail, clearing space for a rough wagon route from the Columbia River, south to Fort Klamath. This road was built to transport goods promised to the Klamath Tribes as part of the Klamath Treaty with the US Government. This route was maintained as a rough wagon road though the remainder of the 1800s to the late 1920s. In 1927, the Dalles-California Highway was constructed along the basic route of the Huntington Wagon Road. In the 1950s the road was updated and relocated in places. It is now the route of Highway 97.

In 1864 the State of Oregon was contracted by the Federal Government to build a wagon road from Eugene, over the Cascade Mountains, east to the Oregon-Idaho border. This was termed the Oregon Central Military Wagon Road. Highway 58 is a modern expression of this route, though relocated several miles north of the wagon route in the eastern Cascades. The OCMWR passed through Chemult, crossed the Klamath Marsh at Military Crossing, and headed south to the Sprague River, then on to Idaho to the east. The State of Oregon was granted alternate sections along the wagon road. One 160 acre parcel within the Jack Creek Watershed was granted to the State and the private corporation that purchased the construction and grant rights from the State. The land grant passed through the Klamath Reservation. Although the signing of the treaty predated the grant of the land for construction of the road, the ratification of the treaty by Congress lagged several years behind. The conflict caused by the claim of checkerboard ownership in the Reservation was to last in the courts until 1906. At this time a deal was worked out to consolidate the private ownership in the northeast corner of the Reservation, and provide payments to the tribes by the corporation that now owned the wagon road grant lands. This then became the Long-Bell Tract, named for one of the early entities, the Long-Bell Lumber Company, that acquired ownership of the land in the agreement. The Military Wagon Road did not cross the Jack Creek Watershed, but later roads off this significant road did eventually venture into the watershed.

In the early 1900s, a road was constructed starting near Beaver Marsh, and headed east along the approximate route of Forest Road 86, to Road 83 and down Road 83, crossing Jack Creek at the Jack Creek Corral location, then due east along what are now minor roads, north of Bear Butte, and east to Silver Lake. This was the first connection between the Klamath County section of Highway 97 with the Silver Lake area. Roads up Jack Creek into the meadows in the center of the watershed were quickly built. These accessed lands acquired by the public in the early 1900s. In the 1950s, the Lamm Railroad Grade, which crossed the Klamath Marsh about 15 miles to the south, was improved and hooked into the earlier route east of Bear Butte to become the Silver Lake Highway. This new highway crossed the lower portion of Jack Creek.

Railroads moved north from Klamath Falls to Kirk in 1909. From here a number of logging railroads extended to the north, east and west into timberlands of the Klamath Reservation and the Bear Creek Tract of the Crater National Forest (later Rogue River, then later yet, the Winema National Forest). In 1926, the railroad again moved north after a long legal battle between the railroad and the government, eventually crossing the Cascades to Eugene. Another line was built from Chemult to Bend in 1927. The expansion of the railroad made logging economical in the Chemult area including the Jack Creek Watershed. (See Logging section for more information on the this activity.

Logging

Logging in the Jack Creek watershed began in the 1930s. In 1926 the Southern Pacific Railroad grade was extended from Kirk to Chemult. At this time harvesting timber in the upper Jack Creek Drainage became financially feasible. Railroad grades and log truck roads extended from the sidings along the mainline to reach the timber. Several early tie mill sites have been found near the Jack Creek Watershed. These indicate the use of the area during the construction of the Southern Pacific or the Northern Pacific Railroads.

In 1924 the Klamath Reservation sold the timber north of the Klamath Marsh to the Fremont Lumber Company, which was a subsidiary of the Shevlin-Hixon Lumber Company of Bend. The North

Marsh Unit included the west half of the Jack Creek Watershed within the Klamath Reservation. It was one of the largest of the Klamath Reservation sales at over 54,000 acres and 185 million board feet. This company sold its rights to the timber in 1927 to the Forest Lumber Company. The Forest Lumber Company was ready to start logging in 1936, but the company went under due to a mill fire. The company sold the timber to the Chiloquin Lumber Company who cut the timber from 1937 to 1946. The North Marsh Timber Sale was a truck to rail system. A primary railroad grade was built from the Manzanita Siding on the mainline around the north end of the Klamath Marsh to a camp on Mosquito Creek. Logs were trucked over roads from the cutting units to the grade where they were reloaded onto the train and sent by rail to the mill in Chiloquin. The 6,000 acres of the sale within the Jack Creek watershed was cut between 1941 and 1945.

The east half of the watershed was harvested as part of the Little Yamsay 1 and Little Yamsay 1A sales. These were truck to rail sales, and no railroad grades were built in the sale areas. These were cut between 1946 and 1953. The Chiloquin Lumber Company continued the logging operations after finishing the harvest of the North Marsh Unit. It is unclear whether the logs were transferred to the railroad cars at the old Mosquito Creek Camp or if they were trucked on into Klamath Falls by roads. A total of 4,300 acres of the sale was within the Jack Creek watershed.

In the 1930s a truck road was constructed from the Beaver Marsh area, east into private lands owned by the Big Lake Box Company. Logs were trucked from the private timber lands to the Diamond Lake Siding on the Southern Pacific Mainline. From there they were shipped by rail to the mills in Klamath Falls. Big Lake Box Company eventually cutover its lands in the Jack Creek area and exchanged the lands in 1943 for timber harvesting rights on National Forest lands. Within the Jack Creek Watershed, 1849 acres were exchanged to the National Forest. In addition, 320 acres of adjacent National Forest land within the watershed were cut by the Big Lake Box Company in the exchange.

The Shevlin-Hixon Lumber Company acquired lands in Northern Klamath County through the 1920s through 1930s. The company purchased the timber cutting rights to the North Marsh Unit on the Klamath Indian Reservation in 1924 and accumulated adjacent lands north of the Reservation to develop an economic block of timber land to harvest. In 1927 it sold the rights to the Forest Lumber Company but held the lands acquired north of the Reservation. From 1942 to 1947 the company operated a camp and logged the Summit Stage Station area along Highway 31 in northernmost Klamath County and southernmost Deschutes County. By 1947, the company had finished logging lands in the Deschutes and Klamath County north of Chemult, and moved operations to the Chemult Block. However two land exchanges in 1945 and 1946 transferred all the Shevlin-Hixon lands in the Chemult area to the Fremont National Forest. The lands were evidently exchanged for timber cutting rights in the Summit Stage Station area where the company was active in 1945 through May of 1947. Shevlin-Hixon must have retained the timber harvest rights to the Chemult Block lands, allowing the logging that took place from 1947 to 1950. In 1950, Shevlin-Hixon sold its holdings in Central Oregon to the Brooks-Scanlon Lumber Company of Bend, Oregon. Brooks-Scanlon continued cutting operations from 1950 to 1953 when it moved the camp and operations to Sisters, Oregon.

Federal Land Management

In 1891 Congress passed the Organic Act allowing for the creation of Forest Reserves to be managed for steady future timber production, water protection, and protection of significant features. In 1893 the Cascade Range Forest Reserve was created. This large swath of land stretched from the Columbia River, south to near the Oregon-California border. It included lands on both sides of the Cascade crest including Crater Lake. In 1902 Crater Lake National Park was carved from the Forest Reserve. In 1903, large swaths of forest lands in south-central Oregon were recommended for Forest Reserve designation. In 1906 the Goose Lake Forest Reserve and the Fremont Forest Reserve were created. These include what is now the Fremont National Forest, the northern two-thirds of the

Chemult RD, and the southern halves of the Crescent and Fort Rock Ranger Districts. In 1907 Forest Reserves were renamed National Forests. The two National Forests were combined in 1908 as the Fremont National Forest. At that time areas near Chemult were transferred to the Umpqua National Forest.

In 1911, portions of the Umpqua, the Fremont, the Crater and the Deschutes National Forests were combined to create the Paulina National Forest with headquarters in Crescent, Oregon. This forest stretched from the crest of the Cascades, east to Silver Creek near the town of Silver Lake, and from the boundary of the Klamath Reservation, north to the Township 22-23 line. It included what is now the Chemult RD of the Winema NF, the Crescent RD and half of the Fort Rock RD of the Deschutes NF, and western half of the Silver Lake RD of the Fremont NF. The Paulina NF was short lived. In 1915 the forest was again split between the Deschutes, Crater and Fremont National Forests with the Umpqua portion going to the Deschutes. The forest boundaries from 1915 to 1961 remained relatively stable with some minor boundary changes between the Deschutes and Fremont forests. In 1954, the Klamath Tribes were terminated as a recognized tribe, and the reservation was held by US Bank in trust.

In 1961 large portions were added to the National Forest System. With the addition of the lands, some redistribution of management was needed. It was decided that a new National Forest, the Winema would be created with headquarters in Klamath Falls. In addition to the former reservation lands, the Klamath Ranger District of the Rogue River National Forest, and portions of the Silver Lake Ranger District and Crescent Ranger District would be added to the new Winema NF. Three Ranger Districts were created for the new forest. The Chiloquin RD was cut entirely from former reservation lands, the Klamath RD was entirely old Rogue River NF lands, and the Chemult RD was created from about equal portions of the former reservation, and the Rogue River, Fremont and Deschutes National Forests. The Winema National Forest lasted as a distinct entity until 2002. At this time the Fremont and Winema National Forests combined to form the Fremont-Winema National Forests.

The Jack Creek Watershed has been a portion of the Fremont National Forest from 1906 to 1911, part of the Paulina NF from 1911 to 1915, again the Fremont NF from 1915 to 1961, and the Winema and Fremont-Winema from 1961 to present. Within the Jack Creek Watershed were several administrative structures meant to enhance management of this remote area. Two fire lookouts were located at the edges of the watershed. Walker Mountain Lookout was constructed initially by the Deschutes National Forest in 1914, and staffed as a primary lookout into the 1990s. The lookout site lies entirely on the Deschutes. Skookum Butte lookout was built in 1934 and used until the early 1970s. In 1970 a new tower on Sugarpine Mountain made this lookout excess to the fire detection needs, and it was removed. Johnson Meadow Guard Station was built in the 1930s within the watershed, and used by fire crews and other departments into the 1970s. The cabin still stands and is in good condition, though abandoned. Davis Flat along Jack Creek was the site of a Guard Station and a Civilian Conservation Corps (CCC) camp in the 1930s. The CCC were an agency created to help alleviate unemployment during the Great Depression. The CCC built towers, cabins, roads, fought fires, and insect outbreaks, built campgrounds and other needs of the National Forests. The camp was only used a few years, and the buildings have long ago been removed. The location was again used as a guard station in the mid 1960s.

Grazing

The first permitted livestock grazing in the area of what is now the Antelope Cattle and Horse Allotment was in 1909 under the jurisdiction of the Paulina National Forest. Prior to this, cattle and sheep grazed the area in much greater numbers. In 1915 administration was transferred to the Fremont National Forest. In 1930 the area was designated the Antelope Cattle and Horse and Tobin Cabin Sheep and Goat allotments. The allotments, which consisted of spring and summer range were used by both sheep and cattle until 1941 and was administered by the Silver Lake Ranger District, Fremont National Forest. Season of use varied from April 25 to November 15 in 1917, and July 1 to September 30 in 1939. Livestock numbers varied from 120 cattle in 1918 to 1,050 in 1938. Sheep numbers fluctuated between 500 and 1,200. In April 1961 the summer range was transferred to the Chemult District and grazed as a separate allotment. Season of use was set from July 1 to September 30 with a stocking rate of 265 head on National Forest lands. In 1977 the allotment was reconfigured. Management of the allotment in conjunction with pastures on the Silver Lake Ranger District was unified with the formulation of the Antelope Coordinated Resource Management Plan. The allotment plan was developed in 1984.

Land Ownership

Of the approximately 60,000 acres within the Jack Creek Watershed, only 960 acres are privately owned. The nearly 59,000 acres remaining are National Forest Lands. Land ownership has changed greatly over the last 150 years since the creation of the State of Oregon. Grants to Oregon, to private individuals, and to corporations reduced greatly the federally held land within the basin.

The Jack Creek Watershed came into ownership of the Federal Government in 1848 with the creation of the Oregon Territory. In 1859, the State of Oregon was created. With the creation of the state, the Federal Government transferred most of the sections numbered 16 and 36 to the State of Oregon. This was to provide Oregon with funds to run its operations. The State of Oregon sold some land to timber companies and private individuals. Eventually all but 160 acres of state land were exchanged back to the government through exchanges with these later owners.

Individuals acquired a great deal of land from the federal government under a number of programs aimed at disposing of lands. Lands were acquired by private individuals under the Homestead Act (grants up to 160 acres), a livestock homestead act (grants up to 320 acres), direct sale of land under an act permitting such disposal (up to 160 acres per person), the Timber and Stone Act (grants up to 160 acres) and grants to veterans for services during wartime. Most of the land acquired as homesteads in the Chemult area were meadows where livestock raising was possible. They were not lands that were of interest to the local timber industry, and most have been retained in private ownership. The vast majority of the lands granted to individuals were under the act of 1820 allowing direct purchase of lands from the government. Parcels totaling 7,564 acres in the watershed were acquired in this way between 1903 and 1929. Most of these were later transferred to timber companies and eventually cut over and exchanged back to the National Forest for timber cutting rights.

Land Grants to Oregon, Private Individuals, and Corporations		
Dates	**Type of Grant**	**Acres**
1859	Oregon Statehood Grant	2,165 (160 acres still private land)
1871	Wagon Road Grant to State of Oregon	160 (within Klamath Reservation, to Reservation 1910 agreement)
1904-1905	Sale Cash Entry Exchange Selection Santa Fe Lieu Selection	3,647 360 280
1906-1907	Sale Cash Entry Northern Pacific RR Grant	824 217

Land Grants to Oregon, Private Individuals, and Corporations		
1908-1909	Sale Cash Entry Northern Pacific RR Grant Santa Fe Lieu Selection Aztec Land and Cattle Lieu	433 280 797 224
1912	Sale Cash Entry Homestead Entry	1,408 320 (320 acres still private land)
1920-1924	Livestock Homestead Entry	913 (320 acres still private land)
1925-1929	Sale Cash Entry Homestead Entry Timber Culture Script or Nature of Script State of Oregon Lieu Select	1,180 400 (160 acres still private land) 200 40 160
Total		14,008 (960 acres still private land)

The southern third of the watershed lies within the former Klamath Indian Reservation. These lands were held by the tribe as a whole. In 1887 the Dawes act allowed for the assignment of 160 acre tracts to individual tribal members. By 1924, 1,624 allotments totaling nearly 250,000 acres had been assigned to individuals. Many of these allotments were later sold to non-tribal people. Although nearly one quarter of the reservation was allotted to tribal individuals, no allotments were made in the Jack Creek Watershed. When the lands in the watershed became part of the National Forest, none of it was privately owned.

Land Exchanges

Within the project area are a number of acres that were acquired by the Federal Government from private individuals and corporations. These included land for land exchanges and land for timber exchanges. These exchanges have blocked up ownership of the watershed. At this point all but 960 acres within the nearly 60,000 acres of the watershed are managed by the National Forest.

Table 2. Land Exchanges within the Jack Creek Watershed

Name	Date	Acres	Exchanged For
Big Lake Box Co.	6/21/1943	1,849	Timber
Shevlin-Hixon Co.	5/15/1945	4,070	Timber
Shevlin-Hixon Co.	6/7/1946	4,920	Timber
State of Oregon	12/29/1969	120	Land
Crown Pacific	x/x/1998	644	Land
Land Purchase	x/x/2003	160	Money
Total		11,763	

Causes of Change

What are the causes of change between historical and current human uses? What are the influences and relationships between human uses and other ecosystem processes in the watershed?

Timber Production and Firewood Gathering

Timber harvest levels of today are much lower than in the 1930s and 1940s. This is partially due to the extensive harvest activities on the former Klamath Reservation and on private forest lands. The National Forest lands have also had some extensive logging in the 1970s to 1980s, but not to the level seen in the earlier period. Beetle kill in the north end of the watershed and subsequent salvage has depleted the timber in that area. Lack of thinning though many stands has now resulted in thick overstocked trees, many of which are out-competing the large older trees. There is a need to remove these smaller trees, and future harvest in the area is likely to increase. The causes of decrease in harvest are the past depletion of the resource by over harvest, and pine beetle mortality in the 1980s. In addition, private timber lands in the Jack Creek watershed have nearly all been transferred to the National Forest. Generally, the National Forest lands have a longer timber rotation period, allowing older stage stands to develop and provide habitat for species dependent on such structure.

Firewood gathering is about the same as in the recent past. Historically very little firewood gathering took place in the area because it was so far from any population centers. Today there has been an increase due to depletion of firewood near towns such as Bend and Klamath Falls. Also, the need to remove dead and down lodgepole from meadow edges convinced the Chemult Ranger District to set up firewood sales along some of these meadows, increasing firewood harvest in the watershed. Tribal firewood collection trends are difficult to judge since no good numbers are available.

Grazing

The range analyses of the 1980's and 1990's identify forage production in harvest units as significant because there are so few acres of riparian habitat (There are approximately 22,800 acres of 1960's-1990's harvest units compared to 3,300 acres of riparian in the approximately 60,000 acre watershed). Shifts in forest community structures and age classes from fire suppression, harvest activities and the natural successional process are affecting forage production.

There is a relationship between characteristics of tree canopy closure and stand density, and understory biomass production. High stand density and canopy closure can lower the shrub/grass/forb production. An area in southcentral Oregon was examined for changes in overstory canopy closure using 1953 and 1988 imagery and a geographic information system.[22] The most pronounced reduction in understory biomass occurred in forest communities above 1,600m in elevation (5,200 feet). The 1988 grass/forb/shrub estimate is 34.4% of the estimate in 1953. Since 1988, there have been essentially no green tree treatments in this watershed, so another 16 years of increasing canopy closure and stand density has further contributed to forage decline in the forested parts of this watershed. All of the Antelope Allotment and most of the Jack Creek Allotment are in this elevational range. More than 94% of this watershed is forested upland communities with extremely poor forage production. Cattle are essentially limited to foraging in riparian communities. Sheep graze primarily on bitterbrush in the uplands. Bitterbrush availability has dropped significantly since 1953.

The Antelope Allotment is managed as an open allotment without any pastures and no rest rotation. Riding has historically been an important tool in getting good cattle distribution. Ability to move livestock around has changed dramatically in the last ten years. Nearly all of the allotment within the

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[22] Peek, James M. Jerome J. Korol. Donald Gay. Terry Hershey. 2001. *Overstory biomass changes over a 35-year period in southcentral Oregon.* Forest Ecology and Management Volume 150. pgs 267-277.

watershed is in lodgepole community types. Approximately 70% of these communities are in the 80-120 year age class with high mortality in the overstory trees, and with rapidly progressing establishment of a replacement understory. Nearly all of the uplands in the Antelope allotment were salvaged in the early 1990's.[23] All projects left a 200-foot buffer of no treatment around riparian habitats. Since these salvages, continued old age mortality and windstorms have put many more overstory trees down. The end result is a nearly impenetrable 200-foot buffer of fallen, jackstrawed old lodgepole along riparian edges. To make matters worse, young lodgepole are growing up through the fallen trees in densities that exceed 1,000 trees per acre. While fallen tree densities and regrowth are less in the uplands, they still provide a significant impediment to a horseback rider trying to move cattle. Cattle find their way into meadows, then trail through the meadows, including mucky, wet soils they would typically avoid. They tend to stay kegged up at waters and favored meadows. These high use areas lead to overutilization of the forage, reduced water quality, and accelerated erosion/puddling rates. Tree barriers have effectively eliminated riding as a management tool to move cattle from these hot spots.

Conditions of the riparian edges are similar in the Jack Creek Allotment portion of the watershed. However, sheep spend most of their time in the uplands and are attended by herders with dogs, so down trees and dense regrowth do not pose the same magnitude of challenge moving sheep.

Limited water availability adds to the challenge of livestock distribution around the allotments. There is great variability in surface waters for drinking from the turnout dates to the end of the season, as well as from one year to the next. In addition to the 5 miles of perennially flowing stream, there are 104 miles of intermittent and ephemeral riparian reaches that flow water during a high spring runoff season. In dry years such as 1991, 2001-2002, none of these had surface water during the peak spring runoff season. In these recent drought years, nearly all the seeps and springs dried up by mid-August. These drought events appear to be within the normal annual precipitation variations for this watershed. Persistent water sources within the Antelope Allotment were mapped during the 2001-2002 drought years.

Water availability in drought years limits proper distribution in the cattle allotment. Herders truck water to the uplands for the sheep. Water is not trucked for cattle. Rather, they drink primarily from ponds and natural waters within the riparian system.

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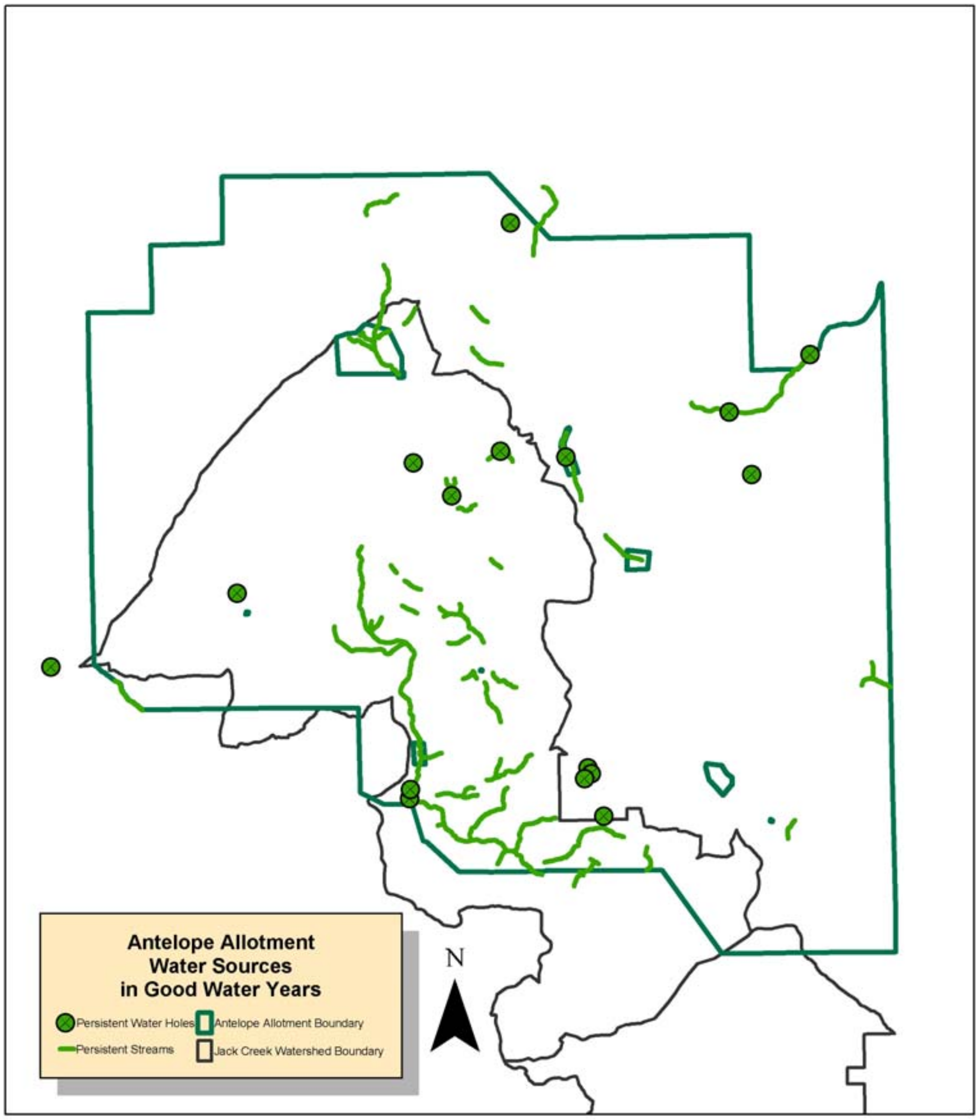
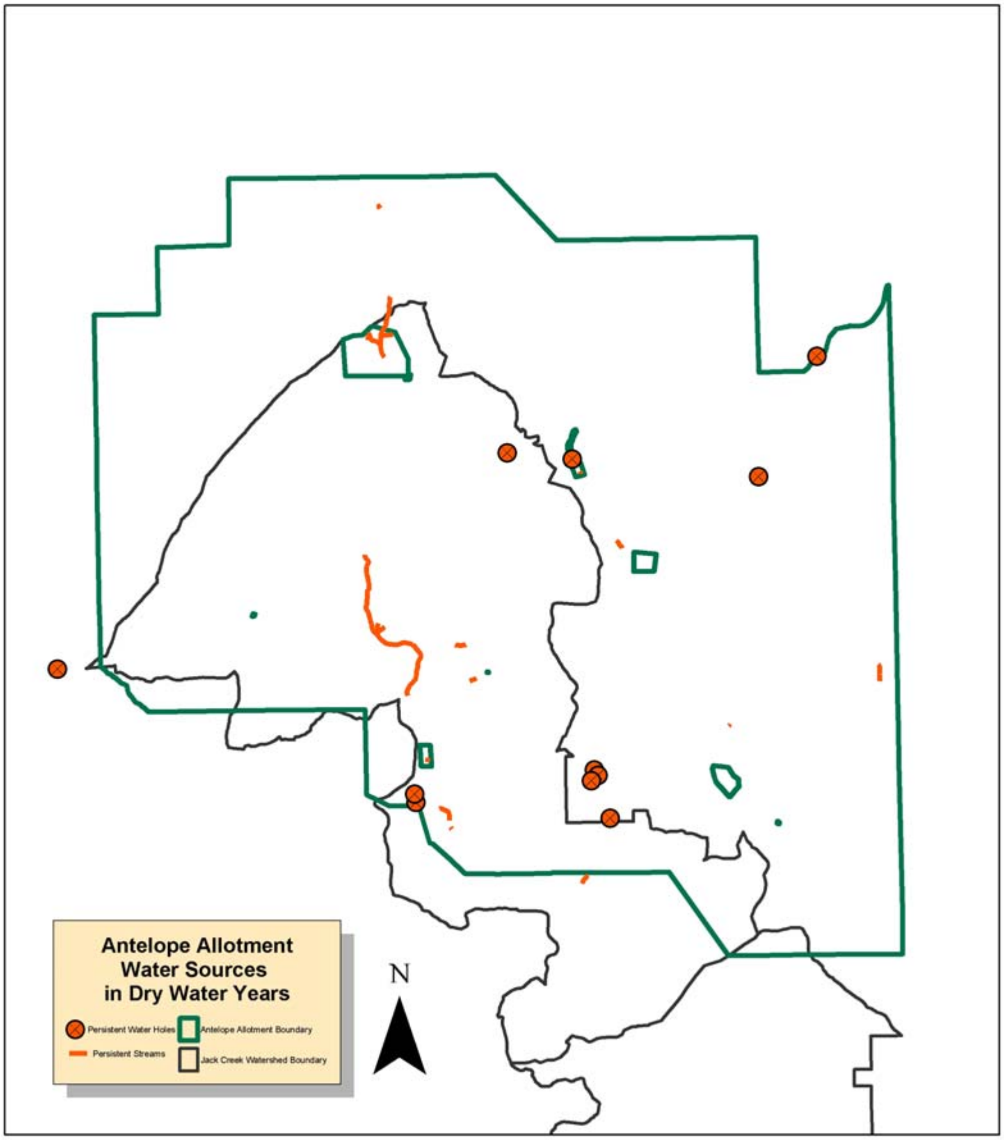
[23] USDA Forest Service, Chemult Ranger District. 1989-1991. Environmental Analyses for Around, First, and Parker Analysis Areas. Chemult Ranger District, Winema National Forest.


Antelope Allotment
Water Sources
in Good Water Years
Persistent Water Holes
Antelope Allotment Boundary
Persistent Streams
Jack Creek Watershed Boundary
N


Antelope Allotment
Water Sources
in Dry Water Years
Persistent Water Holes
Antelope Allotment Boundary
Persistent Streams
Jack Creek Watershed Boundary
N

Soil types in the riparian system are susceptible to compaction/puddling by livestock when wet.[24] During spring and early summer riparian areas have saturated soils. Some soil types will dry out after the spring runoff and become resistant to compaction/puddling by cattle or vehicle traffic. Some soil types stay wet longer and have a higher percentage of the perennially wet soil types included than the drier ecological units. They are resistant to puddling when dry. Some soils rarely dry out and are susceptible to puddling when wet. These wet soils may well be important reservoirs to sustain higher water tables in the nearby drier meadow reaches. Puddling destroys soil structure and reduces its water holding capacity. Refer to the Soils section for details regarding soils types and impacts in riparian areas.

Cattle watering in the creek causes destabilization of streambanks by removal of deep rooted vegetation (riparian hardwoods) and by physically breaking down banks. The area of greatest concern corresponds with the perennial reach between the private inholding called the Moffit Place near the headwaters and the bottom of the cattle allotment. All of the private inholding at Jamison Meadow and about 75% of the reach between the Jamison and Moffit inholding shows sign of degradation. These effects tend to contribute to accelerated erosion rates and channel downcutting (refer to the Stream Channel section for more).

Grazing is not the sole factor in modifying channel conditions and flow levels. Heavy grazing activities along with extended drought conditions make the meadows and stream channels more susceptible to above normal or high intensity runoff events. Heavy runoff events coupled with sparse vegetative cover and weakened root mass accelerate erosion rates and destabilize channels. These conditions are then aggravated by continued grazing pressure.

Recreation/Hunting

Recreational use has always been low in the Jack Creek Watershed. No campgrounds have ever been developed in the area beyond the pit toilet and picnic tables at Indian Spring. With the increase in snowmobile and motorcycle riding there may be additional visitation to the watershed by these folks. However, this has never been a popular spot for either activity. Some recreation use has had impacts on meadows and potentially water quality. Planned activities to move these camps will alleviate some of these effects. Recreational use has had a minor effect to the Jack Creek Watershed as a whole, but some very specific local impacts to meadows. Hunting has not changed greatly over the past few decades. Some deer population numbers indicate that they have diminished since the 1950s, but it is unclear that hunting activity has decreased as well.

Tribal Uses

Changes in the tribal utilization of the Jack Creek Watershed stem from the creation of the Klamath Reservation and the restriction of uses outside the reservation. Two-thirds of the Jack Creek Watershed lies outside the former reservation. After the reservation had been created there was an attempt to restrict the Klamath, Modoc and Paiute to the reservation. This prevented use of the rest of the watershed by these people. Since the elimination of the reservation in 1954, collection and hunting rights were further restricted until court judgments reinstated collection rights on the former reservation. However, archaeological evidence indicates the prehistoric peoples did not heavily use the majority of the watershed.

[24] Dorr, James, Fremont-Winema National Forest Soil Scientist. September, 2004. Personal communication with Terry Simpson. Chemult Ranger District, Winema National Forest.

Fire Suppression

The results of long-term fire suppression combined with recreation and subsistence use, has made the area more susceptible to large scale conflagration that could effect long-term productivity and health of the subwatershed.

Recommendations

- Check soil moisture conditions each year prior to turnout. Manage livestock to minimize damage to wet soils. Not all soils will dry at the same time. The perennially wet ecological units are 2006, 2008, 2017, and 2018. They are likely to have a very limited time period when they are dry enough to graze. The 2001, 2002, 2004, and 2005 ecological units are likely to be wet for the July 1 turnout date in some years and should be checked prior to turnout. The 2000, 2007 and 2012 units are most likely to be dry for the July 1 turnout date. A pasture rotation system would provide the optimum opportunity to facilitate proper timing of turnout under these varied soil moisture regimes.
- Managing livestock use on wet soils will significantly reduce current livestock access to waters. Carefully coordinate water developments with wet soil areas to be protected. Digging stock watering ponds in riparian areas should be avoided. Existing ponds should be decommissioned. Watering sites should be moved to nearby uplands. This may require digging wells and trucking water to supply adequate, clean water well-distributed through the antelope allotment.
- Develop a multi-pasture system to move/control cattle use across the Antelope Allotment.
- Clean-up areas around riparian edges to improve ability to move livestock. Thin dense lodgepole stands along riparian edges. Remove dead lodgepole and meadow encroachment.
- Fix infrastructure or remove cattle from areas of concern. Spring development repairs are needed at Wilshire Meadow, Johnson Meadow, Cleary Spring and Huckleberry Spring. All binwalls need repair. Repair headcuts at Middle Jack, Jamison property line and the furthest downstream structure in Davis Flat. Put up fences to exclude livestock from spring developments and headcuts. Clean up cattle stock driveways to facilitate easier cattle movements. If there are not enough appropriated range dollars to maintain essential structures necessary to protect resources and meet plan standards, permittees should be encouraged to do the maintenance. Allotments should be closed if essential maintenance is not completed prior to turnout each year.
- Adjust allotment capability estimates to reflect decreased forage production in forested communities.
- Monitoring is a critical component of any well-administered program. Given the unlikely event that the current declining budget trend will reverse, more monitoring responsibility should be given to permittees. Allotments should be closed if an adequate monitoring strategy cannot be implemented.

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Appendix A - Beaver Report

A Survey of Historic Beaver Occupancy in Jack and Sellers Creeks, Oregon

During August, 2004 the upper reaches of Jack Creek (from the 94 road to Davis Flat) and Sellers Creek (from Round Meadow to Squirrel Camp) were surveyed for sign related to past beaver activity. The purpose of this survey was to determine the historical extent of beaver use in the area and determine the potential for successful reintroduction of beaver to the area.

JUSTIFICATION

Justification for this survey stems from the concern that beaver once occupied a large proportion of this area but have not been seen there for more than thirty years. Beaver are important keystone species due to their ability to physically manipulate their environment (Naiman et al. 1988). Beaver influence the hydrologic, geomorphic, and vegetative conditions of their habitat through construction of dams, lodges, holes and runs; and extensive foraging, and structural use of riparian vegetation. The alteration of these structural habitat parameters can in turn have a significant effect on biogeochemical cycling patterns (eg. materials transport, carbon and nitrogen cycling, oxidation/reduction reactions etc.), and the biotic community that uses these habitats (Naiman et al. 1988).

The current concern with the status of Jack Creek's Oregon spotted frog (*Rana pretiosa*) population and the degraded geomorphic, and vegetative condition of the creek have stimulated much interest in how historic conditions found in Jack and Sellers Creeks differed from what we see today. The spotted frog is associated with warm, open, and slow moving water and emergent vegetation (Hayes et al. 1994). This essentially means that these frogs are dependent on ponds and marshy habitat. These conditions are limited on Jack Creek and Sellers Creek and are likely to increase in response to beaver activity. The most notable geomorphic concerns on Jack and Sellers Creeks are related to headcuts and downcutting of the stream channels leading to a dewatering of the meadow system. Dams built by beavers can cause channels to aggrade through the deposition of fine sediments and impoundment of water, and also raise water tables through similar processes. These effects make beaver natural, simple, and affordable restoration tools where channel aggradation and a raising of water tables are the primary goals. Successful projects utilizing beaver for stream channel improvement is supported in the literature (Brayton 1984).

If long term stability in our frog populations, meadow systems, and stream channels is a primary goal of management in this area, then maintaining populations of keystone species such as beaver is vital to reaching this goal. Additionally, since beaver are known to restore streams with degraded conditions, then they are not only important for maintaining a healthy system but are also a vital part of the resilience of stream systems in the wake of disturbance such as cattle grazing and high flow events.

METHODS

Historical beaver occupation was determined by visually surveying the creek and documenting signs of beaver activity and using Cybertracker[25] to record the location and habitat specifics of the site. Woody material chewed on by beaver was the most common sign. Occasionally old remnant dams were found, indicating past beaver occupation.

Beaver chewed plants were delineated into *shrub*, *hardwood tree*, or *coniferous tree*. and the extent of the activity at that site was documented. The extent determination of either *occasional* or *abundant* use was used to give an idea of preference for that site. *Abundant* use is assumed to be a

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[25] Cybertracker is a data collection system that integrates a GPS unit and a hand held data logger.

sign of long-term occupation of a site and a preference for the type of habitat found at that site. *Abundant* use was determined as greater than 10 stems (shrub branches) or 5 tree boles chewed on at that site. *Occasional* use was determined to be less than 10 stems chewed on at that site.

In addition to rating the extent of activity in a site, a rating of the reintroduction potential was also given to each site. The three categories for reintroduction potential were *high quality*, *needs management*, and *low quality*. Reintroduction potential was based on a qualitative assessment of the amount of high quality forage (willow, bog birch, and aspen) at that site and its immediate surrounding area. A *high quality* rating means that ample willow, bog birch, aspen, or a combination of the three exists at that site to support extensive use by beaver without over-utilizing the resource. A *needs management* rating means that the site has the potential to support extensive use by beaver but only after 1-5 years of rest from grazing has allowed recovery of the willow, birch, and aspen communities. *Low quality* means that management beyond 5 years of rest would be required to establish suitable habitat. Management needs in a *low quality* site may require active management (ie. willow planting or a raising of the water table) in order to establish suitable habitat. The active restoration may be needed because of large scale problems such as: a complete loss of the riparian shrub community has left a lack of local seed source for new plant establishment; or a lowered water table has left a former willow site too dry for the establishment of willows.

RESULTS

Over a distance of 19.4 kilometers surveyed, 152 sites showing chewed vegetation and 4 beaver dams were recorded. Of these 152 sites with chewed stems 142 had data taken on what type of vegetation was chewed at those sites. Of these 142 sites 74% (108) were hardwood shrubs, 20.5% (30 sites) were conifer sites, and 2.7% (4) were hardwood tree (aspen- *Populus tremuloides*) sites. When analyzing reintroduction potential at the 152 sites with chewed vegetation 54% (82) showed high potential for the ability to support beaver occupation, 28% (43) had low potential for the ability to support beaver occupation, and 18% (27) could likely support beaver after active management successfully improves riparian shrub condition. *Abundant* use (greater than 10 stems chewed) was more common than *occasional* use at the 152 sites, with 67% (102) and 33% (50) sites fitting these categories respectively. Of the 4 dam sites, one occurred in an area with extensive aspen and willows while the other 3 all occurred in the same general area, which had an abundance of bog birch (*Betula glandulosa*) and a moderate amount of willow. The dam in the aspen patch appears to have been built using primarily aspen material.

DISCUSSION

Trends in Occupancy

Over the course of the survey certain observational trends were noted. Although past beaver use was noted throughout most of the area surveyed, some of the areas that did not have beaver sign had distinctly different habitat parameters than sites that did show past beaver use. Two distinctly different habitat types that had no sign of past beaver occupation also had no developed stream channel. One of these habitat types was a wide hairgrass/sedge (*Deschampsia/Carex*) meadow, found on Sellers Creek, and the other habitat type was a marshy, sometimes boggy habitat created by widely dispersed seeps and springs. This latter habitat type contained abundant bog birch and varying amounts of willow and was found on both the main-stem and surveyed tributaries of Jack Creek. Beaver activity was absent from both of these habitat types that lacked a developed stream channel. Interestingly, the most abundant use per linear meter of stream occurred in places that were identical to the marshy/boggy areas except that they also had a developed channel flowing through the area.

Another channel type that contained little or no beaver sign exists along several reaches. This channel type has boulders as the dominant substrate, lower sinuosity, and higher gradient (>2%) than other reaches within the survey. Other than a few remnant puddles, areas with these characteristics were dry during the time of the survey. It is suspected that the intermittent nature of this channel type is the most significant reason beaver weren't using these areas. This channel type exists along several small reaches of Jack Creek and one long reach on Sellers Creek above Squirrel Camp. One exception to this trend is an area on Jack Creek just north of Davis Flat where the dry boulder dominant channel exists in an anastamosed form with a gradient greater than 2% and a substantial amount of aspen occurs. This site shows beaver use of both willow and aspen, with the remains of a dam constructed of aspen branches on one of the channels. The length of perennial stream along Jack Creek has been less extensive in recent drought years (personal communication Terry Simpson). This site may have been one of the places that formerly flowed year round and no longer does.

Trends in Vegetative Condition

In addition to trends in beaver occupancy some trends in general vegetative condition were noted. One common trend noted throughout the survey area was the poor condition and sometimes, total absence of the willow community. Very few robust, healthy looking populations were found. The vast majority of willow shrubs showed sign of heavy repeated browsing. A common trait in heavily browsed willow populations is a lack of a flowering response (Brookshire et al. 2002). This trend appeared to be widespread throughout the survey area as most plants were old and decadent. The recruitment of new plants appeared to be limited to a few small locations and these plants were also browsed heavily, limiting their ability to grow into large robust plants. Domestic livestock are ubiquitous to the area surveyed with cattle from the Jamison private property north and sheep from the Jamison property south. Willow communities on both the cattle and sheep allotments were depauperate and stressed by heavy herbivory. The cattle allotment appeared to have received much more recent browsing (current year) than the sheep allotment but overall willow populations on the sheep allotment were still very limited in extent and suffered from concentrated browsing by both wild ungulates and domesticated livestock. Light use by unauthorized cattle was seen throughout the survey area that fell within the boundaries of the sheep allotment.

The most spatially extensive and vigorous populations of willow occurred in the marshy/boggy habitat type described previously. This trend is likely due to several factors. First of all, because of the springs/seeps, these areas have stable hydrologic conditions that promote the establishment and persistence of willow communities. Secondly, the water in these habitat types is not confined to a channel, it is spread out fairly evenly over a wide area giving the willow an opportunity to persist across the whole width of the meadow system rather than just linearly along the stream channel. This widespread distribution may prevent cattle from "kegging up" around concentrated patches, distributing their browsing influence more evenly. Another possible reason the willow in the marshy habitats is in better condition than at other sites is due to the type of vegetation that coexists with willow at these sites. The marshy areas have very little grasses of high palatability. The majority of graminoids are low palatability sedges and so the cattle tend to avoid these areas until other areas with more palatable vegetation have been fully utilized.

Despite the higher quality condition of willows in some of the marshy/boggy areas compared to other areas, the willow populations at these sites were still in a degraded condition and appeared to represent a downward trend. In addition to willow, these boggy areas also have an abundance of bog birch. The bog birch doesn't get as heavily browsed as the willow and throughout the range of willow and bog birch communities, willows are being replaced by the birch. Often times willow carcasses that showed past beaver use were found by searching through the middles of large birch shrubs. One assumption made in the beaver survey was that high quality habitat could consist of either willow or birch as the available food source, but over the course of the survey no beaver browse of bog birch was noted. What is not known is whether this is because birch was limited in extent at the time beaver were within the watershed, or due to beaver avoiding the birch. No literature could be found regarding beaver food preference in relation to bog birch (*Betula glandulosa*). It is likely that beaver will still use bog birch for food and construction material as they are known to be generalists and to utilize other species of *Betula* (Gallant et al. 2004), but they may prefer willow and so avoid birch when willow is in abundance.

One habitat type that is very limited in willow abundance and health is channels adjacent to moderately mesic hairgrass meadows. Hairgrass is a preferred forage species for cattle and is a known decreaser in response to grazing. These meadows tend to get grazed very heavily by livestock (personal observation) and the limited willow abundance may be related to this fact. Some of these hairgrass meadows had no willow along the channel but beaver use of conifers was abundant. It is assumed that, in order to support beaver populations, these sites formerly had willow populations.

Trends in Channel Condition

Some areas where beaver activity occurred in the past are now considered unsuitable for beaver habitation. These were sites that suffered from a lowered water table and could no longer support willow populations. The lowered water tables were caused by a downcutting of the channel or headcuts, along with drought conditions. One area influenced by lowered water table is just north of where the 8821 road crosses Jack Creek. Downcutting in this area has not been significant enough to make the stream channel unsuitable for willow establishment but willow carcasses mixed with upland vegetation at the meadow's edge suggest that water tables were higher in the past. One headcut just north of the Jamison property has become severe enough that all willows in the surrounding area (within 50 ft. of channel) have died and none are establishing themselves except for right along the new channel that is developing within the old channel. This headcut described above has been treated with multiple enhancement structures and all of them have failed to stop the progression. One thing that has not been tried is removing the problem that exacerbated the headcuts in the first place, cattle.

The most significant influence in developing downcuts and headcuts is vegetation removal and bank trampling by cattle. Without deep-rooted vegetation and stable banks, C and E channel types (those typical of Jack and Sellers creeks) degrade to a state where sinuosity is reduced, and channel morphology becomes more wide and shallow (Belsky et.al 1999, Beschta 1991, Kauffman and Krueger 1984, Kauffman et. al 1997, White 1991). Without lateral scour and point bar deposition processes functioning properly, a reach can go from being depositional in nature to being classified as a transport or source reach (Bestcha 1991). When a depositional reach changes to a transport or source reach downcutting occurs.

RECOMMENDATIONS

Considering the current issues that are prominent within the Jack Creek watershed (headcuts, downcutting, drying of meadows, lodgepole encroachment, and declining frog populations) reintroducing beaver would likely benefit multiple resources within the project area. Using beaver as a restoration tool has numerous benefits that would not be gained through the use of more traditional methods such as artificial structures. For instance, beaver damming causes pond formation, which increases potential frog habitat. Damming also increases sediment deposition, aggrading channels and reversing the effects of downcutting or headcuts, which also raises water tables, and benefits willow establishment and persistence. Additionally, many stream improvement projects (such as those previously done on headcuts in Jack Creek) utilize non-native materials, which is inconsistent with what is known to naturally occur. An example is in the use of hard (rock or trees) materials in a meadow system used to deflect flow away from an eroding bank. The structure may deflect flow away from the eroding bank but a hard deflection is unnatural in these systems. This concentrates the flow, increasing its velocity, and thereby increasing its erosive force. The concentrated flow then hits the opposite bank (which is composed of "soft" material) downstream of the structure causing further erosion.   The use of beavers as a restoration tool ensures that manipulations occur within the parameters of what the stream has evolved deal with, thus avoiding many un-natural problems such as the one described above.

The largest question looming over the reintroduction of beaver into Jack and Sellers Creeks is whether or not the vegetation is in good enough condition to support them. The beaver use survey was designed to classify the quality of habitat based on how much forage and construction material was available. The survey results suggest that ample vegetation exists in many locations but this is based on the assumption that beaver will utilize bog birch in the same manner that they utilize willow. More research is necessary to understand the current trends in bog birch and willow abundance, and the food preferences of beaver in relation to bog birch.   It would be unwise to put beaver in an area that was deficient in willow if birch was not a preferred food.

Further stressing an already degraded willow population could have significant deleterious effects. Current habitat suitability models for beaver have failed to show a strong correlation between vegetation condition and suitability to beaver. Rather, these models suggest strong correlations between channel geomorphology (stream size, gradient, and valley width) and suitability to beaver but lack in a statistically significant correlation between vegetation and beaver suitability (Howard and Larson 1985, Suziki and McComb 1998). Conditions along the whole of both Jack and Sellers Creeks fit within the geomorphic parameters stated as being important to suitability for beaver. If these parameters exist throughout the survey area, then selecting sites based on the most abundant past use and the highest quantity of forage available ought to closely approximate the beavers' needs. If re-establishing beaver populations and improving riparian and channel condition are priorities, then re-introducing beaver and large-scale changes in cattle management is recommended. Current research does not suggest that vegetation is strongly linked to habitat suitability, however, in a situation where willow is in exceptionally poor condition, a threshold may have been surpassed, beyond which the willow population is a limiting factor for successful beaver occupation. In this situation, the heavy grazing pressure combined with the addition of beaver has the potential to create an additional problem beyond what is already seen within the watershed. However, if reintroduction efforts are carefully planned out (careful site selection), and care is taken to improve willow condition throughout the area, then potential problems will be avoided. After establishment of stable populations has resulted in significant water impoundment, wetland and riparian area will be increased and the extent of suitable willow habitat will also be greater than what currently exists.

Appendix B - *E. Coli*

E. coli measured in colonies per 100 ml at Sample Points in Jack Creek subwatershed

	11/6/2002	12/11/2003	5/7/2003	Jul-03	10/15/2003	7/13/2004	8/17/2004	9/9/04	9/14/04
Upper Jack						<2			
Big Camp instream flow	900		<=2	240	11	<2		32	99
Mid Jack Excl Fence spg	<=2		900	<2	<2	<2			
N Fence of S Exclos spg	<=2		11	<2	<2	<2			
Pondo in Rock pool outflow	300		<=2	7	80	<2		411	365
Cabin Spring wood box		<=2	<=2	<2	<2	<2			
Cabin Spring not in box				<2					
Huckleberry Spring		<=2			na	<2			
Lily Camp		<=2	<=2	130	170	<2			
N 8820 Gate Spring		<=2				<2			
Exclosure #1							>200		
Exclosure #5							200		
Exclosure #6 Off channel							34		
Exclosure #8							74		25
G.Luganis site off channel							12		
Headcut off channel							4		
Exclosure #13							9	12	308
Johnson Meadow spr									<1
Below mid exclos, instream								1414	1300

Sources in Cattle allotment

Sources in Sheep allotment (unshaded)

Data exceeds state standards

There are several sites that may prove to exceed the threshold of 5 samples in 30 days of E. coli levels of 126.

Appendix C - Landbird Species

East-Slope Cascades Focal Landbird Species Habitat Needs

White headed woodpeckers need mature large tracts of relatively open canopy, ponderosa pine forests with large snags for foraging and nesting. They excavate soft snags. Excessive downed wood may favor competitor hairy woodpecker and increase density of predators such as ground squirrels. Fire suppression has allowed understory encroachment. Sugar pines are thought to be extremely important locally by providing a secondary seed food source to ponderosa in alternating seed producing years. Woodpeckers will nest in high cut stumps and large root wads when appropriate snags are not available. Other species to benefit from managing for white-headed woodpecker include: flammulated owl, Lewis's woodpecker, white-breasted nuthatch, pygmy nuthatch, Williamson's sapsucker, northern goshawk, Hammond's flycatcher, hairy woodpecker, and brown creeper.

Pygmy Nuthatches need unfragmented ponderosa or mixed forests with a ponderosa component with large trees and snags. They are cavity nesters. Fire suppression has allowed understory encroachment of non-ponderosa pine, limiting ponderosa recruitment, and increasing fuel loads. Other species to benefit from managing for pygmy nuthatches include: white-headed woodpecker, white-breasted nuthatch, pine siskin, northern goshawk and flammulated owl.

Chipping sparrows need interspersion of herbaceous ground cover with shrubs (for foraging) and regenerating pine patches (for nesting and foraging). They are most common in stands with relatively short trees (<89 feet) and open canopies (<40%). Understory removal can be detrimental if the timing, extent and location are not well planned. Other species to benefit from managing for chipping sparrows include: dark-eyed junco, Townsend's solitaire, American robin, dusky flycatcher and gray flycatcher.

Lewis's Woodpeckers need patches of burned old forest, with large snags in an advanced state of decay or trees with soft sapwood for excavation. They require understory a shrub component for insect (food) production. Salvage logging in burns and high grading of old trees and snags has decreased habitat. There is competition for cavities by European starlings. Other species to benefit from managing for Lewis's woodpecker include: Olive-sided flycatcher, American kestrel, black-backed woodpecker, three-toed woodpecker, mountain bluebird, and northern flicker.

Brown Creepers need old growth interior habitat and large trees with furrowed bark. Other species to benefit from managing for brown creepers include: Townsend's warbler, red-breasted nuthatch, evening grosbeak, golden-crowned kinglet, pine siskin and red crossbill.

Williamson's Sapsuckers need large soft snags in mature and old growth forests with canopy closure between 25 and 70%. Fire suppression has allowed understory encroachment, which inhibit growth of large trees. Other species to benefit from managing for Williamson's sapsucker include: pileated woodpecker, hairy woodpecker, flammulated owl, northern pygmy owl, red-naped sapsucker, brown creeper, Vaux's swift, chestnut-backed chickadee, great gray owl, red-breasted nuthatch and winter wren.

Flammulated Owls need a mosaic of open forests with mature or old growth ponderosa pine, with a mixture of other tree species, some patches of dense thickets of forest growth with interspersed grassy openings. Fire suppression has resulted in loss of open understory and invasion of fire intolerant species. Other species to benefit from managing for flammulated owls include: great gray owl, white-breasted nuthatch, white-headed woodpecker, pygmy nuthatch, hairy woodpecker, brown creeper, chipping sparrow, Townsend's solitaire, Hammond's flycatcher, Cassin's finch, western bluebird and western tanager.

Hermit Thrushes need multi-layered, dense canopy and vertical cover. They prefer unthinned stands, brushy areas and regeneration stands providing a dense understory. Other species to benefit from managing for hermit thrushes include: varied thrush, chestnut-backed chickadee, blue grouse, winter wren, and Townsend's warbler.

Olive-sided flycatchers need a patchy mosaic of edges and openings created by wildfire, with tall snags or dead topped tall trees. Fire suppression has resulted in fewer fires, but larger more destructive fires that have reduced the amount of edge of early and late seral forest, and often brush needed for insect production. Other species to benefit from managing for olive-sided flycatchers include: western tanager, Cassin's finch, western wood-pewee, mountain bluebird, northern flicker, American kestrel and American robin.

Black-backed woodpeckers need large blocks of old growth unlogged lodgepole pine with dead and dying trees. Other species to benefit from managing for black-backed woodpeckers include: mountain chickadee, yellow-rumped warbler, Cassin's finch, pine siskin, and dusky flycatcher.

Clark's nutcrackers usually are associated with whitebark pine. They do occur in this area and are probably associated with the seed sources provided by mature ponderosa and sugar pines. Other species to benefit from managing for Clark's nutcrackers include: Steller's jay, common raven, mountain chickadee, red crossbill, pine siskin, red-breasted nuthatch, pine grosbeak, and Cassin's finch.

Bibliography

Agee, J. K. 1996. Fire Ecology of Pacific Northwest Forests. Island Press, Washington D. C. pp. 113-150.

Belsky, A.J., Matzke, A., and Uselman, S. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of

Soil and Water Conservation 54(1): 419-431

Berger, L. 1999. Bibliography of amphibian diseases. James Cook Univ., School of Public Health and Tropical Diseases, North Queensland, Australia.

Beschta, Robert L. 1991. Stream habitat management for fish in the northwestern United States: the role of riparian vegetation. American Fisheries Society Symposium 10:53-58

Blaustein, A. R., D. B. Wake, and W. P. Sousa. 1994. Amphibian declines: Judging stability, persistence, and susceptibility of populations to local and global extinctions. Conservation Biology 8(1):60-71.

Boyer, R., and C.E. Grue. 1995. The need for water quality criteria for frogs. Environmental Health Perspectives 103:352.

Brayton, D. Scott. 1984 The beaver and the stream. Journal of Soil and Water Conservation. March-April 108-109

Brookshire, E.N. Jack. 2002. Cumulative effects of wild ungulate and livestock herbivory on riparian willows. Oecologia. In Press.

Brown, Rick. December 2000. Thinning, Fire and Forest Restoration: A Science-Based Approach for National Forests in the Interior Northwest. Defenders of Wildlife.

Carter, John 2002. *Declining water quality due to livestock production* in Welfare ranching pp.189-192. George Wuerthner and Matteson, ed., Island Press.

Cochran, P.H., et al. 1994. Suggested stocking levels for forest stands in northeastern Oregon and southeastern Washington. USDA Forest Service, Pacific Northwest Region. PNW-RN-513.

Cochran, P.H. 1998. Examples of Mortality and Reduced Annual Increments of White Fir Induced by Drought, Insects and Disease at Different Stand Densities. USDA Forest Service. PNW-RN-525

Engle, Janice 2002. *Threats to frog habitat from livestock production* in Welfare ranching, George Wuerthner and Matteson, ed., Island Press. Pp.207-208.

Environment Canada. 1998. Amphibian and reptile contamination and toxicology bibliography. http://www.cciw.ca/green-lane/herptox/reference-list.html

Gallant, D. et al. 2004. An extensive study of the foraging ecology of beavers (*Castor Canadensis*) in relation to habitat quality. Canadian Journal of Zoology. 82: 922-933

Gerhardt, Rick 1999. Great gray owl monitoring 1999, Unpublished report for Winema National Forest and US Fish and Wildlife Service and ODFW, 6 pp.

Hayes and M. R. Jennings. 1986. Decline of Ranid frog species in western North America: Are Bullfrogs (*Rana catesbeianna*) responsible? Journal of Herpetology 20(4):490-509.

Hayes, M. P. 1994. The Spotted Frog (*Rana pretiosa*) in Western Oregon. Oregon Department of Fish and Wildlife Technical Report. #94-1-01. 30 + figures and appendices.

Hayes, M P. 1997 The Jack Creek population of the Oregon spotted frog (*Rana pretiosa*): Chemult Ranger District, Winema National Forest (Klamath County, Oregon). Report prepared for the Winema National Forest. 13 pp. + appendices.

Hayes, et al. 1997. Status of the Oregon spotted frog (Rana pretiosa sensu stricto) in the Deschutes basin and selected other systems in Oregon and northeastern California with a rangewide synopsis of the species' status. Final report prepared for The Nature Conservancy under contract to the U.S. Fish and Wildlife Service, Portland, Oregon. Unpublished Report. 57 pp.

Hayes, M P 1998a. The Jack Creek population of the Oregon spotted frog (Rana pretiosa) Chemult Ranger District, Winema National Forest (Klamath County, Oregon). Final report prepared for The Nature Conservancy under contract to the Winema National Forest. Unpublished Report 14 pp.

Hayes, M P. 1998*a*. Protocol for Identification and Sampling of the Oregon spotted frog (*Rana pretiosa*). Identification key prepared for the Winema National Forest. 10 pp.

Hayes, M P. 1998b. The Buck Lake Oregon spotted frog (Rana pretiosa) population (Spencer Creek System, Klamath County, Oregon). Final report prepared for the Bureau of Land Management and The Nature Conservancy under contract to Winema National Forest. Unpublished Report. 22 pp.

Hopkins, William E. 1988. Winema National Forest Plant Association Guide.

Hopkins, William E. 1994. Descriptions of early, mid, late, and very late seral conditions for ponderosa pine, lodgepole pine and grandfir/white fir. Plant Succession Paper. Unpublished.

Howard, Rebecca J. and Larson, Joseph S. 1985 A stream habitat classification system for beaver. Journal of Wildlife Management. 49(1):19-25

Hecnar, S.J. 1995. Acute and chronic toxicity of ammonium nitrate fertilizer to amphibians from southern Ontario. Environmental Toxicology and Chemistry 14:2131–2137.

Kauffman, J. B., and W.C. Krueger. 1984. Livestock Impacts on Riparian Ecosystems and Streamside Management Implications: A Review.Journal of Range Management 37(5): 430-437.

Kauffman, J. Boone et al. 1997. An ecological perspective of riparian and stream Restoration in the western United States. Fisheries. Vol. 22, no 5 12-22

Kephart, D. G., and S. J. Arnold. 1982. Garter snake diets in a fluctuating environment: A seven-year study. Ecology 63(5):1232-1236.

Kiesecker, J. M., and A. R. Blaustein. 1997. Influences of egg laying behavior on pathogenic infection of amphibian eggs. Conservation Biology 11(1):214-220.

Licht, L. E. 1969. Comparative breeding behavior of the red-legged frog (*Rana aurora aurora*) and the western spotted frog (*Rana pretiosa pretiosa*) in southwestern British Columbia. Canadian Journal of Zoology 47:1287-1299.

Licht, L. E. 1971. Breeding habits and embryonic thermal requirements of the frogs, *Rana aurora aurora* and *Rana pretiosa pretiosa*, in the Pacific Northwest. Ecology 52(1):116-125.

Licht, L. E. 1974. Survival of embryos, tadpoles, and adults of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* sympatric in southwestern British Columbia. Canadian Journal of Zoology 52:613-627.

Licht, L. E.1975. Comparative life history features of the western spotted frog, *Rana pretiosa*, from low- and high-elevation populations. Canadian Journal of Zoology 53:1254-1257.

Licht, L. E. 1986. Food and feeding behavior of sympatric Red-legged frogs, *Rana aurora*, and Spotted frogs, *Rana pretiosa*, in southwestern British Columbia. Canadian Field-Naturalist 100(1):22-31.

Marco, A. 1997. Effects of nitrate and nitrite in the Oregon spotted frog and other amphibians. Abstract. The Oregon Chapter of the Wildlife Society, Corvallis, Oregon.

Marco, A, C. Quilchano, and A. Blaustein. 1999. Sensitivity to nitrate and nitrite in pond-breeding amphibians from the Pacific Northwest, USA. Environmental Toxicology and Chemistry 18: 2836–2839.

McAllister, K.R., and W.P. Leonard, 1997. Washington State status report for the Oregon spotted frog. Washington Department of Fish and Wildlife, Olympia. 38 pp.

Naiman, Robert J. et al. 1988. Alteration of North American streams by beaver. Bioscience Vol. 38 no. 11 753-761

Northern Prairie Wildlife Research Center. 1998. North American Reporting Center for Amphibian Malformations. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/narcam (Version 22DEC98).

Pearl, C. A. 1997. The Oregon spotted frog (*Rana pretiosa*) of Penn Lake, Oregon: Summer 1997 field survey. Report to the U.S. Fish and Wildlife Service, Portland, OR.

Pearl, C. 1999. The Oregon spotted frog (Rana pretiosa) in the Three Sisters Wilderness Area/Willamette National Forest. 1998 summary of findings. Unpublished report prepared for the U.S. Fish and Wildlife Service. 20 pp. FROM USFWS 2003 Listing priority assignment for Oregon spotted frog.

Ruediger, Bill, Jim Claar, Steve Gniadek, Bryon Holt, Lyle Lewis, Steve Mighton, Bob Naney, Gary Patton, Tony Rinaldi, Joel Trick, Anne Vandehey, Fred Wahl, Nancy Warren, Dick Wenger, and Al Williamson. 2000.

Ruggiero, L. F., K. B. Aubry, S. W. Buskirk, L. J. Lyon, W. J. Zielinski, tech eds. 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx and Wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: USDA, FS, Rocky Mountain Forest and Range Experiment Station. 184 pp.

Ruggiero, Leonard F.; Aubry, Keith B.; Buskirk, Steven W.; Koehler, Gary M.; Krebs, Charles J.; McKelvey, Kevin S.; Squires, John R. 2000.

Stern, Mark A. 1990. Abundance and Distribution of Yellow Rails in southcentral Oregon. The Oregon Natural Heritage Data Base Program. Portland, Oregon. 12pp.

Suzuki, Nobuya and McComb, William C. 1998. Habitat classification models for beaver (*Castor Canadensis*) in the streams of the central Oregon coast range. Northwest Science. Vol. 72, No. 2 102-110

Turner, F. B. 1960. Population structure and dynamics of the Western spotted frog, *Rana p. pretiosa* Baird & Girard, in Yellowstone Park, Wyoming. Ecological Monographs 30(3):251-278.

USDA Forest Service, Rocky Mountain Research Station. Ecology and conservation of lynx in the United States. General Technical Report RMRS-GTR-30WWW. Fort Collins, CO.

USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT. Canada lynx conservation assessment and strategy.

USDA Forest Service, USDI Bureau of Land Management. 2000. Interior Columbia Basin Ecosystem Management Project, Integrated science report and Supplemental draft environmental impact statement.

USDA Forest Service and U.S.D.I. Bureau of Land Management. July 8, 2004. Internal memo: A framework for incorporating the aquatic and riparian habitat component of the interior Columbia basin strategy into BLM and Forest Service plan revisions, 7 pp.

USDI Fish and Wildlife Service. 1996. Endangered and threatened wildlife and plants; determination of threatened status for the California red-legged frog. Federal Register 61:25813–25833.

USDI. Fish and Wildlife Service. Feb., 2003. Candidate and listing priority assignment form for Rana pretiosa. 24 pp.

USDI Forest Service and USDI Bureau of Land Management. 1998. Survey protocol for the lynx. FS: 120/2600 FS and BLM: Instruction Memorandum No. OR-99-25. Portland Oregon. 56 pp. unpublished.

Williams, Clinton K., Lillybridge, Terry R. 1983. Forested plant associations of the Okanogan National Forest. R6-Ecol-132b. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Region. 116 p. [2566]

White, Ray J. 1991. Resisted lateral scour in streams-its special importance to salmonid habitat and management. American Fisheries Society Symposium 10:200-203