FIRE HISTORY AND RANGE ENHANCEMENT STUDY
FOR
THE CAYUSE CREEK AREA

Submitted By: Jim Beck
April 17, 1984
Submitted To: J. Howard
G. Gibson
P. Ommundsen

MEMORANDUM

To: J. Howard
G. Gibson
From: J. Beck

Date: April 17, 1984

Re: Final Report

The attached report outlines the fire history data and results obtained from my study in the Cayuse Creek area. The study area is located approximately 29.5 km northwest of Castlegar, B.C. on the north side of lower Arrow lake. Access to the site is obtained via Broadwater road and a small logging hall road.

The study area is contained in the ICHal (dry site) zone and is seral Ponderosa pine community. This community has developed naturally with a 11.6 year fire frequency. The introduction of modern forest fire suppression activities has greatly reduced the natural fire frequency in the study area. By altering the natural occurrence of fire the productivity of this site has being greatly reduced for both wildlife and forest.

Prescribed burning within the natural fire frequency can be used to imitate the natural occurrence of fire in Ponderosa pine communities. Prescribed burning at a natural frequency can greatly improve a site's productivity with no damage to the community. Prescribed burning will reduce fuel loads, check the encroachment of less fire-resistant species, recycle forest nutrients, and increase forage production and quality for wintering ungulates.

For more information and data regarding my findings in the Cayuse Creek study area, see the attached report.

J.L.B.

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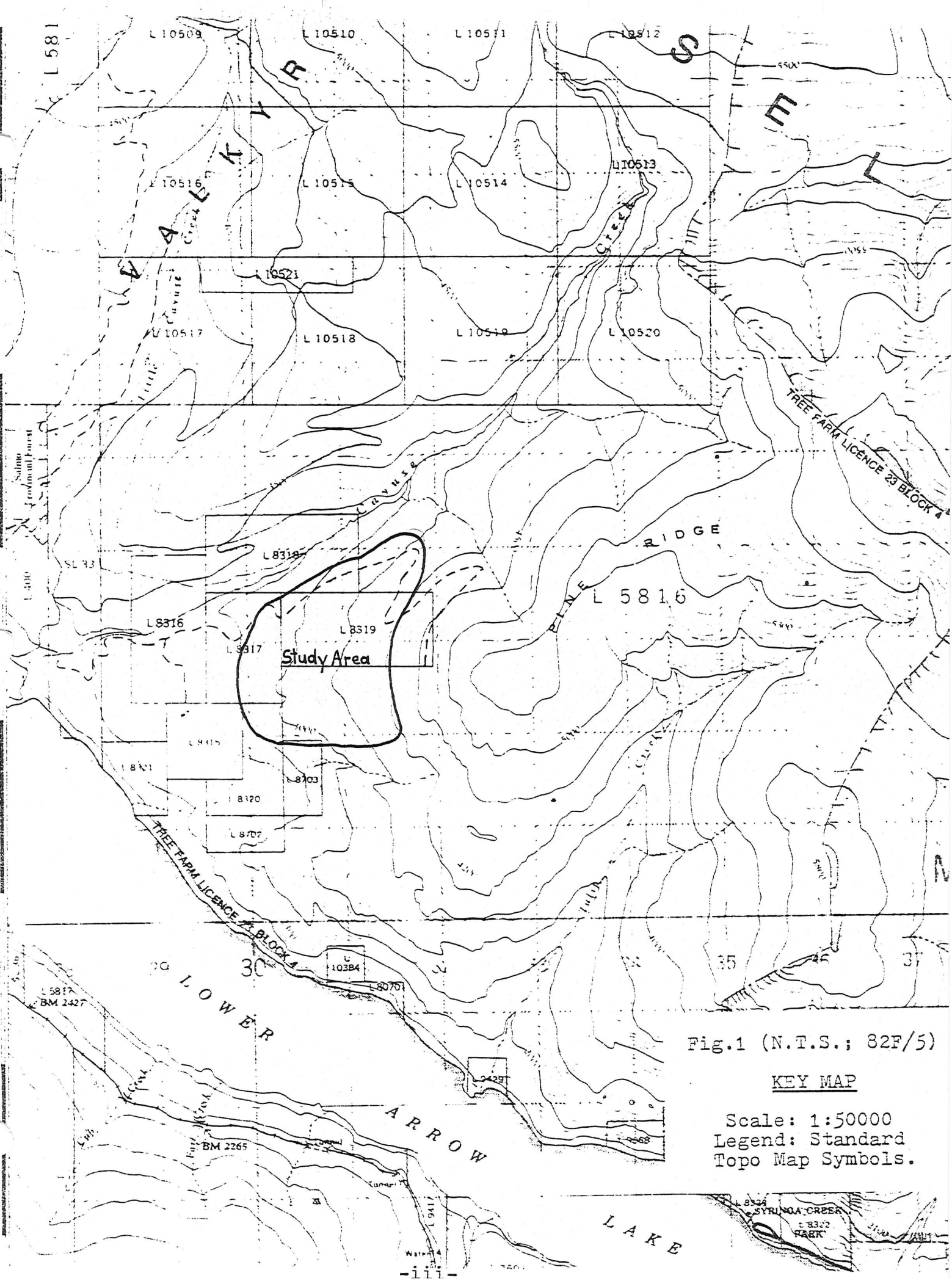

Fig.1 (N.T.S.; 82F/5)

KEY MAP

Scale: 1:50000
Legend: Standard Topo Map Symbols.

SUMMARY

A fire history study was carried out in the Cayuse Creek area of the west Kootenays in order to determine the natural occurrence of fire in the area. Fire history findings were used to predict the effects of prescribed burning on rangeland in the study area. A feasible range enhancement treatment was then developed for the study area to improve range conditions for wintering deer and elk. It was found that, this seral Ponderosa pine community has developed naturally with a 11.6 year fire frequency. Without periodic fire disturbance this habitat type tends to become less productive for both wildlife and forestry. Periodic underburning in Ponderosa pine stands was found to increase Ponderosa pine growth vigor, reduce fuel loading, check the encroachment of less fire resistant species, recycle nutrients locked in forest litter, increase forage production for ungulates, improve quality and palatability of browse, and rejuvenate decadent plants. Low intensity prescribed burns at the natural fire frequency can be used to imitate the natural occurrence of fire in Ponderosa pine communities with no damaging effects. It is recommended that the Cayuse Creek study area be enhanced for wintering deer and elk using a combination of prescribed burning and mechanical thinning. Mechanical thinning is suggested in certain sections of the study area as these areas are presently extremely over stocked with Douglas-fir and/or Lodgepole pine and therefore, prescribed burning would be too hazardous in these sections.

INTRODUCTION

PURPOSE

The purose of this report is to determine the natural frequency of fire in the Cayuse Creek area in order to determine the possible effects of prescribed burning. With the above information I then developed a feasible enhancement treatment for the site. The enhancement treatment is aimed towards increasing the value of the Cayuse Creek area for wintering deer and elk. The intended audience for this report is the Ministry of Environment, Nelson Fish and Wildlife Branch.

NEED

The need for this study and report stems from the fact that there is very little published data on the fire history of various ecosystems in this area, and none on the Cayuse Creek area. Therefore, it is difficult to determine when and how to use fire as a range enhancement tool in these areas. Guy Woods, Wildlife Biologist with the Nelson Fish and Wildlife Branch, has also expressed an interest in information about the natural fire history in this area.

In the past, fire played an important role in the maintenance and modification of most forest ecosystems. Since the introduction of modern forest fire protection plans, the natural

occurrence of fire on most forest sites has been minimized, thereby resulting in an unnatural modification of the forest site. In some areas, this unnatural modification has greatly decreased the quality of range for wintering ungulates.

By determining the natural fire history of a site one can obtain a good idea of how prescribed fire will modify that site's present condition. From past fire studies it is now known that when prescribed fire is used correctly winter rangeland can be enhanced and maintained at a high quality for ungulates.

In addition, the ever-increasing demands placed upon the land base by urbanization and commercial development have substantially reduced the total area of suitable winter rangeland available to ungulates. Therefore, there is a need for the enhancement and maintenance of remaining wintering areas.

METHOD OF INVESTIGATION

Information on the natural fire history of the Cayuse Creek area was obtained using the techniques developed by the Intermountain Forest and Range Experiement Station, Ogden, Utah. These techniques are outlined in detail in the methodology section of the report. Stand composition and crown

cover characteristics were gathered by establishing random sample plots throughout representative areas of the study unit. A forest densiometer was used to measure overstory crown closure. A 5 B.A.F. prism was used to select sample trees from which species, age, vigor, height, D.B.H. and crown class data was recorded. Various published studies having related fire frequency findings and ecosystem types were used to better predict the effects of prescribed burning in the Cayuse Creek area.

SCOPE

I choose to carry out my fire history and enhancement study in the Cayuse Creek area because of the abundance of fire scar samples throughout the area. In addition, the Nelson Fish and Wildlife Branch has expressed an interest in this area for wintering ungulates. Presently, this area is used by wintering White-tailed deer, Mule deer, and Elk. Therefore, these species would benefit from the enhancement of the range conditions.

Prescribed burning with the use of some mechanical thinning is the primary method of enhancement proposed. This method should provide the best results at the least expense.

An alternative method of enhancement, which would not in-

volve determining the natural fire history, would be to use mechnical techniques such as raking, cutting and thinning to promote browse resprouting, thinning and nutrient recycling. This alternative would obtain similar results in most areas, but would be very slow and labour-intensive. Another possible alternative would be the use of prescribed burning without determining the natural fire frequency and present stand composition. This alternative may result in favorable changes to the range, but these changes would be very difficult to predict. One would also have no base-line data from which to measure changes with this method. Therefore, these alternative methods have not been considered in this report.

The one criterion used in this study was that the natural fire frequency, determined by the history study, would determine the frequency of prescribed burning on the site. The limitations in determining the natrual fire history consisted of the following:

a/ only fire scars recorded before 1936 were used in the fire chronology, since these fires reflect the time period when organized fire suppression was not well established and effective in this region. Therefore, these fires represent the natural fire frequency.

b/ sample fire scarred trees were only sampled if they

were located within the study area and expressed at least one clear fire scar.

c/ scar cross-sections expressing clear rings were used to adjust dates from unclear cross-sections.

d/ cross-sections with large amounts of rot and/or unclear rings were not used in the fire chronology.

e/ date adjustments were kept down to 1-3 years.

1.0 Study Area

1.1 Location

The area of study is situated in the southeast portion of British Columbia, in the west Kootenays, and is part of the Valhalla Range of the Selkirk Mountains. The study area is located 29.5 km northwest of Castlegar, B.C. on the north side of Lower Arrow Lake. Access to the area is obtained by travelling 27.5 km north of the Robson/Castlegar ferry via Broadwater Road, then turning right onto a small logging access road located approximately 200m east of the Cayuse Creek bridge on Broadwater Road. The study area's south boundary begins 2.0 km up the logging access road. (See key map, Fig 1)

1.2 Topography

The topography throughout the study area is gently rolling with a number of small, level benches. The area is located on a south aspect and contains few rock outcrops. The elevation of the study area ranges from 2500m on the south boundary to 4000m on the north boundary. The total area contained in the study area is approximately 20 hectares.

This area has been classified by the B.C. Forest Service classification system as being within the ICHal (Dry Site) zone.

1.3 Vegetation

The vegetation type in the study area can be classified as a seral Ponderosa pine community. This habitat type occurs primarily in southern British Columbia, western Montana, northern Idaho, and northeastern Washington. This habitat type is found on areas that are intermediate between the dry Ponderosa pine lands and the more moist Larch-Douglas fir type. This habitat type has definite fire origins, and without periodic fire disturbance tends to pass slowly into a Douglas-fir climax with significant amounts of Ponderosa pine and Larch (Wright and Bailey 1982). Other species occurring in this community are Grand fir (Abies grandis) and Lodgepole pine (Pinis contorta). Common grasses and forbs in this habitat type include Yarrow (Achillea millefolium), Princes pine (Chimaphila umbellata), Western fescue (Festuca occidentalis), Pine grass (Calamagrostis rubescene), and Bluebunch sheatgrass (Agrosyros spicatum). The more common shrubs in the habitat type are Huckleberry (Vacc-

inium spp.), Wild rose (Rosa spp.), Douglas maple (Acer glabrum), Mallow ninebark (Physocarpus malvaceus), Ocean spray (Holodiscus discolor), Oregon grape (Mahonia aquifolium), Snowberry (Symphoricarpos albus), Redstem ceanothus (Ceanothus sanguineus), Snowbrush (Ceanothus valutinus), and Hazelnut (Corylus cornuta).

1.4 Soil

Soils in the study area were derived from the Nelson batholith parent material consisting of decomposed granite, gneiss, and rhyolite. The soil is a dystric brunisol, characterized by a thin Ah horizon and moderate development from the original parent material. The texture of this soil varies considerably from area to area. This variation in texture can, in most cases, be detected by the vegetation growth on the site. The finer textured soils tend to support a larger number of stems per hectare. The coarser soils support fewer stems per hectare, are low in fertility, water holding capacity, and weak structured.

2.0 Methodology

2.1 Field Reconnaissance

The first step in the collection of field data for

this study was a field reconnaissance of the proposed study unit. The general area of study was suggested to me by Mr. P. Ommundsen, a Wildlife Management instructor at Selkirk College. The general reconnaissance of the area was carried out by walking through the unit noting the number of fire-scarred trees and habitat type changes. Following this rough assessment of the total area, a representative sample area was then selected. A detailed reconnaissance of the selected sample area was then carried out. Rough transect lines were established to determine habitat type changes, species composition, age class data, and the number and location of fire-scarred trees.

2.2 Sampling Fire Scarred Trees

After completing the field reconnaissance and noting the location of fire scarred trees, final selection and marking of sample trees was carried out. Trees with the greatest number of externally visible, individual fire scars were given the highest priority for sampling. Where candidate sample trees had similar numbers of scars and soundness, Ponderosa pine species were preferred over Douglas-fir or Larch because the former usually has clearer scar rings. Cross sections

were taken from one side of the scar cutface on sample trees using a roller-tipped chainsaw. Sample trees and cross sections were then labelled for easy identification and re-sampling if needed.

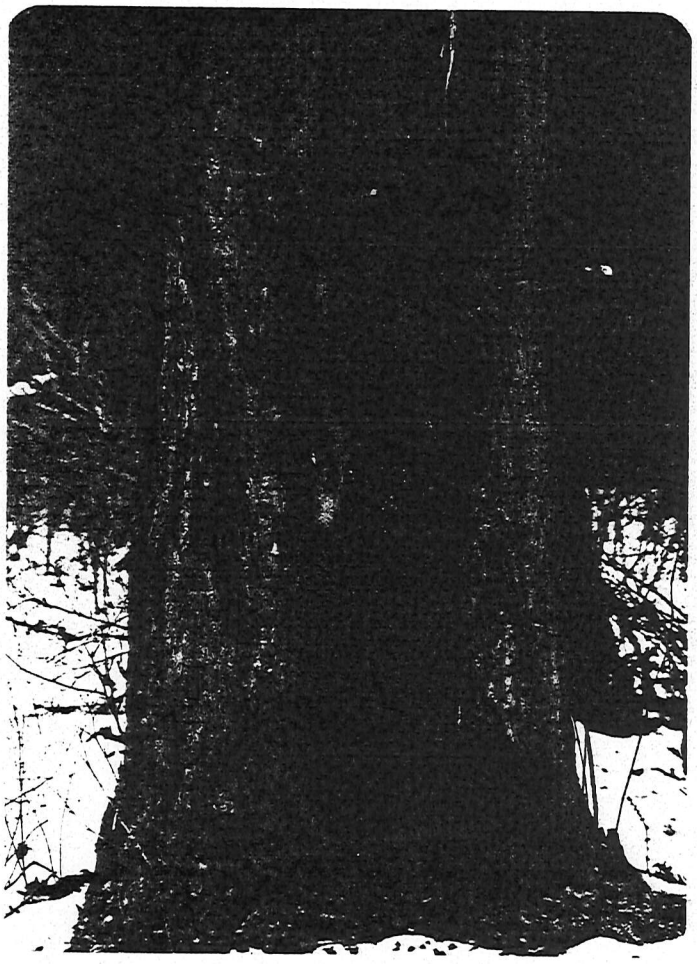

Fig. 2 Fire-scarred veteran Larch

2.3 Laboratory Analysis

After each day of sampling, cross sections were laid out for drying in a heated building. Within one to two weeks, surfaces were dry enough to sand. A rotary disc sander was used to smooth sample surfaces in order to obtain clear, accurate ring

counts. Ring counts were made using a high-power magnifying glass. Counts were made inward from the cambium counting one year for every light band of wood. Ring counts were made twice, or until constant readings were obtained. Dates of historic fires from the ring counts were then ploted on graph paper in order to obtain a clear picture of the site's fire history. Dates from cross sections expressing clear ring counts were used to adjust dates from unclear cross sections where needed. These date adjustments were kept down to 1-3 years. The total number of fires, maximum and minimum fire free intervals, and fire frequency was then calculated using the graph data outlined above.

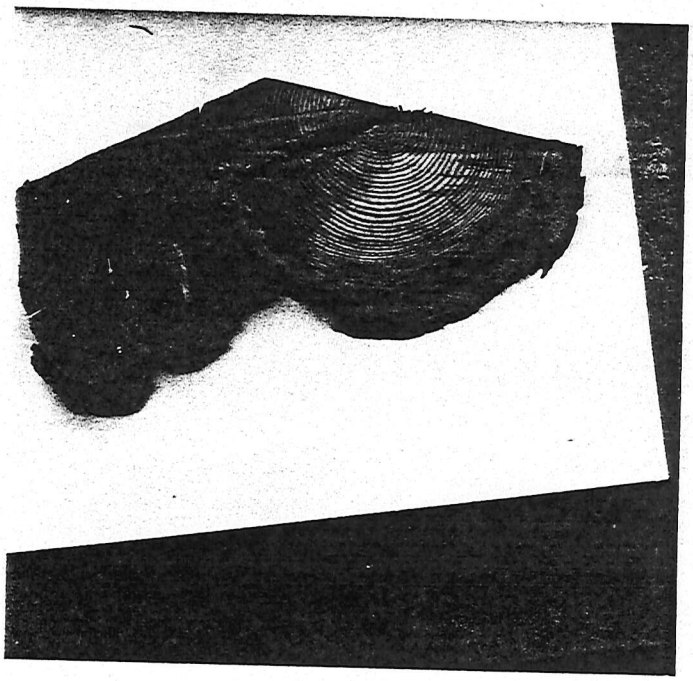

Fig. 3 Sample cross-section showing five separate fire scars.

2.4 Vegetation Survey

A vegetation survey was carried out in the study area in order to determine the present stand composition and crown cover characteristics. Random sample plots in representive areas of the study area were established using a 5 BAF prism. Species, age, vigor, height, DBH and crown class data was recorded for trees within sample plots. A forest densiometer was used to measure overstory crown closure. Four closure readings; north, south, east, and west, were taken at each plot and the average of the four readings was recorded.

3.0 Results

3.1 Vegetation Inventory

Presently in the Cayuse Creek study area there are very few veteran stems per hectare as a intense stand-destroying fire occurred 47 years ago. The remaining veteran trees are composed primarily of Ponderosa pine, with a small percentage of Larch and Douglas-fir. Douglas-fir forms the dominant level of the canopy and composes 58% of the stand. Western larch is also found in the dominant level of the canopy but only composes 32% of the stand.

The average age of the Douglas-fir on the site was 124 years. The average height of this species was 27m with an average DBH of 26.2 cm. Douglas-fir expressed high growth vigor during the first 26-40 years but declined sharply beyond this point. The Western larch on the site expressed similar growth vigor although the height of Larch averaged 2-5m greater than that of the Douglas-fir. The average age of the veteran Ponderosa pine was found to be 329 years. The growth vigor of these veteran stems was low in the last 2.5 to 3 cm of growth. Beyond the 2.5 to 3 cm point, growth vigor was moderately high.

The overstory crown closure on the site ranged from 60-67%. Dominate and intermediate Douglas-fir stems contributed greatly to the overstory crown closure readings. The veteran Ponderosa pine stems were generally everly and widely spaced.

Conifer regeneration was moderately low throughout the area although dense, stagnate patches of Douglas-fir regeneration do occur in most moisture-receiving areas. (See Figure 4). All other moisture-receiving sites were populated by mixed Aspen, Poplar, and Alder stands. Western larch and Pon-

derosa pine regeneration was extremely low throughout the area.

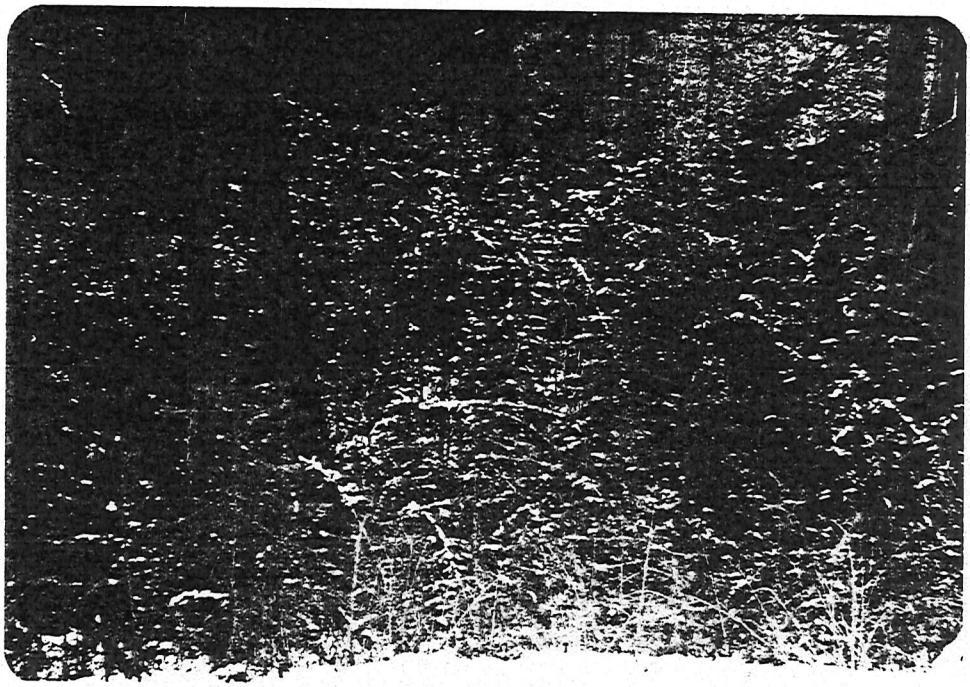

Fig. 4 Stagnant patch of Douglas-fir regeneration.

3.2 Fire Frequency

Underburning has been common in the Cayuse Creek area as indicated by numerous fire-scarred trees. The range of fire scar dates covers a period from 1762 to 1950. The scar dates prior to 1937 represent the period of time in which organized fire suppression activities were not well established in this region. Therefore, these fires likely represent the natural occurrence of fire in this area.

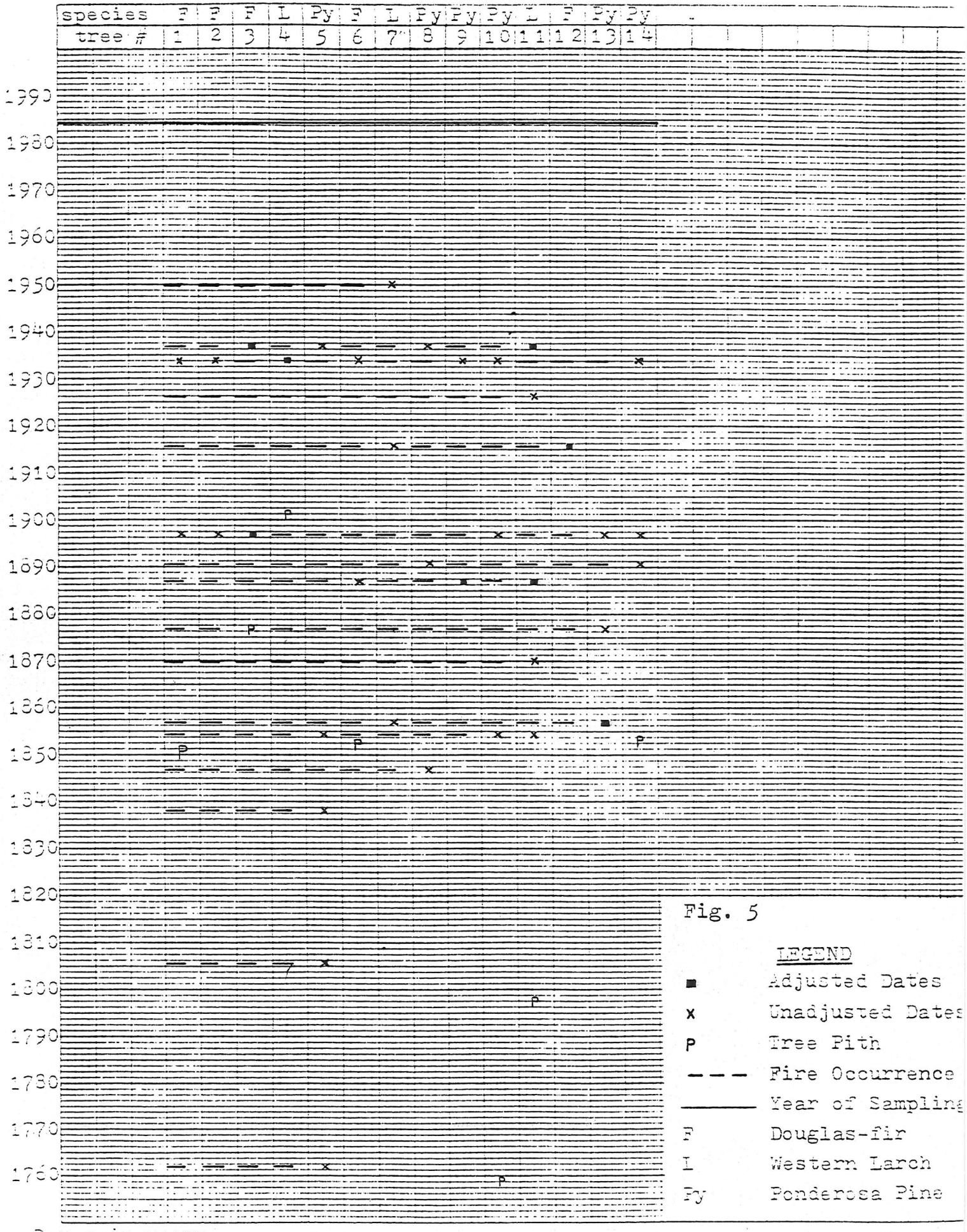

Fig. 5

Dates in years

The natural fire frequency in the Cayuse Creek study area was calculated over a 175 year period which ranged from 1762 to 1937. The natural frequency of fire during this time period was 11.6 years. The minimum and maximum fire free intervals were 3 and 44 years respectively. Figure 5 presents a clear summary of these fire frequency findings.

4.0 Natural Fire Cycle in Ponderosa Pine Communities

With the advent of modern forest fire suppression activities the frequency of fire in forest communities has been greatly reduced. "Historical evidence indicates that fires have always been an ecological force in Ponderosa pine communities, regardless of whether they were seral or climax" (Hall 1976). By altering the natural frequency of fire in a Ponderosa pine community, the natural development of the community is also altered. This results in a less productive stand for both wildlife and forestry.

The natural development of a Ponderosa pine community can be summarized by the following events. Patches of over-mature trees lose vigor and eventually die resulting in increased fuel loading. Low intensity fire moves into the site and quickly gains intensity due to fuel loads.

This results in the formation of an open area of exposed mineral soil. Surrounding Ponderosa pine seeds are blown into the opening. Seeds germinate and establish easily on the bare mineral soil surface in open sunlight (Schubert 1974). A new, vigorous, Ponderosa pine stand begins to develop from the ashes and charred remains of the old stand.

Later, grasses and shrubs compete with the pine seedlings and partially thin them (Pearson 1942). Eventually, the pine seedlings overcome the grass competition and begin to dominate the site. While the opening is still predominantly grass, subsequent fires act as a natural thinning agent. The fires will be of low intensity as fuel accumulations are low. Therefore, fire will only kill the smaller, thin-barked saplings leaving the healthy, more vigorous trees (Biswell et al 1973). Dense thickets of young Ponderosa pine and related species will also be killed in the fire, causing the cycle to begin from mineral soil again (Hall 1976). Repeated fires check the encroachment of the less fire-resistant species associated with both seral and climax Ponderosa pine communities. This burning cycle aids in the development of mature, vigorous, evenly spaced Ponderosa pine stands.

As the trees reach greater heights, they become more vulnerable to lighting. The largest trees in isolated

groups are commonly struck by lightning (Biswell et al 1973). These trees serve as conductors igniting surface fires which burn dead and diseased trees, thickets, and heavy fuel accumulations. The cycle then repeats itself forming a mosaic of uneven aged groups of Ponderosa pine (Wright and Bailey 1982).

5.0 Impacts of Fire Suppression

The habitat type in the Cayuse Creek area is classified as a seral Ponderosa pine community. Without periodic fire disturbance this habitat type tends to change into a climax Douglas-fir, Larch type (Wright and Bailey 1982).

By reducing or removing fire from Ponderosa pine development by modern fire suppression activities, we greatly limit the productivity of these stands. A study carried out in the Blue Mountains of Oregon by Hall (1973) confirmed these speculations. Hall found that Ponderosa pine, which developed on sites which did not receive periodic underburning, averaged 40 rings per inch diameter growth. Old growth Ponderosa pine on the same site, which developed with periodic underburning, showed 5 to 7 rings per inch diameter growth. In addition to increasing productivity, periodic underburning reduces the hazard of intense wildfire for 5 to 7 years (Truesdell 1969).

In the Cayuse Creek area much of the winter rangeland has been classified as class 1 and 2 range by the B.C. Fish and Wildlife Branch. I feel that this classification may be correct, but also believe that this area is presently far below its potential carrying capacity. Water and shelter requirements for deer and elk are easily met in this area as there are numberous watering sources and adequate levels of cover throughout. Usable forage volume seems to be the major limiting factor in this area.

I feel that the low usable forage volume in this area is a result of the fire frequency being greatly reduced over the past 47 years. Between 1937 and 1984 there was only one fire detected and recorded in my fire history study. This reduces the average fire frequency from 11.6 years prior to 1937, to 47 years after 1937. This reduced fire frequency is likely due to forest fire suppression activities in this area. By reducing the natural fire frequency, we have altered the natural development of this seral Ponderosa pine community.

Grass and forb production seems to be very low throughout much of the area as forest litter build-up and increased crown closure have produced a undesirable environment for many of these species. The increased crown closure in the study area is mainly due to the encroachment of

less fire-resistant species, such as Douglas-fir.

These is a substantial shrub population found in the understory throughout much of the study area. Many of these shrub species show evidence of browsing, but the majority of them are over mature and have either stagnated or grown beyond a usable level (1.5m). I feel that with the proper management and enhancement techniques, the quality of this winter range area can be greatly improved.

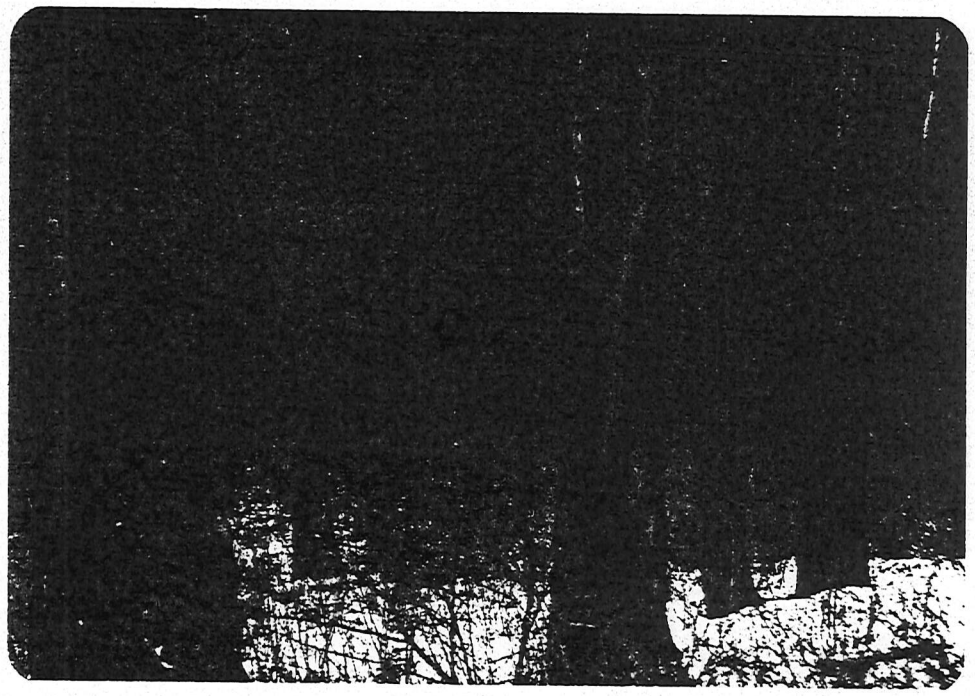

Fig. 6 Substantial Shrub Population in Stand Understory.

6.0 Probable Response to Prescribed Burning

The majority of information regarding the probable response to prescribed burning in the Cayuse Creek study area has been derived from published studies carried out

by Merrill, Mayland, and Peek (1982), Keay and Peek (1980), and Leege and Hickey (1971). These studies were carried out in ecosystems having similar site characteristics to those of the Cayuse Creek area.

The predicted responses to prescribed burning will be reduced fuel loading in the understory and removal of stagnant patches of conifer regeneration. This should stimulate grass and forb production. Natural thinning of the stand, particularly the less fire-resistant species, should reduce the present overstory crown closure. Decreased crown closure combined with the removal of excess forest litter will likely promote browse regeneration from seeds, increase nutrient recycling, and stimulate Ponderosa pine regeneration. Burning should also reduce the level of competition on the fire-resistant species, thereby promoting faster growth. The height of shrub species will be reduced and over-mature, stagant plants will be rejuvenated. Resprouting of many browse species should occur, increasing browse quality and palatability for wintering ungulates. Species composition and mineral concentrations of the understory plants should not be greatly altered by light burning within the natural fire frequency of the community (Arno 1980). However, an increase in total production and a change in the balance of production among species may occur (Wright and Bailey 1982).

CONCLUSION

The Cayuse Creek study area is a valuable winter range for white-tailed deer, mule deer, and elk. The present condition of the range in this area is far below its potential as modern forest fire suppression activities have greatly reduced the natural occurrence of fire over the past 47 years. This seral Ponderosa pine community in the Cayuse Creek study area has developed naturally with a 11.6 year fire frequency. By reducing the fire frequency, the productivity of this area has been greatly reduced. Grass and forb production seem to be very low throughout the area. Many shrub species are over mature and have stagnated. Encroachment of less fire-resistance tree species has produced a high level of competition between tree species. Ponderosa pine regeneration rates are extremely low due to a lack of exposed mineral soil, increased crown closure and high site competition from Douglas-fir regeneration. Much of the Douglas-fir regeneration is located in the moisture receiving sites and is extremely over-stocked and presently stagnant. Prior to 1937, periodic underburning was common in the Cayuse Creek area. By reducing the frequency of fire in this area we have altered the natural development of this seral Ponderosa pine community. Prescribed burning within the natural fire frequency is a very effective method of increasing the productivity of Ponderosa pine communities for both forestry and wildlife.

RECOMMENDATIONS

I recommend that the winter range in the Cayuse Creek study area be enhanced for wintering deer and elk by using a combination of prescribed burning and mechanical thinning. This recommended treatment could easily be applied to other winter ranges in this region which express similar ecosystem characteristics. Slight modification may have to be made to the following treatment if used elsewhere as my recommendations are site specific.

As sections of the Cayuse Creek study area are presently extremely over-stocked with Douglas-fir and Lodgepole pine, prescribed burning in these areas would be extremely hazardous. Therefore, heavily over-stocked areas should be mechanically thinned using chainsaws. 20 to 30 percent of the over-stocked areas should remain untreated as there areas may serve as cover sources for ungulates during mid-winter months or fawning areas durning late spring to early summer. The diameter of these over-stocked cover leave areas should be 5:1 sight distances and composed primarily of Douglas-fir 20m in height or greater. Douglas-fir provides good snow interception and is a food source for both deer and elk.

The remaining area should be divided into sections of similar slopes, aspects, species, and stocking levels and treated with a low intensity head fire. These sections should be

treated as separate burns as each will produce different hazard problems. Multiple burns on certain sections may be needed to obtain an even and complete burn. Burning should be carried out in early spring while plants are still dormant. Early spring burning will reduce plant mortality levels due to burning and will allow plants a full growing season before winter browsing.

On large winter range areas, burn sections should be rotated over the entire range and spread over a 2-5 year period. This rotational burning spread over a 2-5 year period distributes ungulate browsing pressures over the entire range, reduces inter-animal conflicts and allows for close monitoring of range response.

Due to the relatively small size of the Cayuse Creek study area, rotational burning is not feasible within the study block. However, by selecting similar south facing slopes in and around the Cayuse Creek Deer Creek area, rotational burning could easily be used as a feasible enhancement technique in this area.

The frequency of prescribed burning should imitate that of the natural fire frequency. If a stand has developed naturally with a eleven year fire frequency, imitating this frequency with low intensity prescribed burns should have no damaging effects to the stand. Monitoring of range response at any burning frequency should be carried out as minor

adjustments may be needed. If forage production and density levels steadily decline after each burn, the burning frequency is likely too short. If forest litter levels build-up or browse plants grow above a usable level and begin to stagnate, the burning frequency is likely too long.

In summary, I feel that a combination of prescribed burning and mechanical thinning is the most feasible and economical method of enhancing the range conditions in the Cayuse Creek study area.

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APPENDIX ONE

Contents: Detailed Graph of Fire History Findings.

APPENDIX TWO

Contents: Additional Photographs From The Study Area.

Merrill, E, Mayland, H. and Peek, J. 1982. Shrub responses after fire in an Idaho ponderosa pine community. in Journal of Wildlife Management. Vol 46 (2): 496-501.

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