Ural-Tweed Bighorn Sheep Wildlife Mitigation Project

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URAL-TWEED BIGHORN SHEEP - WILDLIFE MITIGATION PROJECT

ANNUAL REPORT

January 1, 1986 - December 31, 1986

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URAL-TWEED BIGHORN SHEEP - WILDLIFE MITIGATION PROJECT

PROJECT 84-38: KOOTENAI NATIONAL FOREST
PROJECT 84-39: MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

ANNUAL REPORT
January 1, 1986 - December 31, 1986

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ABSTRACT

This report sunmarizes the results of the project activities from September 1, 1984 to December 31, 1986. To date, habitat treatments have been initiated on eight areas. The treatments include selective slash and burn, prescribed fire and fertilization. Inclement weather precluded the completion of the prescribed burns scheduled during fall 1985 and fall 1986. The lower Stonehill prescribed fire was rescheduled from fall 1985 to spring 1986 with the burn accomplished, producing varied results. Extensive pretreatment vegetative information has been collected from all units scheduled for habitat manipulations Additionally, future projects have been delineated for other areas frequented by bighorn sheep.

Ten adult bighorn sheep (5 ewes and 5 rams) have been fitted with radio transmitters. Systematic aerial and ground surveys were utilized to monitor the movements and seasonal habitat preferences of the instrumented sheep. Age and sex information was gathered whenever possible to aid in the development of a population model, Monthly pallet group collections were initiated in May 1985 to provide samples for 2.6 diaminopimetic acid (DAPA), food habits and lungworm larvae analysis. The majority of the data analysis is ongoing and will be presented in later reports

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INTRODUCTION

The Ural-Tweed bighorn sheep (Ovis canadensis) population, the last remnant native bighorn sheep population in northwestern Montana, occupies the east face above Lake Koocanusa. The historical distribution of the population has been along the east face of the Kootenai River valley from Cripple Horse Creek north to Pinkham Creek, and the Kootenai River east to the top of the Pinkham Divide (Brink 1941, Couey 1950, Brown 1979). Available information indicates this population underwent steady population growth from the 1940's (Ensign 1937, Brink 1941) until it stabilized in the mid 1960's at approximately 150-200 head. US. Dep. of Inter. (1965) estimated there were 170 sheep in the population. During the late 1960's the population suffered a catastrophic decline to a population level estimated at 20-25 animals (Brown 1979). The population has remained at a low level since the decline: however, recently the population has steadily increased in numbers and may be slowly recovering from the decline.

The decline of the Ural-Tweed population was attributed to two factors (Yde and Olsen 1984):

1. Construction of the Libby Dam project and associated facilities, including the relocation of Highway 37 through the bighorn sheep range: and

2. Ecological succession from the preferred open ponderosa pine (Pinus ponderosa) - bunchgrass disclimax community to a more closed canopy Douglas-fir (Pseudotsuga menziesii) community.

The construction of Libby Dam and the impoundment of Lake Koocanusa inundated approximately 4350 acres of habitat which provided essential habitat components for winter and spring range (Yde and Olsen 1984). The inundated habitats provided nutritional forage during periods of adverse winter weather and during the important spring "green-up". Brown (1979) documented the historical spring use of the Kootenai River floodplain by bighorn sheep. With the important "green-up" areas inundated by the reservoir, the bighorn sheep have been forced to use lower quality, dormant vegetation for a longer period than they normally would, with a suspected reduction in physical condition resulting in reduced reproductive success. "Green-up" areas are important for ewes during late stages of preqnancy and lactation (Stelfox 1976 and Wishart 1978).

The construction of Riqhway 37 through the bighorn sheep range directly removed approximately 580 acres of seasonal habitat (Yde and Olsen 1984). The lengthy sections of shear highwalls - up to 0.6 miles - created during highway construction act as barriers for free movement to and from the island of habitats located between the highway and Lake Koocanusa. Additionally, it is

suspected the highway has increased the amount of human harassment. In a summary of various studies, Thorne et. al. (1979) concluded stress due to human harassment (active or passive) had a detrimental impact on bighorn sheep by increasing the overall energy expenditure and reducing the chances of survival and/or growth of lambs, ewes and young rams.

Ecological succession has also dampened the ability of the Ural-Tweed herd to rebound from the catastrophic population decline. The quality of the sheep range and presence of the open ponderosa pine - bunchgrass community has historically been maintained by wildfire. This was documented by the abundance of fire scarred trees in the area and aerial photos taken in 1944 (Kootenai National Forest file) which illustrate the presence of a habitat mosaic created by many fires. However, with the initiation of intensive fire suppression in the 1930's, the role of fire in maintaining the preferred ecological disclimax community was circumvented and more densely forested Douglas-fir communities became established on once quality bighorn sheep habitat. Stelfox (1976) noted the same type of fire suppression and resulting loss of bighorn sheep habitat due to advanced ecological succession in the Athabasca Valley, Alberta, Canada between 1921 and 1953.

In accordance with the Pacific Northwest Electric Power Planning and Conservation Act of 1980, P.L. 96-501, a joint project between the Kootenai National Forest and Montana Department of Fish, Wildlife and Parks, funded by Bonneville Power Administration, was initiated in September 1984 to mitigate the impacts of the construction of Libby Dam hydroelectric facility and Highway 37 on the Ural-Tweed bighorn sheep population, This project is directed at habitat improvement within selected winter and spring bighorn sheep use areas. The objectives of the project are:

1. Plan, design and construct travel corridors to facilitate movement of bighorn sheep across Highway 37 to the island of habitat between the highway and Lake Koocanusa;

2. Cooperatively design habitat improvement projects to enhance the bighorn sheep seasonal habitats. The Kootenai National Forest has the responsibility to conduct the enhancement projects, while the Department of Fish, Wildlife and Parks has the responsibility to determine the effectiveness of the habitat improvement projects in enhancing bighorn sheep, other wildlife and their habitats; and

3. Outline a program to maintain a viable Ural-Tweed bighorn sheeppopulation.

DESCRIPTION OF THE PROJECT AREA

The project area (Figure 1) encompasses the current range of the Ural-Tweed bighorn sheep population and corresponds to the area studied by Brown (1979). This range extends north along the east side of the reservoir from the Five-mile Creek drainage to Holdup Gulch, an area of approximately 34,000 acres. The majority of the sheep range is located along the slopes above the reservoir: however extensive seasonal use areas up three major drainages - Five-mile Creek, McQuire Creek, and Sutton Creek - are also included in the project area. For a more detailed description of the project area see Brown (1979).

The initial habitat improvement projects have been located between Lake Roocanusa and Highway 37 with the exception of two treatments above the highway on Stonehill and one area between McQuire and Tweed creeks. The primary reasoning for this was the presence of habitats known to receive high seasonal use by bighorn sheep (Brown 1979) combined with the consensus that well designed habitat manipulations would provide favorable vegetative responses - increase in the production of understory vegetation - which would in turn benefit the bighorn sheep population. Additionally, a large helicopter logging operation (Figure 2) was planned to enhance approximately 3,200 acres of the bighorn sheep range. The timber to be harvested within this sale area is located above Highway 37 and no additional habitat manipulation can take place within the sale units until the timber has been harvested and removed.

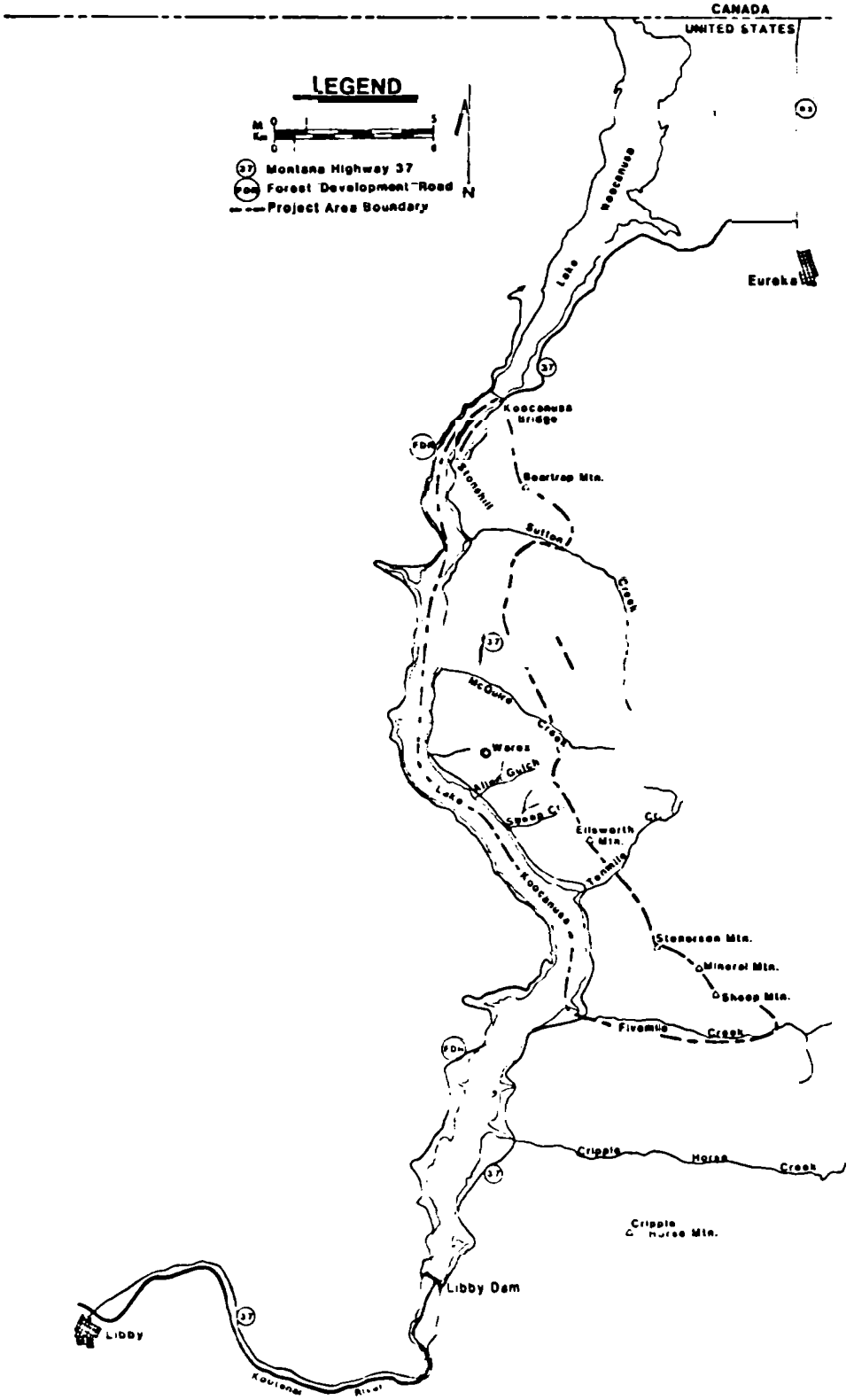


Figure 1. Map of the Ural-Tweed bighorn sheep project area.

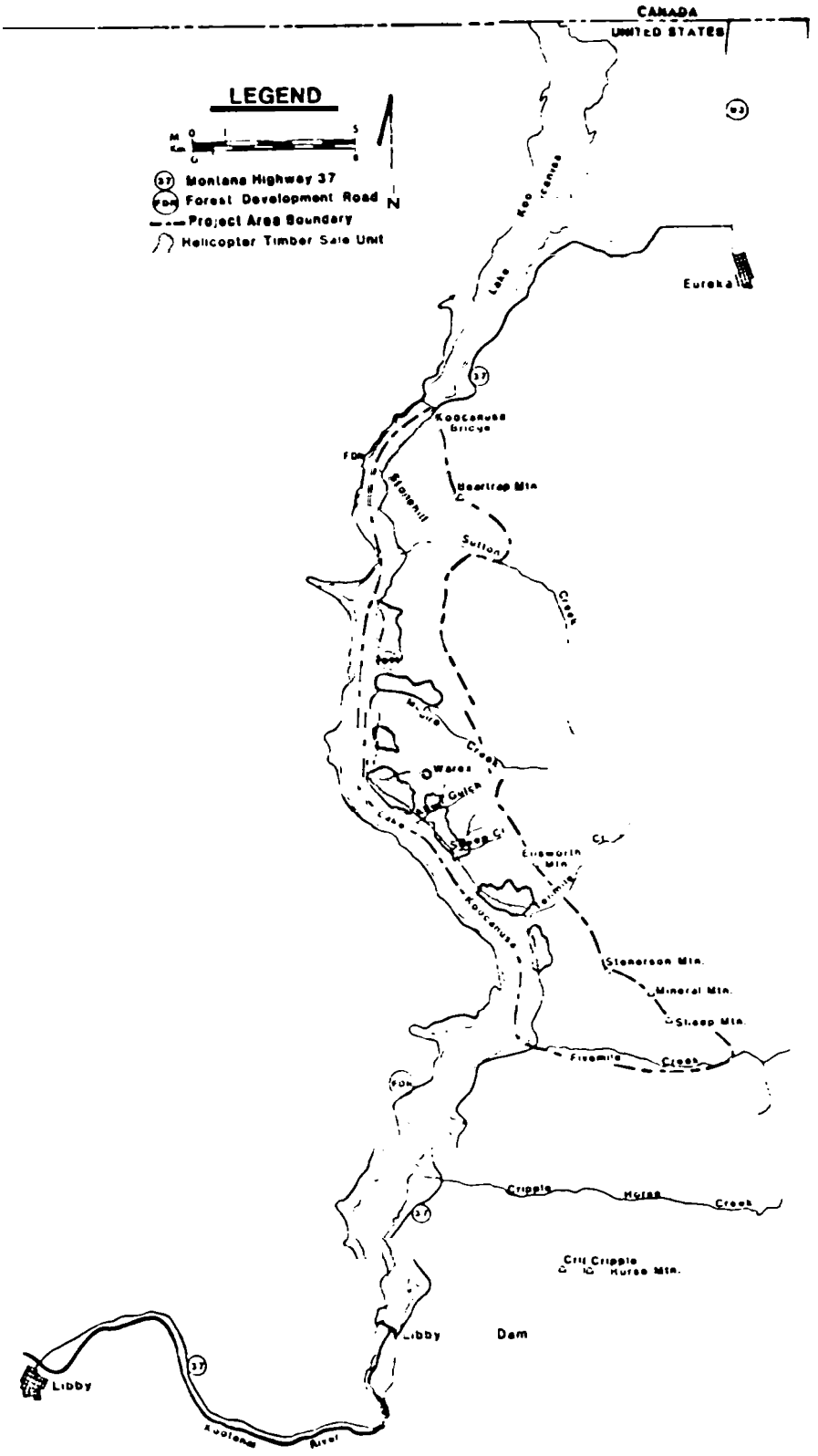


Figure 2. Location of the Whirlybird timber sale units.

METHODS AND MATERIALS

Determination of habitat threatments

Objective is to reduce plant succession to earlier stages through:

1. Slashing of conifers present on the site or which have encroached on the site as a result of fire suppression; or

2. Removal or reduction of vegetation on the site through the use of prescribed fire; or

3. A combination of the above, where slashing is used to increase fuel loads in preparation for subsequent prescribed burns.

After a review of the possible habitat treatments and the habitats and topography of the project area, it was determined that several habitat treatments should provide beneficial modifications to the habitat. The anticipated benefits were also compared to the various treatment costs to provide that the maximum beneficial results would be obtained for a reasonable cost. The selected habitat treatments include:

1. **Slash and thin.** Trees of a particular species and/or size (usually less than a given diameter breast high - d.b.h.) are cut, thereby opening the canopy and providing for a release of the understory vegetation. Also, the solar radiation intercept is reduced providing for warmer soil temperatures which are not as conducive to the establishment of conifer regeneration This reduction in vegetative competition provides for an increased release of understory vegetation - forage. A prescribed fire is usually a follow-up treatment used to remove slash and to stimulate understory vegetation

2. **Strip slash.** Amodification of the slash and thin where alternative strips of a predetermined width are cut or left undisturbed. A prescribed fire is usually a q up procedure used for slash removal and to burn through the leave strip, thereby opening it up alsa

3. **Prescribed burn.** A fire designed to provide a predetermined result is used to modify the vegetation of a treatment area. The fire also produces a release of the understory vegetation through removal of decadent or dead portions of the plant, resprouting and/or less vegetative competition. The prescribed fire is scheduled for spring or fall based on desired results, fuel loads and topography.

4. **Fertilization.** The aerial or ground (broadcast) application of fertilizer to selected grass slopes was determined to be the most applicable method to provide additional forage on selected areas. The selected areas were usually steep, rocky slopes which are not conducive to burning (low fuel loads and non-continuous fuels) or any other habitat treatment.

Four slashing prescriptions were developed to match the needs of the various treatment sites (Appendix A). In summary, they consisted of slashing all trees <10 in. d.b.h., all conifers <10 in. d.b.h. within a 60-ft. strip, all conifers except those designated, or all trees <8 in. d.b.h. with a 20-25 ft. interval 'between leave trees. Slashing was accomplished through the use of gasoline powered chain saws of greater than 3.0 $in.^3$ displacement equipped with conventional 18-24 in. bars. The work was accomplished both by contract to lowest bidder and with force account labor (seasonal Forest Service employees).

Fire prescriptions (Appendix B) were developed from the past experience of the personnel from the US. Forest Service combined with the use of the computer model BEHAVE. BEHAVE was used to determine the extreme fire behavior presented within the contingency plan. Prescribed burning was scheduled independently of slashing or in conjunction with slashing of some sites to increase available fuel loads. Prescriptions identified desirable flame heights of 2.0-5-0 ft, and fuel loads in the range of 7-43 tons/acre.

Two methods of ignition areplanned for the prescribe fires within the project. Ground ignition using several individuals with drip torches fueled with a mixture of diesel oil and gasoline, or fusees (highway flares) is used on the areas where topography and fuel loads allow for good safety. Generally, the crew members will walk in parallel lines along the contour across the burn site at intervals of 50-150 ft. according to fuel loads and prescription. On areas of steep topography and/or heavy fuel loads, aerial ignition will be utilized. Generally ignition has been planned to take place after 1200 hours to take advantage of higher afternoon temperatures, lower humidity and prevailing winds. Timing of the burn will be determined by fuel moisture contents. Moisture readings will be taken with a Delmhurst Fuel Moisture meter (Model G22) for the l-100 hour fuels and a Computrace Drying oven or microwave for the fine fuels (litter). Professional expertise by the Fire Management Officer from the Rexford Ranger District is also utilized to determine proper burning time.

Treatment Areas. Treatment areas were selected based on the known bighorn sheep use of the area (Brown 1979) and information gathered during the current project combined with the identification of specific areas where grass and shrub stands needed to be rejuvenated and/or conifer encroachment had to be reduced. Topographic features were used to determine the boundaries of the

areas. The topographic features delineate normal use areas of bighorn sheep and will contain treatments such as prescribed fire.

Seasonal movements and distributions of individual sheep have demonstrated a use of the entire project area (Brown 1979, Unpublished data, current project). While the sheep demonstrate preferences for specific seasonal use areas, the majority of the project area receives some sheep use. Additionally, individual sheep have demonstrated the desire and ability to move from one area to another at any time of the year: thus, there are usually sheep distributed throughout the project area, with concentrations of sheep found within scattered, preferred areas. Therefore, habitat enhancements have been planned throughout the project area. This willhelpto maintain the currentmovementpatterns throughout the area. Additionally, by being spread across the entire range the treatments are more likely to be utilized by more sheep and during more than one season.

Some selected treatments were designed to provide benefits for sheep; however, the primary emphasis was to enhance the unit for the mule deer and moose that use the area. By doing this, these species will stay distributed throughout their current range and not concentrate onthetreatments designed to enhance key sheep use areas. Hopefully, this will help maintain a low level of interspecific competition throughout the project area.

The treatment areas have been planned so as they are of sufficient size to be found and utilized by the sheep. Additionally, the treatment areas have also been planned to complement ongoing management programs (Whirlybird Timber Harvest, Rocky Gorge ponderosa pine seed cone plantation, etc.).

Vegetation monitoring. In order to properly monitor the changes in vegetation composition and structure resulting from the selected habitat treatments, extensive transects and long-term monitoring plots were established, Many publications were used in the establishment of the various methods, including Anon. 1977, Chambers and Brown (1983). Floyd and Anderson (1984), Dilworth and Bell (1982), Nudds (1977), U.S. Dept. Aqric. (1985) and U.S. Dept. Inter. (1978). Additionally, numerous field personnel, as well as personnel from Montana State University and University of Montana were consulted and their recommendations incorporated into the final methods.

To ensure sound analysis of the results of the various habitat manipulations, pre-treatment transects were established in each transect area, as well as in a control area paried to each treatment area. Due to the topoqraphic and gegetative features of the McQuire-Tweed treatment area combined with the logistics of slashing and prescribed burning,no control was established for this one treatnent. The vegetation data were collected from the treatment and paired control areas within as short of time period as logistically possible to ensure comparability of the data.

Where possible, the transects consisted of two segments oriented so they formed an X across the treatment/control area and monitored the vegetation from corner to corner. The end points of the transects were located to maximize the area of the coverage and no less than 150 ft. from the edge of the treatment/control area. This design allows for the monitoring of the vegetation across the entire treatment/control area, including variation due to changes in elevation and topography, and should eliminate the effect of treatment edge. Where necessary, due to topography, vegetation and/or configuration of the treatment/control area, modifications were made to conform the sampling methods to the given situation. Where changes in methods were needed, the same changes were made for both the treatment and paired control area.

A total of 100 sampling points were located at equidistance along each transect segment (200 points/transect). The point of measurement was a point directly in front of the toe of the investigators boot/shoe. At each point, ground cover (vegetative, litter, soil, rock, etc.) was recorded, as well as the understory canopy components in each layer to a height of 3.0 ft. above the sampling point. This allowed for the estimation of total ground cover, plant composition and understory canopy composition within the respective treatment/control area. Additionally, at every tenth point along each segment the following were completed:

1. A 2.40 ft^2 frame was used to estimate grass and forb production. The vegetative production within the frame was estimated (grams/species). In addition, at 4 of the plots, randomly selected prior to starting, the production (by species) was estimated and then the plots were clipped with the individual species weighed. A correction factor was then calculated to convert the estimated weights to actual weights. Green weights (grams/0.22 m^2) were then converted to lbs/acre. General phenology of the vegetation in the area of the transect was recorded.

2. A shrub characterization/volume plot was centered on the respective sampling point with the size of the plot varying according to species being sampled. A 0.0033 acre plot was used for the following species, which are usually very numerous when present within a plot: Rose (Rosa spp.), shiny-leaf spirea (Spirea betulifolia), common snowberry (Symphoricarpos albus), Huckleberry (vaccinium spp.) and any other shrubs with similar growth forms. A 0.01 acre plot was used for the remaining shrub species which were generally larger and less numerous within a plot. Starting at a random point and proceeding in a clockwise direction, the first 10 plants of each species were characterized by age and form class. Additionally, height (up to 6.0 ft.), length (along the contour) and width (perpendicular to the contour) were measured to estimate the volume of the shrubs - an indicator of production. The height over 6.0 ft. was not measured as

it would have to be estimated and is normally out of reach for browsing animals, especially bighorn sheep

Shrub volumes were later calculated using the following (Lyon 1984):

$$\text{volume} = \tilde{} \; hlw/4$$

$$= 3.12$$

l=length
h = height w = width

This formula estimates the cylindrical volume of the shrub. Volumes were then calculated on a per-acre basis. These volumes will be used to monitor vegetative changes over time.

3. A variable plot (basal area factor of 20) was used to estimate the tree basal area for mature - >15 in d.b.h. - and large regeneration - 5-15 in. d.b.h. The number of stems/acre of small regeneration - >5 in. d.b.h. - was estimated using a 0.0033 acre fixed plot,

4. Four sphericaldensiometer readings - located 15-20 ft. from plot center at 90° intervals around the sample point - were made. As designed, these readings will monitor the change in overstory canopy as the treatments are canpleted.

5. Slope and aspect at the sample point were determined using a clinometer and compass, respectively.

In order to provide a long-term method of monitoring the change in vegetation structure, 3 to 5 photo plots were established within each treatment/control area. Metal posts were used to permanent1y mark the 15 m plots. A 0.5 m x 2.0 m board, divided into 1.0 dm^2 squares alternately painted black and white, wasplacedatone endofthe plot and a photo taken with a 35 mm camera (50 mm lens, 64 ASA Kodachrome film) from LO m above the other end of the plot. To provide uniformity between photos the camera was focused on a spot 0.5 m above the bottom of the photo board.

Wildlife use of treatment areas. Permanent browse utilization transects were established to monitor the seasonal use of the shrubs within the treatment/control areas. The methodologies used are described in Anon. (no date), with the utilization data collected along the same general transects established to monitor the vegetation composition and structure. Browse utilization data were collected during the growing season, fall and early winter, allowing for determination of the season of use. Additionally, pellet group surveys - again corresponding to the general vegetation monitoring transect - were established within each of the treatments/controls. It was scheduled to complete the pellet group surveys in the spring in conjunction with the vegetation sampling, while in late summer/early fall and in late fall/early

winter they were scheduled for completion in conjunction with the browse utilization transects. At every tenth point along the respective transect a 0.01 acre circular pellet group plot was completed. Every pellet group within the plot was recorded and identified to genus whenever possible. If the investigator was in question astothe identity of a particular pellet group, it was lumped into one of the following: elk (Cervus elaphus)/moose (Alces alces) or deer (Odocoileus s&/bighorn sheep. A total of 20 plots per treatment/control per season were completed,

Through the use of breeding bird and small mammal surveys combined with casual observations, a wildlife species list will be established and periodically updated. The surveys will be established so the effects of the various habitat treatments on the wildlife community can 'be determined. When possible, as the various habitat treatments are established, considerations will be made to reduce detrimental impacts to other wildlife species and, where practical, to preserve or enhance habitats which are important in the maintenance of a diverse wildlife community.

Response of bighorn sheep. Free-ranging bighorn sheep were immobilized using an intramuscular injection of xylazine hydrochloride (Rompun®) and ketamine hydrochloride (Vetalar®). The standard 3.0 cc dosage was 2.0 cc xylazine (100 mg/ml) and 1.0 ketamine (100 mg/ml) administered with hypodermic syringe darts propelled from a Palmer powder charged Cap-Chur gun. Sheep were approached while they used roadside mineral licks and grassy roadcuts adjacent to Highway 37 and the dart administered at a distance of 15-30 m. Additionally, sheep were captured in a corral trap set up around a mineral lick frequented by bighorn sheep. Animals were fitted with radio transmitters, individually-marked neck bands or colored ear streamers, depending on the age, sex and body size of the individual. To date ten adults have been fitted with radio transmitters, one yearling ewe has been fitted with an individually-marked neck band, and a lamb has been fitted with colored ear streamers. Measurements, including horn length (total and annuli), horn circumference (base and annuli), zoological length, neck circumference, heart girth and height at shoulder, were made for all animals unless conditions did not allow. Starting in 1986, it was attempted to obtain a blood sample from each captured sheep.

Systematic on-the-ground and aerial relocation surveys of the instrumented animals were conducted. Bi-monthly fixed-wing survey flights were scheduled, as well as weekly on-the-ground relocations. During the parturition and nursery period, it was attempted to monitor the instrumented females every 1-3 days in an attempt to determine lambing/nursery areas, survival of young lambs and association with other bighorn sheep. In addition to the radio relocations, observations of bighorn sheep obtained during daily field activities were recorded.

Helicopter surveys (Bell 47) were conducted to determine population size and habitat use during selected seasonal use periods (early and late winter). During 1985 an attempt was made to survey the sheep during the spring while the ewes were more concentrated during lambing. This attempt was very unproductive due to lack of snow cover and topographic and vegetative conditions. Flights were timed so they were conducted during high activity periods when the sheep would be more readily observable. It was attempted to cover the entire range during each of the flights. Various flight patterns were utilized in an attempt to determine a method that allowed the investigator(s) to observe the sheep in the open rock outcrops/benches, as well as the closed canopy conifer forest.

Whenever possible, the sex and age of observed sheep were determined. This will facilitate the establishment of a population model which will accurately predict the population size and age structure. This model will be a valuable tool in the long-term management of the Ural-Tweed population.

Systematic monthly collections of fecal samples were initiated in May 1985. Only defecations known to be bighorn sheep have been collected. If any doubt existed as to whether a fecal sample was bighorn sheep or another ungulate species, the sample was discarded. In order to allow for a more complete comparison of the various test results, the sex and age of the individual animal was noted. Each sample was divided into two subsamples - one for analysis of the presence of lungworm (Protostrongylus spp.) larvae, one for analysis to determine the level of 2.6 diaminopimetic acid (DAPA). An agreement with the Montana State Veterinary Research Laboratory has been made to conduct the lungworm analysis. The samples to be analyzed for DAPA levels - an indicator of the nutritional quality of the diet (Nelson et al. 1982) - will be sent to the Wildlife Habitat Management Laboratory, Washington State University. A monthly subsample of the latter samples will be microhistologically examined to determine monthly food habits.

Travel corridors. Several areas within the extensive highwalls along Highway 37 have been delineated for modification to facilitate the movement of bighorn sheep, as well as other wildlife species, between the habitats above the highway and those within the island of habitat between the highway and Lake Koocanusa. Delineation of these areas was based on the findings of Brown (1979), input from personnel from MDFWP and the Kootenai National Forest knowledgeable of the sheep movements within the area and direct field observation by the project biologist (MDFWP). A representative from the Montana Highway Department was contacted on the feasibility of completing the modifications - this included a field inspection of the areas. Modification plans are currently being drafted.

Consultation and coordination. The nature of this project - a joint venture between the Kootenai National Forest and Montana Department of Fish, Wildlife and Parks to provide for the long-term, sound stewardship of important big game habitat - demands there be extensive interagency coordination between the various involved agencies. Coordination of the various aspects of the project has included field inspections, as well as interagency meetings. An interagency effort was also initiated to coordinate the habitat improvements resulting from the helicopter timber sale - also designed to enhance the bighorn sheep range - with the ongoing mitigation project. This will help maximize benefits to the Ural-Tweed population and other wildlife species inhabiting the area, and provide a plan for the maintenance of the range ensuring good stewardship of the habitats.

RESULTS

Habitat treatments. Habitat treatments have been scheduled on a total of 17 sites within the project area (Tablel). The habitat treatment scheduled for the Holdup Gulch area was moved to the McQuire-Tweed Creek area. It was felt that this would result in an increased benefit to the bighorn sheep project. Additionally, several potential sites have been delineated and future treatments may be established to enhance them. A summary of the habitat enhancement work that has been completed to date follows (Figure 3). Table 2 contains a summary of the enhancement costs incurred to date.

1. South Sheep Creek. This area, located below Highway 37, consists of approximately 120 acres of south- to southwest-facing slopes. The area was at one time a more open ponderosa pine/bunchgrass community; however, conifer encroachment, including ponderosa pine and Douglas-fir, reduced the forage production potential of the site. A slash and prescribed burn were scheduled to reduce the canopy density, open the stand and stimulate the understory vegetation. It was decided to slash all conifers <lO in. d.b.h. This reduced the canopy coverage and increased the fuel load for later prescribed burning. A follow-up prescribed fire was planned to dispose of the slashed trees, reduce ground litter, further open the conifer canopy and stimulate the understory vegetation.

This area has potential to provide yearlong habitat to the bighorn sheep population. Past (Brown 1979) and current observations indicate the bighorn sheep use this area and adjacent habitats, with preference for the area demonstrated during the winter and spring periods. Numerous bands of ewes and lambs have bean utilizing this area during the current project.

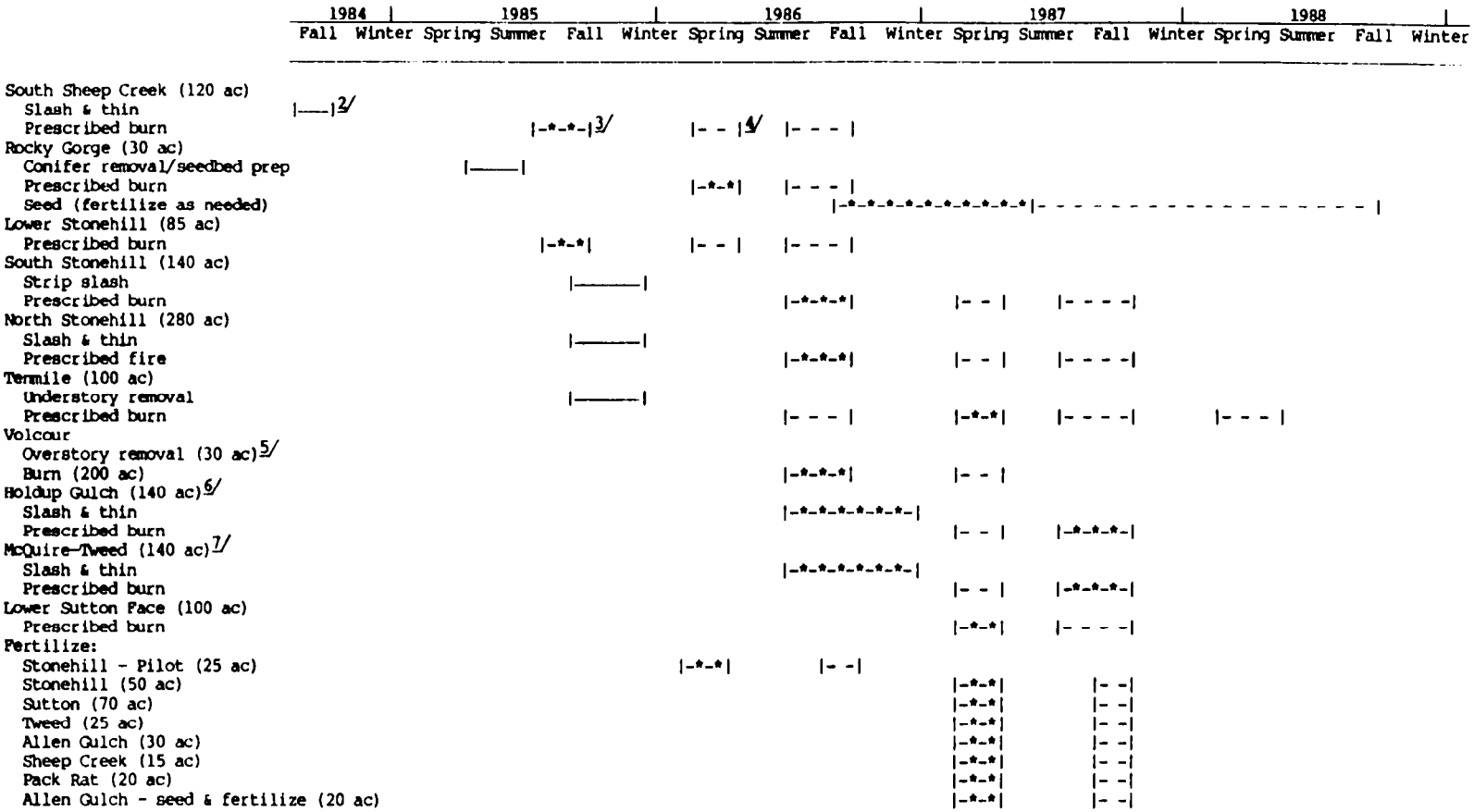
1984. The majority of the young conifer <10 in. d.b.h. were slashed during October and November and left to dry. While some of these trees were of limited commercial value, a combination of topography and logistics precluded any commercial timber harvest.

1985. A prescribed fire was scheduled to be completed during the fall of 1985. Due to unfavorably wet conditions during August and September, the prescribed burn was not accomplished and was rescheduled for fall 1986.

1986. Again, unfavorable wet conditions during September and early October precluded any attempt to burn the area. The burn was rescheduled for fall 1987.

2. **Rocky Gorge.** Several small peninsulas along the shore of lake Koocanusa receive extensive use by mule deer and limited use by bighorn sheep. A large mineral lick is located within the area and is utilized seasonally by both species. All the peninsulas

TABLE 1. Habitat treatments and treatment schedule for Ural-Tweed bighorn sheep - wildlife mitigation project (84-38 and 84-39).[1]



[1] As amended during USFS and MDFWP coordination meeting August 30, 1985.
[2] Project completed as planned.
[3] Preferred schedule.
[4] Alternative schedule.
[5] Need to resolve land owner conflict before this project can be implemented.
[6] A suitable substitute treatment within a core bighorn sheep seasonal use area may be designed during the fall/winter 1985.
[7] This area was substituted for the Holdup Gulch area during the 1986 contract period.

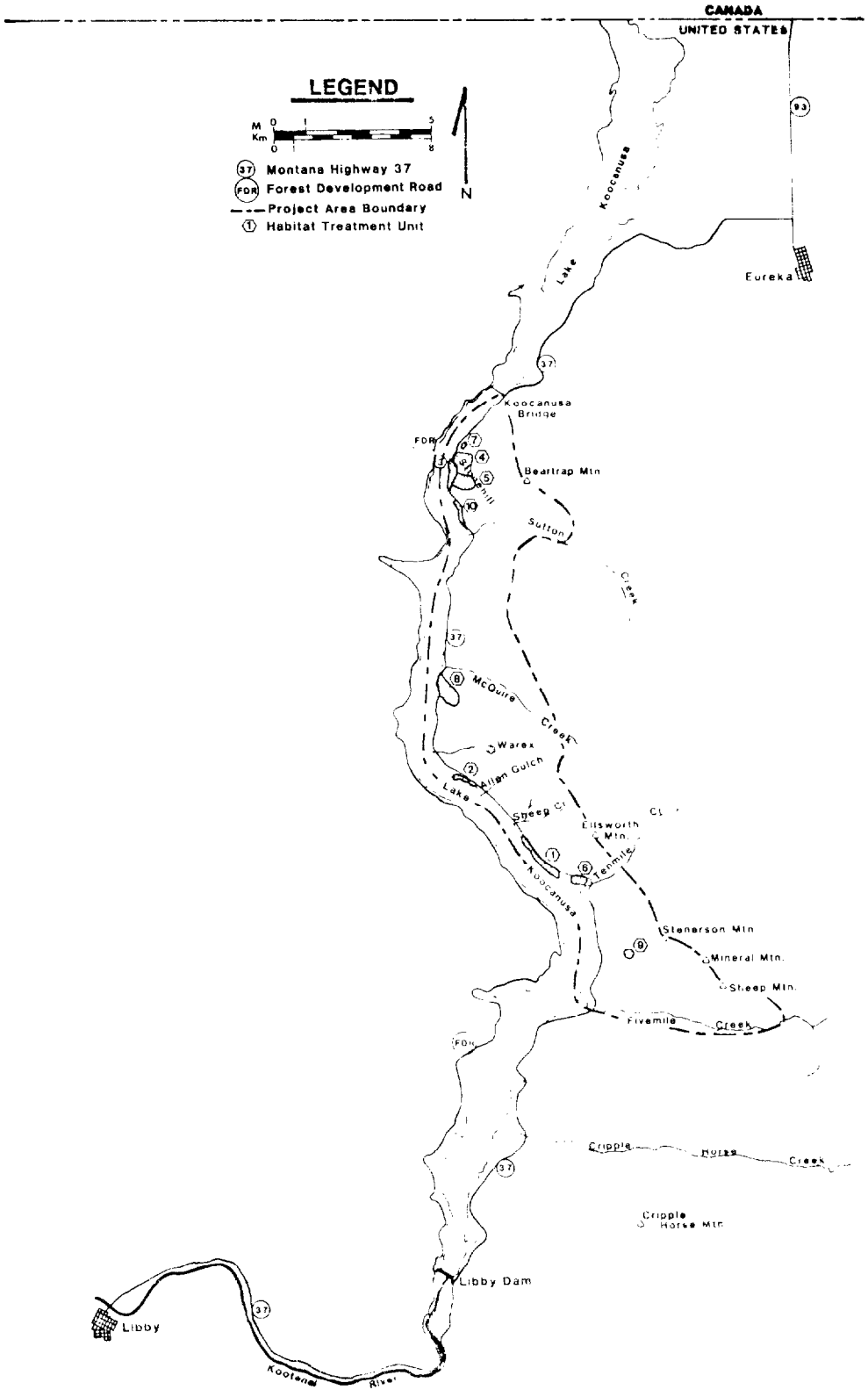


Figure 3. Location of the habitat enhancement projects -- Ural-Tweed bighorn sheep mitigation project.

Table 2. Costs associated with the habitat management efforts accomplished during this contract period.

Site	Acres	Treatment	Labor	Costs/ Acre ($)	Total Costs($)
1984					
S. Sheep Creek	120	Slash	Force Acct.	45.00	5,400
1985					
Rocky Gorge	15	Slash & Pile	Force Acct.	92.60	1,390
North Stonehill	300	Slash	Force Acct.	38.60	11,583
South Stonehill	75	Strip Slash	Contract	64.00	4,800
Tenmile	60	Slash	Force Acct.	132.00	7,920
TOTAL - 1985	570			53.85	30,693
1986					
Lower Stonehill	55	Bum	Force Acct.	36.00	2,000
Stonehill Fert.	25	Fertilize	Force Acct./ contract helicopter	128.00	3,200
McQuire-Tweed	140	Slash	Force Acct.	108.00	15,120
TOTAL - 1986	220			92.27	20,300

were within the area cleared during the initial construction phase of the Libby Dam project, and had revegetated into relatively dense stands of lodgepole pine (Pinus contorta). It was decided to slash the conifer regeneration and, after the slash was dried, broadcast burn the treated peninsulas.

This treatment will complement two existing management units. In 1984 the Forest Service thinned an adjacent stand of ponderosa pine to create a seed cone plantation. The conifer thinning was consistent with winter range habitat treatments for mule deer and bighorn sheep. A large unit of the Whirlybird Timber Sale, designed to enhance the sheep range, also lies adjacent to the area. The combination of these treatments and the remaining untreated bench to the northwest is considered to be an effective mixture of daily and seasonal habitat components.

1984. No treatments were conducted in 1984.

1985. Using a lo-person crew, 15 acres of young lodgepole pine were slashed and piled for burning. On one peninsula where numerous small cottonwoods (Populus trichocarpa) were present, the slashed conifers were piled away from the cottonwood stands to prevent damage to them during prescribed burning. It was decided to maintain the cottonwood trees within the area in an effort to preserve habitat diversity, which should be more attractive to a larger number of wildlife species, particularly cavity nesters and those avian species dependent on the deciduous tree canopy. The slash piles were burned with the fires allowed to wander through the treated peninsulas.

A metal swinging gate was installed on road #14008 to restrict motorized traffic and subsequent human harassment within the Rocky Gorge area.

1986. The Forest Service conducted an underburn within the adjacent seed cone plantation. Part of this latter fire burned into the eastern-most control unit, but did not modify a very large percentage of the area.

3. Lower Stonehill. This area of approximately 55 acres is located within the 1958 burn which scorched the west slope of Stonehill. The area is a relatively flat bench with a steep west-facing slope to Lake Koocanusa. Mule deer and moose use the area yearlong, while bighorn sheep utilize the area and adjacent habitats primarily during the winter months.

A fall prescribed burn was scheduled to reduce the amount of conifer regeneration and stimulate the shrub production within the area. While the area contained low ground fuel loads, it was hoped that the fuels were sufficient to get a satisfactory burn, killing a large percentage of the conifer regeneration.

Selected areas of deciduous shrubs were targeted for protection from the burn. These large, robust shrubs add increased habitat diversity to the area and are heavily utilized by a number of avian species.

1984. No treatment was completed.

1985. The fall prescribed burn was postponed due to wet, unfavorable conditions.

1986. Approximately 55 acres were burned in two stages. In late March a strip along the upper side adjoining Highway 37 was burned to create a blackline on the uphill side. Then, in early April, the remainder was burned using a force account crew of eight people. An ignition pattern was used that created the hottest possible firegiven the generally light fuels. The spring burn was a change from the originally planned fall burn. The change of seasons was based on the fire management specialists evaluation of the fuels, aspect and elevation of the site. Their analysis indicated that similar results would be obtained with either spring or fall burning.

Immediately after the burn, a 33 percent mortality of the conifers was estimated. By mid-summer the mortality was estimated to approximate 46 percent (Appendix C).

The conifer mortality was lower than 46 percent across the majority of the area; however, the fire caused almost 100 percent mortality within a dense stand of lodgepole along the south side of the unit. This mortality increased the overall kill for the treatment.

To further enhance the area, reduce the standing trees, and provide for greater conifer kill, the area was selectively slashed during the fall.

4. North Stonehill. A 300+ acre treatment area within the 1958 Stonehill burn was scheduled for extensive slashing followed by prescribed fire. The area is a series of south- to west-facing benches largely covered with dense conifer regeneration The area contains fairly abundant bunchgrass and shrub foraging areas. As designed, the slashing treatment added abundant fuel loads of conifers to the available ground fuels. After two years of drying, the area will be prescribed burned. A successful burn will greatly reduce the slashed trees and the remaining conifer regeneration, and should increase the available bunchgrasses and shrubs. Due to the discontinuity of the fuels there will be areas of conifers left, which will serve as thermal and security cover for the big game species utilizing the area.

The area is utilized extensively yearlong by bighorn sheep, mule deer and moose, with some use noted by elk. The area is important winter range for the first three species. Therefore, increased forage production - grasses and shrubs - is the primary management objective while maintaining stands of conifers to provide thermal and security cover.

1984. No treatment was canpleted.

1985. The slashing was completed during the fall and winter. The slashed trees will be allowed to dry for two years prior to burning.

1986. A joint field review of the area after the slashing was completed resulted in revision of the wildlife prescription for the area. Concensus during the review was that the prescribed burn should be planned to remove the majority of the remaining conifers. The burn prescription was revised to incorporate this change, as well as the combined aerial ignition of the North and South Stonehill units.

During the summer, the slashed fuels were checked for gross moisture conditions. The slashed trees on top of the piles were dry, while those toward the bottom were still green and maintaining high moisture conditions. This indicated the two-year drying time was necessary.

5. South Stonehill. This area, a west- to northwest-facing slope within the 1958 Stonehill burn, is approximately 75 acres of dense, diverse shrub and conifer regeneration. The area is extensively utilized by mule deer and moose throughout the year. Bighorn sheep seldom utilize the area for foraging; however, they frequently travel through the area as they move between adjacent habitats which they use regularly.

The treatment design for the area is a series of alternate 60-ft. strips which were slashed or left. The slashed areas will be allowed to dry for two years. During 1987 prescribed fire will be used to reduce the slashed trees and other ground fuels within the cut strips. The fire will also burn into the leave strips, providing for additional opening of the habitat.

The treatment will enhance the area for use by mule deer and moose. Additionally, the open areas will provide forage sites for bighorn sheep, as well as facilitate movement 'between segments of the range.

1984. Treatment planning was accomplished: however, no on-the-ground treatment was accomplished.

1985. The area was slashed during November and December. The slash is scheduled to be allowed to dry for two years.

1986. No habitat treatment was completed during 1986; however, the burn prescription was revised to incorporate the burn into a joint aerial ignition project with the North Stonehill Unit.

6. Tenmile. This is an area of approximately 60 acres at the mouth of Tenmile Creek between Highway 37 and Lake Koocanusa. The area contained a multi-story conifer canopy. A past logging operation removed selected mature conifers prior to the Libby Dam project. To achieve the desired results it was planned to slash all conifers <lO in. d.b.h., leaving the mature ponderosa pine, Douglas-fir and scattered larch (Larix occidentalis). The riparian habitat along Tenmile Creek and another smaller drainage were targeted for non-treatment, preserving important habitat components and diversity.

The grassy meadow associated with the area receives heavy recreational use during the spring, summer and early fall months. To preserve the importance of the area to wildlife and protect the investment in habitat enhancement the access road to the area is scheduled to be permanently closed.

The area receives use by mule deer, primarily during the winter and spring months. Bighorn sheep travel through the area on a regular basis. Because the area is used as a traditional travel corridor for yearlongbighorn sheep movements, it is felt that the habitat enhancement will be used 'by sheep as a foraging area.

1984. No treatments were conducted. Project planning was initiated.

1985. The conifers <lO in. d.b.h. were slashed using Forest Service force account crews. The slash will be dried for two years at which time the area will be fall burned.

1986. In November, a force account crew closed the access road into the area. The road closure will maintain the value of the area for wildlife and protect the investment already made in habitat enhancement.

7. **Stonehill Fertilization Pilot,** Several areas throughout the sheep range contain stands of bunchgrasses. The majority of these stands are on steep rocky slopes unsuitable for most habitat enhancement treatments (ie. burning). In an attempt to improve these stands it was decided to experiment with the potential of aerial application of fertilizer.

The Stonehill Pilot is a relatively flat bench with a mixed grass/shrub community. Its location, accessibility and vegetative community make the area a good site for this pilot program. Additionally, bighorn sheep utilize the area extensively during winter, spring and early summer. Mule deer also make yearlong use of the area.

1984. No work accomplished on this project.

1985. The area was selected for the pilot fertilization area. Soil samples weretaken from the area and analyzed to determine the best fertilizer composition to apply to the area.

1986. Vegetative data collection **was** initiated prior to the application of the fertilizer. The sampling was finished after the application, but prior to any vegetative response. The 25-acre plot was separated into a 17-acre treatment and an 8-acre control. In early June, the fertilizer was applied to the test plot using a spreader slung below a helicopter. The fertilizer (21-0-0 nitrogen) was applied at a rate of approximately 200 lbs./acre. Good rainfall throughout the remainder of the month served to move the fertilizer into the soil where it was available for uptake by the vegetation.

8. **McQuire-Tweed** Originally, 140 acres of slashing and burning were scheduled for Holdup Gulch on the northern end of the sheep range. Based on a field review by the project biologists, an area between McQuire and Tweed creeks was selected for treatment. Selection was based on good spatial relationship to other treatments, sheep use of the area, and current vegetative conditions that could be effectively treated by slashing and thinning. Holdup Gulch, Sutton Face and Sheep Creek (above the highway) were reviewed but not selected due to being located close or adjacent to areas already or soon to be treated, or still having a fairly good vegetative condition

This area is a relatively steep, west-facing slope bisected by a series of rocky benches. Bighorn sheep use the area yearlong; sometimes as a travel corridor, while at other times they utilize the area for a period of days to 2-3 weeks

1984. No work was completed on this treatment.

1985. No work was completed on this treatment.

1986. A review of several areas was made and the McQuire-Tweed Creek site selected for a slash and prescribed burn treatment. A six-man force account crew slashed approximately 140 acres in October. Generally all conifers <8 in. d.b.h. were slashed. Aspen groves and conifer stands in draws were left unslashed to provide vegetative diversity, cover for big game other than bighorn sheep, and watershed protection. A few areas of very dense, small diameter trees were slashed with 100-ft. cut strips alternating with 50-ft. leave strips. The area is scheduled for prescribed burning in the fall of 1988.

9. Volcour. Approximately 200 acres were originally scheduled for burning in 1986. Field review of the area showed that due to the size of trees and limited fuels on the ground over much of the area, a normal preacrioed fire would not achieve the desired

results for bighorn sheep Slashing and burning appear feasible on 32 acres and are scheduled for 1987 and 1988, respectively. The potential for using helicopter logging to removethelarger trees is being explored.

10. Lower **Sutton** Pace. A prescribed burn has been scheduled to modify approximately 100 acres of habitat on this bench above the reservoir. This area contains extensive stands of mixed shrubs which are currently being encroached upon by conifer regeneration The treatment has been designed to reduce the conifer regeneration while stimulating the forage species - mixed shrubs and grasses.

The area currently receives yearlong use by mule deer and moose, with winter use by bighorn sheep. During periods of deep snow, the area increases in value to wintering bighorn sheep.

1984. The initial treatment prescription was developed.

1985. No work was completed on this unit.

1986. Project review was completed by an interagency team. The original prescription was modified and the prescribed burn was scheduled for spring 1987. In order to help reduce the young conifer regeneration, the area was opened to commercial Christmas tree harvest during December 1986.

Vegetation Monitoring. During 1985, pre-treatment monitoring transects and photo plots were established within five treatment areas; North Stonehill, Lower Stonehill, Rocky Gorge Peninsula, South Sheep Creek and Tenmile. Additionally, due to perceived differences in vegetation across the South SheepCreek unit, it was decided to separate the treatment area into 2 separate units, with complete data collection (treatment and control) for both units. The separation was for data collection and analysis only, as it is logistically impractical not to treat the area as one unit when completing the habitat modifications.

During 1986, the above units were again sampled to provide initial post-treatment (Rocky Gorge and Lower Stonehill) or mid-treatment (North Stonehill, South Sheep Creek, and Tenmile) conditions. Additionally, monitoring transects were established within the Stonehill Fertilization Pilot and McQuire-Tweed units. Pre-treatment vegetation data was collected from both areas.

Within five areas the sampling methods had to be modified to adapt to the conditions of the respective treatment area. The peninsulas at Rocky Gorge were linear in nature, therefore, instead of an X pattern for the transect segments, the total transect (200 points) was divided between the peninsulas within the treatment/control area. The transect was completed along a line centered between the reservoir shoreline and the edge of the adjacent conifer stand The topography within the North Stonehill unit consists of a series of rocky benches. The vegetation on the

benches generally consists of an outer zone of grasses and forbs, an intermediate zone of mixed shrubs and young conifer regeneration and an inner zone of more mature shrub and conifer regeneration. The point transect was conducted linearly along the grass/forb zone. To establish the sampling points for forage production and shrub measurements, the photo plots were placed within the inner 2 zones (an equal number - 9 - within both the treatment and control). The photo board stake was then used as a permanent sampling point with the respective sampling plots centered on the stake. This sampling method provides permanent sampling points, and therefore, possibly a better measure for comparison of the data over time. However, the method is more time consuming than the randomized transects and impractical to conduct within all the treatment areas. The topography and vegetative characteristics of the McQuire-Tweed unit precluded the establishment of a control area. Therefore, the sampling points were permanently marked so the same point can be monitored during successive years. Additionally, an abbreviated transect was set up in an adjacent area (approximately 20 acres) which burned during the summer of 1984.

A minimum of three photo plots were established within each of the habitat treatment areas, as well as the paired control areas. The initial photos of these plots indicate that they will be a valuable tool in the long-term monitoring of the vegetation changes.

Browse utilization transects were completed in conjunction with the pre-treatment vegetation monitoring. Within the North Stonehill unit where the sampling methodologies were modified the utilization transects were completed within the intermediate shrub zone in a linear pattern parallel to the outer edge of the respective bench. During 1985, the early and late fall utilization transects were not completed as planned. This was due to completion of the vegetation transects as late as mid-August - therefore not much change in utilization - combined with a lengthy period of inclement weather and conflicts with other scheduled tasks. During 1986, the seasonal utilization transects were completed as scheduled. The analysis of the vegetation data is ongoing and will be presented in later reports.

Animal Response. To date, 12 bighorn sheep have been captured and individually marked (Table 3). Table 4 summarizes the immobilization efforts A corral trap was baited and set for all or part of 53 days from December 3, 1984 to June 15, 1985, and 18 days between December 3, 1986 and December 21, 1986. During this time three sheep were captured on June 15, 1985 and three on December 14, 1986. On two occasions the trip string was cut by small mammals; the nylon string was then replaced with thin piano wire. On several occasions, when the trap was set during the warm daytime hours, the shift to colder night temperatures contracted the trip wire and released the trap door. Sheep consistently used the mineral lick directly in front of the trap

Table 3. Summary of marked bighorn sheep on the Ural-Tweed bighorn sheep range, December 31, 1986.

Animal #	Date captured	sex	Age	Ear tags L	Ear tags R	Marker	color	Frequency
01	12-11-84	F	5.5	8854	R855	Radio	White	151.770
02	12-12-84	M	2.5	R857	R856	Radio	White/black	151.581
03	12-13-84	M	1.5	R858	R859	Radio	White	151.561
04	12-17-84	H	5.5	R860	R861	Radio	Fed	151.520
05	01-16-85	P	2.5	NONE		Radio	White w/ black cntr	150.950
06	06-15-85	P	5.0	R863	R864	R&iO	Lt. blue	151.229
07	06-16-85	P	5.0	R869	R870	Radio	Red/white/ blue	151.250
08	06-15-85	P	1.0	R866	R865[a]	Neck	Red w/ white cntr	—
09	06-15-85	n	0.08	R868	R867	Ear streamers	Lt. blue	[b]
10	01-11-78[c]	P	3.5	A0771	A0772	Radio	White[d]	151.132[e]
11	01-17-78	H	3.5	A0773	A0774	Radio	Lt.blue	151.106
12	12-19-85	n	7.5	R876	R877	Radio	Yellow	151.399
13	07-18-86	F	7.0+	8871	R872	Radio	Green	151.290
14	12-14-86	H	1.5	R875	RB78	Radio	Black/yellow	151.410

[a] Ear tag recovered at trap site after sheep released 6-16-85.

[b] This animal was apparently the lamb of animal 06. This lamb was apparently lost from the population 2-3 weeks after capture and marking.

[c] Animals 10 and 11 were captured and marked during an earlier study conducted by Brown (1979).

[d] Collar now appears very worn and tan in color.

[e] Radio transmitters 10 and 11 are no longer functional.

Table 4. Summary of immobilization results, Ural-Tweed bighorn sheep-wildlife mitigation project, December 1, 1984 - December 31, 1986.

#	Sex	Age	Date	Dosage	Results	Time(min.)	Comments
1	F	5.5	12-11-85	Standard[a]	Immobilization	10	Accompanied by young lamb
2	M	2.5	12-12-84	Standard + 1.0 cc xylazine at 21 min.	Immobilization	15-30	Animal partially alert, difficult to subdue.
3	M	1.5	12-13-84	Standard	Immobilization	8	Good response to drugs - apprx. 7 hrs to recover.
4	M	5.5-6.5	12-17-84	2.5cc xylazine + 0.5 Phencyclodine HCl	Non-Capture	-	Hit low in abdomen - limited effect of drug.
5	M	5.5	12-17-84	2.5cc xylazine + 0.5 Phencyclidine HCl	Immobilization	13	Complete immobilization - sheep snoring when approached.
6	F	Ad	12-19-84	Standard	Non-capture	—	Glancing hit with dart, limited response to drug.
7	F	Ad	01-02-85	Standard[c]	Non-capture	—	Very limited response to drug
8	F	Ad	01-03-85	Standard	Non-capture	—	Sheep bedded and very groggy; fled when approached.
9	F	Ad	01-08-85	Standard	Non-capture	—	Limited response to drugs
10	F	Ad	01-09-85	Standard	Non-capture	—	Hit high behind right shoulder; limited response to drugs.
11	F	2.5	01-16-85	Standard[d]	Immobilization	5-10	Good response to drugs.
12	M	1.0	06-03-85	Standard	Non-capture	—	Went down with limited alertness, however, fled as investigator approached.
13	F	Ad	06-04-85	Standard	Non-capture	—	Good response to drugs; however, could not be approached.
14	F	5.0	06-16-85	Standard	Immobilization[e]	—	Good response to drugs.
15	F	1.0	06-16-85	Standard	Immobilization	—	Good response to drugs.
16	F	5.0	06-17-85	Standard	Immobilization	10-15	Good response to drugs.
17	M	7.5	12-19-85	Standard	Immobilization	10-15	Good response to drugs, approx. 2.5 hrs. to recover
18	M	2.5	12-20-85	Standard	Non-capture	---	Hit in knee and showed no response to drugs after 12 minutes.
19	F	Ad	07-18-86	Standard	Non-capture	---	Hit in rump, animal took off running uphill and was never observed to be effected by the drugs. Searched the area for 2+ hours.
20	F	Ad	07-18-86	Standard	Immobilization	36	Good response to drugs, did take long time for animal to lay down; however asleep on its feet after 15-20 min.
21	M	1.5	12-14-86	Standard	Immobilization		Good response to drugs.

[a] Standard dosage = 2.0cc xylazine (100 mg/ml) + 1.0cc Ketamine HCl (100mg/ml). Dart placement was in the rump area except where noted otherwise.

[b] Sheep were not always kept in sight until complete ataxia, therefore an estimate of immobilization time was made based on last visual contact before complete ataxia.

[c] One or both of the drugs used during attempt 7-9 had lost potency (possibly due to excessive cold) and resulted in only slight to moderate ataxia.

[d] Standard dosage administered to the left shoulder.

[e] Attempts 14, 15 and 21 were sheep within the corral trap.

door; however, only on a few occasions during 1985 - all but one when the trap was tied open - did animals venture into the trap On several occasions during December 1986, sheep and mule deer fed on the alfalfa and fermented apple mash within the trap, but did not trip the door.

Three mule deer weretrappedinthe corral trapduring 1985. An adult female and a 0.5 year old were trapped and released on 16 January 1985 and a 2.0 year old male was trapped, marked and released on 5 June 1985 (Ear tags L-889, R-888; orange neck collar).

Due to the limited success of this effort the trap was removed and utilized on another sheep range during the winter 1985-1986. During early fall 1986 a panel trap was reconstructed at the site and attempts were made to capture sheep during late fall and winter. In an attempt to improve the trapping success, fermented apple mash was used in addition to the alfalfa hay and salt.

Systematic on-the-ground relocations of the radio-collared sheep combined with periodic aerial surveys has proven to be the best method to determine the seasonal movements and habitat preferences of the animals. As determined by Brown (1979) and the results of this project, random on-the-ground surveys are ineffective in locating sheep. The steep, heavily timbered slopes combined with the small population size makes this survey method impractical. To date, on-the-ground relocations of the instrumented animals were the primary method of obtaining movement and habitat selection data from the sheep population. Due to the small number of instrumented animals (10), accessibility to the majority of the project area and the ability to coordinate relocation surveys with other field work it was considered the most efficient and cost effective method to obtain the data. Aerial surveys were utilized primarily when transmittered sheep were in inaccessible areas, such as upper McQuire Creek. Aerial surveys were only effective during periods of good climatic conditions. The steep, rocky, convoluted slopes are conducive to "signal bounce", and if poor weather, including high winds, was present the airplane (Cessna 182 or SuperCub) could not be maneuvered close enough to the slopes to obtain a good "fix".

Bighorn sheep used the entire range, concentrating in particular areas during the various seasons. The pattern of use was similar as that identified by Brown (1979); however, expanded use of the area was noted. Of particular note has been the use of the northwest side of the Sheep Creek drainage as a lambing/ nursery area, and the use of Pack Rat and Volcour drainages by ewes and lambs during summer, fall and winter. During the spring of 1986, two additional lambing areas were observed. Animal 06 (6 yr. old female) was observed with a newborn lamb (<2-3 days old) in the McQuire Creek drainage. Animal 07 (6 yr. old female) was also utilizing the same area. While the latter was not observed with a lamb while in the drainage, later observations indicated

she had lambed, in which case it was also probably within the McQuire Creek area. Animals 05 (4yr. old female) and 10 (12 yr. old female) utilized the Pack Rat drainage during lambing. Animal 10 was later observed with a lamb indicating she had apparently lambed within this drainage.

During the first two years of the project, nomadic movements by rams have been observed. On May 18, 1985, a yearling ram was observed along Highway 37 at the mouth of Cripple Horse Creek. This young animal was probably demonstrating the nomadic behavior typical of Class I rams (Geist 1971). During July and August 1986, animal 02 (4 yr. old male) wandered extensively throughout the project area and apparently left the project area for parts unknown during a portion of that time. Due to logistical problems his movements weren't monitored enough to determine all his wanderings. Additionally, on several occasions, extensive attempts to locate him from the ground were unsuccessful.

To date, six helicopter surveys of the sheep range have been conducted (Table 5). The goalofthe surveys was to determine a population estimate and a time of year when such surveys would be most efficient. With the exception of the December 1985, March and December 1986 surveys, the results of the flights were disappointing. During most flights, the heavily timbered slopes precluded the observation of all but the occasional herd of sheep. When sheep were observed in the open, their reaction was to flee into a timbered area and stand under the canopy of one or more large trees. This type of behavior combined with the vegetation and topographic features makes an aerial survey difficult. Additionally, the north to south orientation of the project area dictates the flight be conducted after the early morning sun has risen high enough so that glare on the helicopter bubble is no longer a problem (usually after 1000-1100).

During the March 1986 helicopter survey, visual observations of all the instrumented animals were obtained. This was facilitated by the use of the telemetry equipment and persistence of the observers in searching the area once the sheep were located. A total of 39 individual sheep and 10 of the 11 marked sheep were observed. Only the two year old, neck banded female (#08) was not observed. The results of this flight were good; however, comparison of the totals to minimum numbers of particular sex and age classes (rams, young, etc.) indicated the count was not complete and several bands had not been located.

During the December 1986 helicopter survey, a total of 47 sheep were observed. This was the highest survey count to date. While the survey was conducted under poor light conditions, snow cover throughout the area provided for good visibility. The pilot and observer noted that the sheep appeared to be more accustomed to the helicopter than during previous flights. This change in behavior allowed for better visibility of the sheep as they continued normal activity and did not tend to hide under trees.

Table 5. Summary of helicopter surveys conducted within the Ural-Tweed bighorn sheep range, September 1984 - December 1986.

Date	Hours Flown	Number of Observations	# sheep observed Y	F	M	Un	Total	Conditions/Comments
03-13-85	3.0	2	2	4	0	0	6	Good light-patchy snow
04-09-85	4.0	5	4	6	14	0	24	Good light-one observation of 11 rams - 2 of 7 collars observed.
05-23-85	5.0	1	1	2	0	0	3	Good light-extensive search effort.
12-04-85 and 12-05-85	2.5 2.0	7	9	1	4	8	0	31	Good light - 3 of 10 collared animals observed.
03-01-86	3.0	3	3	1	0	8	0	21	Good light - 4 of 11 Marked animals observed.
03-02-86	3.0	4	1	12	14	0	27	Good light - 9 of 11 marked animals observed
12-09-86 and 12-10-86	2.0 3.5	9	10	17	19	1	47	Overcast, intermittent light snow - 5 of 12 marked animals observed.

This change in behavior was credited to the extensive helicopter flights associated with the helicopter logging operation currently being conducted within the area. Further analysis of the telemetry data will provide additional insight into the relationship of the sheep and the helicopter operation.

General observations of bighorn sheep throughout the Ural-Tweed range have provided baseline population parameters. The information is currently being analyzed and will be incorporated into a computer population simulation which will be presented in later reports. When the project was initiated, it was estimated there were 25 sheep within the population (Yde and Olson 1984). Preliminary observations indicate more sheep than the initial estimate. Based on the helicopter survey of April 9, 1985 combined with the number of marked rams and their known associates itwasdeterminedthata minimum of 17 rams (22 month or older) were in the population. Additional observations during June 1985 indicated at least 5 yearling rams within the population, for a total minimum male population (12 months or older) of 22 sheep. Using visual observations combined with marked animals not observed, a minimum population of 28 females (12 months or older) was determined for July 1985. Additional population information was gathered during the helicopter surveys conducted during December 1985 and March 1986. Field observations in 1986 indicated recruitment into the population was good with at least nine yearlings present and good lamb production. The timbered slopes - including the nursery areas - combined with the fact the lambs were often left for extended periods in nursery groups, precluded efforts to estimate the number of young present within the population at any one time; however, field observations have indicated lamb production is at a fairly high level. These observations indicate the population has begun to increase since the catastrophic decline of the late 1960's early 1970's.

Fecal samples have been collected on a monthly basis since May 1985. Scheduling conflicts, inclement weather and dispersal of sheep precluded some sample collections. Since only direct observation of defecations or fresh defecations collected from known bedding sites or foraging sites immediately after the sheep have left the area are utilized, it is often difficult to complete the collections. However, the similarity between bighorn sheep and deer pellets precludes collection of pellets where the investigator is uncertain of the source. Preliminary lungworm analyses indicate a very low level of lungworm larvae within the samples, indicating that the lungworm infestation of the population is low and probably inconsequential at its current level.

Initially, it was determined that several segments of the extensive highwalls adjacent to Highway 37 were suitable for modification to facilitate movements of bighorn sheep. Investigations during the current project, including telemetry information from transmittered animals, indicate the need for all the modifications may not be necessary. Two areas where the

modifications are appropriate are within the highwall between mileposts 36.5 and 37.3.

The area below Highway 37 receives extensive use by bighorn sheep during the rutting, winter and spring/early summer periods. Observations of bighorn sheepcrossingtoand from the habitats below the highway indicate that modifications within this segment of the highwall are warranted. There are two locations in this segment of highwall where the height of the highwall is approximately 20-30 feet, making the modifications realistic. Consultation with an engineer from the Montana Department of Highways further determined the feasibility of the modifications. It is felt that a series of rough "steps" can be built into the highwalls, thereby facilitating animal movements. Due to the fractured nature of the rock at the two locations, the excess rock can probably be removed using a crew with a jackhammer. The excess rock would then be loaded onto a truck and dumped at a site along a highway fill area. The initial estimate oftheproject costs are $5-8,000 each. If blasting is required to loosen the excess rock, additional costs, including matting the highway, increased security bond, flag persons, etc, will be incurred

Both bighorn sheep and mule deer cross the highway extensively in the area of the Tenmile Creek Bridge. This area has two sharp, blind corners on inclines. These corners remain icy for the majority of the winter, making for hazardous driving conditions The presence of sheep and mule deer on the highway increases this hazard. Therefore, it is proposed to fence a 0.5 mile segment of the highway right-of-way with a 6-8 foot woven wire fence. This fence would keep the animals off the highway in an area that has had at least five accidents since December 1984, one of which involved a bighorn sheep and one a mule deer. It would also direct the animals under the Tenmile Creek Bridge, thereby not restricting current migrations between seasonal use areas. NO cost estimate has been obtained on this potential project as there has been no engineering field inspection to determine its feasibility.

Three areas along Highway 37 have been identified for potential modifications to facilitate animal movements while providing reduced risk to motorists. The next step is to have an engineer inspect the sites and draw up the modification plans and develop further cost estimates. If these projects remain economically feasible, funding will be requested in the future.

DISCUSSION

To date, numerous on-the-ground activities have been completed. Habitat manipulation projects have been located, designed and initiated with additional treatments scheduled for future years. One problem that arose was treatments were initially scheduled before pre-treatment vegetative and wildlife use data could be collected. After this conflict was resolved the remainder of the projects were scheduled to allow adequate time for the collection of pre-treatment data.

Another consideration in the development of specific projects was cultural resources. Any activities which necessitate earth disturbance require prior approval from cultural specialists. Slashing, burning and the application of fertilizer, however, do not significantly disturb the ground and generally do not conflict with cultural resources.

During both 1985 and 1986, prescribed burns were cancelled due to unfavorable burning conditions. During the winter of 1986-87, project personnel are planning on reviewing the historical weather patterns which the project area has received, particularly during the spring and fall burning periods. This information will be combined with the known response of selected, preferred grass and shrub species to determine the optimal period when prescribed burns should be scheduled.

Where applicable in the future, timber sales will 'be used to enhance the sheep range - similar to the ongoing Whirlybird sale. Since these sales would potentially return K-V funds to the U.S. Forest Service, which would in turn be used for further habitat modifications such as prescribed burns, no mitigation funds will be used to set up or conduct the sales. However, in certain circumstances the timber that needs to be removed is not of sufficient economical value to merit a timber sale. In this situation, mitigation funds will be used to provide a service contract to conduct the timber removal activities. The direct costs of the service contract would be subsidized by allowing the contractor salvage rights to the involved timber.

Several areas, McQuire Creek, Warex Mountain to Tenmile Creek and Huckleberry Mountain, are currently scheduled for timber harvest activity. These areas are historical sheep seasonal habitats and are adjacent to currently occupied habitats. Within the Kootenai National Forest Plan, these areas are allocated to big game summer range (MA-12). There is an opportunity to work cooperatively with the foresters in the design of the harvest units and access roads. Proper planning will allow for the timber management objectives to be met, while at the same time expanding the areas which are suitable for sheep use.

Additional monitoring of the bighorn sheep population is scheduled for 1987 with additional radio transmitters scheduled to be fitted on adult sheep. Further study of the lungworm larvae loads, DAPA levels and monthly food habits will continue.

LITERATURE CITED

Anonymous. 1977. Handbook of biological techniques. Wyoming Dep. Game and Fish, Rept. Cheyenne, WY 393 pp.

Anonymous. No Date Big game habitat analysis for New Mexico. Joint rept. New Mexico Dept. Game and Fish, U.S.D.I. Bureau of Land Manage. and U.S.D.A. U.S. Forest Service. 17 pp & appendices.

Brink, B. W. 1941. Summary report of the Ural-Tweed Sheep Project, October 15, 1940-June 15, 1941. U.S.D.A., Forest Service Rept. 33 pp.

Brown, G. W. 1979. Ural-Tweed bighorn sheep investigation, October 1, 1976 - May 31, 1979. Montana Dept. Fish, Wildl. and Parks, Wildl. Manage Div., Project Completion Rept., in cooperation with U.S. Army Corps of Engineers. Contract No. DACW67-76-C-0083. 94 pp.

Chambers, J. C. and R W. Brown. 1983. Methods for vegetation sampling and analysis on revegetated mined lands. Gen. Tech. Rep. INT-151. Ogden, UT; U.S.D.A., Forest Service, Intermountain For. and Range Exp. Sta. 57 pp.

Couey, F. M. 1950. Rocky mountain bighorn sheep in Montana. Montana Dep. Fish and Game, Bull. No. 2. Helena. 90 pp

Dilworth, J. R, and J. F. Bell. 1982. Variable probability sampling - variable plot and three-p. O.S.U. Book Stores, Inc. Corvallis, OR. 130 pp.

Ensign, W. W. 1937. Winter game study of Warland District, l936-1937, with detailed study of the Ural-Tweed band of mountain sheep. U.S.D.A., Forest Service, Rept. 21 pp.

Floyd, D. A. and J. E. Anderson. 1984. A comparison of three methods for estimating vegetal cover. In: Idaho National Engineering Laboratory radioecology and ecology programs. 1983 progress rept; 0. Doyle Markham, ed. U.S.D.E., Radiological and Envoirnmental Sciences Lab., Idaho Falls, ID. pp 114-126.

Geist, V. 1971. Mountain sheep - a study in behavior and evolution. The University of Chicago Press, Chicago, IL. 383 pp.

Lyon, L. J. 1984. The Sleeping Child Burn - 21 years of postfire change. US.D.A Forest Service, Intermountain For. and Range Exp. Sta. Res. Paper INT-330. Ogden, UT. 17p.

Nelson, J. R, R.M. Koes, W. H. Miller, and B. B. Davitt. 1982. Big game habitat management on a nutritional basis - a new approach. pp. 157-166. In Proceedings of the Western States Elk Workshop, Flagstaff, Arizona

Nudds, T. D. 1977. Quantifying the vegetative structure of wildlife cover. Wildl. Soc. Bull. 5(3):113-117.

Stelfox, J. G. 1976. Range ecology of Rocky Mountain bighorn sheep in Canadian National Parks. Canadian Wildl. Service Rept., Series No. 39. 50 pp.

Strickler, G. S. 1959. Use of the densiometer to estimate density of forest canopy on permanent sample plots. USDA, For. Serv. Pac. NW For. and Range Exp. Sta. Res. Note 180. 5pp.

Thorne, T., G. Butler, T. Varcalli, K. Becker, and S. Hayden-Wing. 1979. The status, mortality and response to management of the bighorn sheep of Whiskey Mountain Wyoming Game and Fish Dep. Wildl. Tech. Rept. No. 7. Cheyenne, WY. 213 pp.

US. Department of Agriculture. 1985. Field instructions: stand examination and forest inventory - Region One. Stand Exam. Handbook. FSH 2409.21 Rl Chapter 300, May 1985. U.S.D.A., Forest Service Rept.

US. Department of Interior. 1965. A detailed report on fish and wildlife resources affected by Libby Dam and Reservoir Project, Kootenai River, Montana. U.S.D.I., U.S. Fish and Wildl. Ser.Rept. Portland, OR 51pp & appendices.

U.S., Department of Interior. 1978. Soil and vegetation inventory method manual. U.S.D.I. Bureau of Land Manage. Rept. 48 pp. & appendices.

Wishart, W. 1978. Bighorn sheep. In: Big game of North America, ecology and management, (eds.) J. L. Schmidt. and D. L. Gilbert, pp. 160-171, Stackpole Books. Harrisburg, PA. 494 pp.

Yde, C. A. and A. Olsen. 1984. Wildlife impact assessment and summary of previous mitigation related to hydroelectric projects in Montana, Vol. One - Libby Dam. Montana Dep. Fish, Wildl. and Parks rept. in cooperation with Bonneville Power Administration, Proj. No. 83-464. Helena, MT. 91 pp. & appendices.

APPENDIX A

Wildlife Prescription - North Stonehill

Wildlife Prescription - 10-Mile

WILDLIFE PRESCRIPTION

Stand No. 18-3-16
Worth Stonehill

Photo No. 147

Area: 300 A.

Slope: Flat benches in between steep rock cliffs-sane 40-60%

Elevation: 2800-4400

Aspect: W-NW

Successional Stage:
Grass/Forb-j Pole/Sapling

Habitat Type:
DF/Phma & DF/Fesc

Fuels: Light but continuous on benches.

Site Productivity: Low for timber, Moderate for forage.

Wildlife Species to manage for:
Bighorn sheep, MD, Moose, Elk

Vegetation Species to manage for.
Fesc, Feid, Amal, Ceve, Privi, PP, DF

Land Management Objectives: Management Unit 10 - Same objective as other prescription.

Present Stand Situation: The stand was burnt by wildfire in 1958. The benches have restocked in heavily with DF, PP and LP. There has been no stand examine data collected on the area, but the densities are >500 TPA on the benches and in a small stand on the NW corner of the area. The benches and side hills that do not have trees on them are covered with bunch grasses and browse species with some forbs. The bunch grasses are predominately Fesc, Feid, and Agsp. The browse species are: Amal, Salix, Ceve, Cese, Privi, Phma, Hodi, Syal and some Acgl. The stand is presently receiving light to moderate use by moose, mule deer, bighorn sheep, and elk. The preferred browse species of Salix, Amal, Privi are in Form class 2 or 3. The grass species appear to be receiving light use.

Because of the light use on the grasses there has become a high amount of decadence within the crown, therefore reducing the production that the site is capable of. Also some of the browse species have been hedged severely enough that the vigor and production of these species is in a downward trend. Also some of the browse species have died due to the shading effect from the conifer reproduction that has reestablished itself.

Proposed Treatment: In order to reduce the stocking level of trees on benches and rejuvenate decadent browse species and grasses, fire will be induced on the entire area by the use of the helicopter drip torch. Prior to fire - a force account slashing

crew will cover the benches and spot slash in order to add additional fuels on the ground in order to allow fire to get into the crowns of dense pockets and thin out the timbered pockets.

Flame heights should be in the 2-7 foot range in order to get into the crowns and carry into the timber pockets.

There are two control areas within the stand that will be flagged in blue and will not have any slashing or fire introduced into the areas (See Photo).

It is recommended that the preferred treatment of this area with fire will be fall. If it is to be burnt in the fall then it could be ignited with the South stonehill unit.

Alternative Treatment: An alternate treatment to the area would be just to burn the area with the helicopter drip torch without any prior slashing treatment.

Proposed Treatxnent Schedule:

Pall - 1985 - Oct-Dec - Spot Slash
Fall - 1986 - Sept-Oct - Burn (preferred)
Spring - 1987 - May-April - Bum (alternate)

SLASHING SPECS

The stand in the northwest corner will have a 20 ft strip left above the cut bank. From there a 50 ft leave strip will be left then another 50 ft strip will be slashed. This should continue up the stand until the meadow is reached The rest of the treatment area is made up of timbered stringers. One half of these stringers, unless >lOO ft wide, will be slashed and then every 100 ft cut a 50 ft swath clear through the stringer. In the stringers all PP & WL >8 fttallshould be left. If the stringer is greater than 100 ft wide just slash a 50 ft swath on the lower edge of the stringer.

The south side of the area (see map) is a PP stand and this will be thinned leaving PP > 5" dbh where these are clustered thin to 25 ft spacing plus or minus 5 ft.

Donald Godtel
Wildlife Biologist

BURNING PLAN COVER PLAN

5150

PRESCRIBED BURNING PLAN

STONEHILL
Burning Unit

REXFORD Banger District

Kootenai National Forest

Prepared By: Don Godtel Date: 8/16/85

Reviewed By: George A. Ellis Date: 8/17/85

Reviewed By: Date:

Reviewed By: Date:

Reviewed By: Date:

Reviewed By: Date:

The approved Prescribed Burning Plan constitutes the authority to burn. No one has authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved Prescribed Burning Plan will be fully supported. Peronnel will be held accountable for actions taken which are not in compliance with the approved plan, regardless of the outcome of the burn. The same level of authority required to approve the Prescribed Burning Plan is required to amend the plan. This project and plan are rated as Complex, Intermediate X, Non-Complex, pursuant to R-1, 1961, Fuel Management and Treatment Guides.

Approved by: H. Drew Bell Date: 8/20/85

ACCOUNTING COST: 000929
EST. COST/ACRE : $25
FINAL COSTS:
TOTAL COST/ACRE :

SALE: Stonehill Unit: 1
LOCATION: T 35N R 29W SEC. NW24
STAND : 18-3-99 ACRES ELEVATION: TOP 2800 BOTTOM 2600
DRAINAGE: Lake Koocanusa SLOPE: 10-60 % ASPECT: SW
HABITAT TYPE: NFDR FUEL MODEL: C F,B,FUEL MODEL : 2/9

FUELS: NATURAL X ACTIVITY AGE ASSESSMENT: L Mx H
DOWN WOODY PRIVATE PROPERTY ADJACENT None
0-1/4" 0.1 T/A DUFF DEPTH 0.2 IN. FUEL DEPTH 1.4"
1/4-1" 0.6 T/A TOTAL FUEL 7.3 T/A
1-3" 1.2 T/A ADJACENT FUEL Highway 37 provides an excellent fuel
3+" 5.3 T/A break. Area across hwy is same as unit (FM 2/9).

OBJECTIVES OF BURN (CHECK)		(RANGE OF ACCEPTABLE RESULTS)
HAZARD REDUCTION	X	Reduce buildup of grass and pine needles
SILVICULTURE		
SITE PREPARATION		
WILDLIFE HABITAT	X	Reduce dense reproduction pockets of trees less
RANGE MANAGEMENT		than 10' by 30-50%. Reduce hardwoods in the
		stringers by 20-30%. Increase and improve browse
OTHER		and grass conditions.

PRESCRIPTION

TEMPERATURE:	50 TO 85		
R.H.	20 TO 35		
WIND SPEED	2 TO 10		
DIR.	S SW to NW		
	(Preferred)	(Accepted)	
ERC	TO		
BI	TO		
RATE OF SPREAD	2 TO 7		
FLAME LENGTH	2 TO 5		
SCORCH HEIGHT	5 TO 35		

SEASON: Fall TIME: 1200-2000

FUEL MOISTURE	INSIDE	OUTSIDE
0-1/4	7 TO 11	7 TO 11+
1/4-1	9 TO 13	9 TO 13+
1-3	13 TO 20	13 TO 20+
DUFF (LOWER)	N/A TO -	- TO -
SHRUBS	50 TO 5050	10 150+

IGNITION METHOD Drip torches/fuses

FIRING PATTERN Strip headfire

EXPECTED FIRE BEHAVIOR Fire will spread well where there's continuous fuel but will take a lot of lighting in the rocky and steep areas where there's little fuel. Scorch height will vary depending on fuel concentrations and the effect of shading on fuels from the thick stands of short-roduction. Fireball lived and will go out quickly.

PREPARATION:
TYPE OF FIRELINE: ROAD x TRACTOR CREW SIZE: IGNITION 6 HOLDING 2
PORTATANK 5 PUMPS HOSE ENGINES 1 SHOVELS 8 PULASKIS 8
SAWS 1 TORCHES 8 FUSES 30 4
PREPARATION NEEDED PRIOR TO BURN Will need to constuct a hand line down the draw on the south end of the unit. This could be done by the pickup crew when they are not involved in other burns.

FIRING AND HOLDING PLAN: (See attached map or photo) The strip along the road will be lit first and allowed to cool to anchor the unit. Then 6 torches will be staggered across the unit using strip headfires to burn the unit.
Holding: A 300 gallon engine with 2 people will patrol the highway with any interested people passing by. No problems are expected as the wide highway provides an excellent fire and fuel break.
** Hardwood stand on photo should not have fire lit such that it would run through the stand. There is also some Indian paintings on a rock wall that will be somewhat protected by an old skid trail and lighting pattern.

HAZARD AREA: (See attached map or photo) None

MOP UP AND PATROL PROCEDURES: It will be patrolled daily until it is felt safe and then periodically until out. Any hot spots along the edge will be mopped up if an extended dry spell continues after the burn so that it can handle a dry cold frontal passage.

TEST FIRE: (If applicable) Not needed.

SMOKE MANAGEMENT: Smoke from this burn will likely drift to the NE. Air quality is usually not a problem when burning in the spring. The SO Fire Desk (Air Quality Coordinator) will be notified prior to burning.

SAFETY:
Public: A sign will be placed along the road warning people of the burning operations. Highway Patrol will be notified. Engine crew will explain to people passing by the objectives of the burn.
Burn Crew: A preburn briefing will be held covering the ignition and holding plans. Protective clothing and gear will be worn. Good communications will be a must.

I & I CONTACTS: An article will be placed in the Tobacco Valley News.

REMARKS:

PREBURN INFORMATION:

FUEL MOISTURE %:

DATE	0-1/2"	1/4-1"	1-3"	3"+	DUFF	PRECIP

BURN MONITORING: DATE: _____ TIME OF IGNITION: S T O P :

BURNING BOSS: _____ FIRING BOSS: _____ H O L D I N G B O S S :

ACTUAL WEATHER:	TEMPERATURE	R-H.	WIND SPEED/DIRECTION	STATE OF WEATHER
1 HOUR BEFORE	_____ F	_____ %	_____ MPH	_____
START	_____ F	_____ %	_____ MPH	_____
30 MINUTES	_____ F	_____ %	_____ MPH	_____
60 MINUTES	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____

FUEL MOISTURES %: 0-1/4"_____ 1/4-1"_____ 1-3"_____ DUFF_____ S H R U B

FIRE BEHAVIOR R A T E / S P R E A D CH/HR, E R C _____ , x FLAME LENGTH E T .

x FLAME HEIGHT _____ x SCORCH HEIGHT _____ FT.

POST BURN EVALUATION (Objectives Met?) _____

CONTINGENCY PLAN:

FIRE BEHAVIOR FUEL MODEL ND. D I S C U S S I O N : Open fuel type with only scattered jackpots of fuel. Area is broken by rocky bluffs. Good fuelbreaks provided by highway

FIRE BEHAVIOR INPUTS "HOTTEST" CONDITIONS: SHADE 2 DRY BULB 85 RH 20 HR 7 10 HR 9 100 HR 13 LIVE 100 WIND SPEED 10

PROJECTION TIME 1 _____ hour

PREDICTED FIRE BEHAVIOR: ROS 70 CHS/HR HT/UNIT AREA 411 FIRELINE INTENSITY 385

FLAME LENGTH 6 PER I METER 1 80 CHS. AREA 228 ACRES

PLAN OF ACTION: NO. OF PEOPLE FR20 WHERE Eureka

A 30 LINE TO BUILD 20 MAX. ACRE ALLOWED TIME NEEDED 1Hr

PLAN OF ACTION: Rock bluffs should prevent fire from spreading as far as the above TI-59 outputs show. Highway 37 will prevent fire from spotting above the unit In most If not all areas. In the event a slopover does develop, extra people will be called for If needed. The ground above the unit is too steep for dozers. FLAME LENGTH WILL EXCEED 4' AT DENSE STANDS OF PUTR. (Bitter Brush)

WILDLIFE PRESCRIPTION

Stand No.l0-Mile	Photo No. 90
Area:106A-60A to be slashed/burned	Slope: 0-60%
Elevation: 2500-2800	Aspect: S-SW
Successioml Stage: POLE/SAPLIS W/OVERSTORY	Habitat Type: DF/PHMA
Fuels: LIGHT/CONTINUOUS IN GRASSES AND BRUSH	Site Productivity: Moderate
Wildlife Species to manage for: BIGHORN SHEEP AND MULE DEER	Vegetation species to manage for: GRASSES AND SHRUBS— Fesc, Feid, Amal, Prvi, Cese

Land Management Objectives: MANAGEMENT AREA 10
Maintain or enhance the habitat effectiveness for winter use by big game species. Maintain or enhance the viewing resource in areas visible from major travel corridors.

PRESENT SITUATION: The area is made up of several different stands due to past treatments. Basically the area contains an overstory of PP and DF with an understory of DF, PP, LP, & WL. The ground cover is composed of bush grasses andadiversityof shrubs. This is a highly productive site both from the standpoint of timber and wildlife forage. Logging has taken place in the past in about two different entries-in the 50's and then again in the 60's. There are two hardwood draws that have springs and streams running in them.

The area is used primarily by mule deer, currently bighorn sheep use the area as atravelcorridor and is is anticipated that the planned treatment will enhance the area for bighorn sheep use. Host of the preferred forage species are in form class 2 or 3. The browse species are becoming decadent due to the shading that istakenplace by the conifer reproduction.

PROPOSED TREATMENT: In order to reduce the stocking level of reproduction a slashing treatment followed up by fire will be used. Force account slashing crews will be the source of manpower. Al regen <8" dbh of PP, DF & WL & LP regen <10" DBH will be slashed. No slashing should take place within 50 ft of the draws. Any stringers of 8-10" DF, PP that have small regen (<6'tall) among slashing. The north end of the stand will be the control for this project (see map). Burning should take place at the time of the year that will give flame heights of 2-4 ft and of moderate intensities. The objective of the hum will be to reduce

the hazard and impediment to big game movement that has been created by the slashing, and to rejuvenate the decadent browse and grass plants that exist on site. Due to the fuel loadings that are expected by the slashing, the bum will probably take place in the spring or late fall (late Sept or early Oct.).

This area has been examined by an archeologist and nothing of significance was found. The proposal also will have short time impact on the viewing resource due to the reddening effect on the remaining trees; however, this is short term and the result will be an open PP stand with conifer/hardwood draws.

ALTERNATIVE TREATMENTS: If it is determined by the FMO that there will be too heavy of fuel loading by slashing the entire treatment area, stripslashing will be utilized to add fuel to the site to facilitateburnin to create an open grown PP/DFstand.

Donald Godtel
Wildlife Biologist

APPENDIX B

Wildlife Prescription -South Sheep Creek Unit

WILDLIFE PRESCRIPTION

Stand No.: SOUTH SHEEP CK II **Photo No.: 113**

Area: 155A Slope: 30-60%

Elevation: 2490 - 2800 Aspect: SW

Successional State: Young > Mature Habitat Type: DF/Syal-Aggsp

Fuels: Light but continuous Site Productivity:*

Wildlife Species to manage for: Bighorn Sheep Vegetation Species to manage for: Fesc, Agsp, Amal, Cese.

Land Management Objectives: "Big Game Winter Range" - the intent is to "manage areas of high potential for winter range, to maintain or enhance the habitat for the benefit of the appropriate species while recognizing the viewing resource in critical areas."

Present Situation: This stand has an overstory of BF and PP with a major part of the understory being grasses (Caru, Feid, Agsp). There is a shrub component of Amal, Cese, Acgl, within the stand. Bighorn sheep and mule deer are presently using this area for winter range and spring range.

The shrub component has about 10-15% of the plants (Amal) in form class three and the production of Amal is very low. The Cese seems to be producing in the low-moderte range (50-90 #/A). The grasses have been underutilized and have built up considerable amounts of decadence in the rood crown.

Proposed Treatment: Recommend this stand be underburned to regenerate the browse component and also reduce the amount of decadence in the bunch grasses. There is very little need to reduce conifer reproduction because of the lack of it. Up to 28% of the trees could be lost that are under 5" and still have very little effect on the cover component. Up to 5% could be lost of the larger mature trees for snags and snag replacement for enhancement of raptor habitat (Eagle and Osprey).

This stand could be burnt either in fall (first 2 weeks of September or early October) or in the spring (March or April) and still achieve the desired results. A strip headfire would be the technique to use.

DON GODTEL, Wildlife Biologist
After review with Yde & Brown - it was decided to go ahead and slash the unit by cutting down everything ≤8" and ≤6" except quaking aspen and birch. Sawcrew will slash

BURNING PLAN COVER PLAN

5150

PRESCRIBED BURNING PLAN

SOUTH SHEEP CREEK
Burning Unit

REXFORD Ranger District

Kootenai National Forest

Prepared By: DON GODTEL Date: 8/15/85

Reviewed By: George A. Curtis Date: 8/19/85

Reviewed By: Date:

Reviewed By: Date:

Reviewed By: Date:

Reviewed By: Date:

The approved Prescribed Burning Plan constitutes the authority to burn. No one has authority to burn without an approved plan or in a manner not in compliance with the approved plan. Actions taken in compliance with the approved Prescribed Burning Plan will be fully supported. Peronnel will be held accountable for actions taken which are not in compliance with the approved plan, regardless of the outcome of the burn. The same level of authority required to approve the Prescribed Burning Plan is required to amend the plan. This project and plan are rated as Complex___, Intermediate X, Non-Complex___, pursuant to R-1, 1981, Fuel Management and Treatment Guides.

Approved by: H. Alfred Bellon Date: 8/26/85

ACCOUNTING COST: 000929
EST. COST/ACRE: $25
FINAL COSTS:
TOTAL COST/ACRE:

SALE: South Sheep Creek Unit- 1
LOCATION: T 33N R 28W SEC. 17,20
STAND: ACRES: ELEVATION: TOP 2800 BOTTOM 2500
DRAINAGE: Lake Koocanusa SLOPE: 20-70 % ASPECT: SW
HABITAT TYPE: NFDR FUEL MODEL: C F.B. FUEL MODEL: 2/11

FUELS: NATURAL X ACTIVITY X AGE 1 YRS ASSESSMENT: L__ Mx H__
DOWN WOODY PRIVATE PROPERTY ADJACENT None
0-1/4" 1 T/A DUFF DEPTH 0.9 FUEL DEPTH 16"
1/4-1" 4.2 T/A TOTAL FUEL 43 T/A
1-3" 4.0 T/A ADJACENT FUEL Highway 37 provides an excellent fuel
3+" 22.2 T/A break. S. end heavy canopy-light fuels of grass/shrub understory
3+" R 11.7

OBJECTIVES OF BURN (CHECK)		(RANGE OF ACCEPTABLE RESULTS)
HAZARD REDUCTION	X	Reduce buildup of grass and pine needles plus slash that was created to ~~5/10TPA~~. depth to <12". ≤4"T/ac of 3"...-3"
SILVICULTURE		
SITE PREPARATION		
WILDLIFE HABITAT	X	Rejuvenate browse species and decadent grasses. Reduce overstory canopy by another 20-50%.
RANGE MANAGEMENT		
OTHER		

PRESCRIPTION

TEMPERATURE: 50 TO 85
R.H. 20 TO 35
WIND SPEED 2 To 10
DIR. S SW to NW
(Preferred) (Accepted)

SEASON TIME: 1200-2000

FUEL MOISTURE	INSIDE		OUTSIDE	
0-1/4	7	TO 10		11+
1/4-1	9	13	9 TO	13+
1-3	13	TO 20	13 TO	20+
DUFF (LOWER)	N/A	TO -	TO	-
SHRUBS	50	TO 150	50 TO	150+

ERC TO
BI TO
RATE OF SPREAD 2 TO 7
FLAME LENGTH 2 TO 5
SCORCH HEIGHT 5 TO 35

IGNITION METHOD Drip torches or Heletorch

FIRING PATTERN Strip headfire

EXPECTED FIRE BEHAVIOR Fire will spread well where there's continuous fuel but will take a lot of lighting in the rocky and steep areas where there's little fuel. Scorch heights will vary depending on fuel concentrations and the effect of shading on fuels from the thick stand of reproduction. Fire will be short-lived and will go out quickly in the light fuel areas but may hold over in logs.

PREPARATION:
TYPE OF FIRELINE: ROAD x Hand S.end CREW SIZE: IGNITION 6 HOLDING 3
PORTATANKS PUMPS HOSE ENGINES 1 SHOVELS 8 PULASKIS 8
SAWS 1 TORCHES 8 FUEL 30 RADIOS #6-Forest... 1-... 2-Flag per:
PREPARATION NEEDED PRIOR TO BURN This area is ready to burn when we start burning the topline the pumper should prewet along the guardrail so as not to damage any guardrail posts with fire.

FIRING AND HOLDING PLAN: (See attached map or photo) The strip along the road will be lit first and allowed to cool to anchor the unit. Then 6 torches will be staggered across the unit using strip headfires to burn the unit.
Holding: A 300 gallon engine with 2 people will patrol the highway and can meet with any interested people passing by. No problems are expected as the wide highway provides an excellent fire and fuel break.

HAZARD AREA: (See attached map or photo) The north end of the unit is very steep and rocky. If we light this by hand the torchman must be very careful not to be under the torchman abve them. The best goat torchman should be in this area.

MOP UP AND PATROL PROCEDURES: Unit will be patrolled daily until it is felt safe and then periodically until out. Any hot spots along the edge will be mopped up If an extended dry spell continues after the burn so that it can handle a dry cold frontal passage. Make sure no fire is left at dead fall posts.

TEST FIRE: (If applicable) Not needed.

SMOKE MANAGEMENT: Smoke from this burn will likely drift to the NE. The SO Fire Desk will be notified prior to burning.

SAFETY:
Public: A sign will be placed along the road warning people of the burning operations. Highway Patrol will be notified. Engine crew will explain to people passing by the objectives of the burn. We may need flag people. ★
Burn Crew: A preburn briefing will be held covering the ignition and holding plans. Protective clothing and gear worn. Good communications will be a must.

I & I CONTACTS: An article will be placed in the Tobacco Valley News.

REMARKS: ★ Use one lane traffic on inside of road if it is necessary, with the aid of two flag persons on each end of burn. Will light the road strip in 3 segments- the flag people should be by the immediate fire danger areas while lighting the strips.

PREBURN INFORMATION:

FUEL MOISTURE %:

DATE	O-I /2"	1/4-1"	1-3"	3"+	DUFF	PRECIP

BURN MONITORING: DATE:_____ TIME OF IGNITION:_____ STOP: _____

BURNING BOSS:_____ FIRING BOSS:_____ HOLDING BOSS:_____

ACTUAL WEATHER:	TEMPERATURE	R.H.	WIND SPEED/DIRECTION	STATE OF WEATHER
1 HOUR BEFORE	_____ F	_____ %	_____ MPH	_____
START	_____ F	_____ %	_____ MPH	_____
30 MINUTES	_____ F	_____	_____ MPH	_____
60 MINUTES	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____
_____	_____ F	_____ %	_____ MPH	_____

FUEL MOISTURES %: 0-1/4"_____ 1/4-1"_____ 1-3"_____ DUFF_____ SHRUB_____

FIRE BEHAVIOR RATE/SPREAD _____ CH/HR, ERC _____ , x FLAME LENGTH _____ .

x FLAME HEIGHT _____ x SCORCH HEIGHT _____ FT.

POST BURN EVALUATION (Objectives Met?) _____

CONTINGENCY PLAN:

FIRE BEHAVIOR FUEL MODEL NO. DISCUSSION: Timber canopy sta of young PP & DF 40-60 years old, mostly needle, grass & shrubs for understory N end of unit is in rock ar talus. Highway 37 will be a good break on un side.

FIRE BEHAVIOR INPUTS "HOTTEST" CONDITIONS: SHADE 2 DRY BULB 85 RH 20
1 HR 7 10 HR 9 100 HR 13 LIVE 100 WIND SPEED 10

PROJECTION TIME 1 hour

PREDICTED FIRE BEHAVIOR: ROS 70 CHS/HR HT/UNIT AREA 411 FIRELINE INTENSITY 385
FLAME LENGTH 6 PERIMETER 180 CHS. AREA 228 ACRES

PLAN OF ACTION: NO. OF PEOPLE FROM WHERE Eureka
ETA 30 LINE TO BUILD 20 MAX. ACRE ALLOWED TIME NEEDED 1Hr

PLAN OF ACTION: Rock bluffs should prevent fire from spreading as fast as the above TI-59 outputs show. Highway 37 will prevent fire from spotting above the unit in most if not all areas. In the event a slopover does develop, extra people will be called for if needed. The ground above the unit is too steep for dozers.

APPENDIX C

Initial vegetative response within the Rocky George & Lower Stonehill units.

Plant list, Ural-Tweed bighorn sheep project area, Lincoln County, Montana.[1]

Life Form	Scientific Name	Common Name
Grasses		
	Agropyron caninum	Bearded wheatgrass
	Agropyron intermedium	Intermediate wheatgrass
	Agropyron spicatum	Bluebunch wheatgrass
	Agrostis interrupta	Interrupted apera
	Bromus inermis	Smooth brome
	Bromus tectorum	Cheatgrass brome
	Calamagrostis purpurascens	Purple reedgrass
	Calamagrostis rubescens	Pinegrass
	Dactylis glomerata	Orchardgrass
	Danthonia spicata	Poverty danthonia
	Danthonia unispicata	Onespike danthonia
	Elymus glaucus	Wild rye-grass
	Festuca idahoensis	Idaho fescue
	Festuca octoflora	Six-weeks fescue
	Festuca scabrella	Rough fescue
	Koeleria cristata	Prairie junegrass
	Oryzopsis asperifolia	Roughleaf ricegrass
	Phleum pratense	Common timothy
	Poa annua	Annual bluegrass
	Poa compressa	Canada bluegrass
	Poa pratensis	Kentucky bluegrass
	Poa sandbergii	Sandberg bluegrass
	Stipa richardsonii	Richardson's needlegrass
Sedges and grasslikes		
	Carex geyeri	Elk sedge
Forbs		
	Achillea millefolium	Western yarrow
	Adenocaulon bicolor	Trail-plant
	Allium cernuum	Nodding onion
	Alyssum alyssoides	Pale alyssum
	Anaphalis margaritacea	Pearly everlasting
	Antennaria luzuloides	Woodrush pusseytoes
	Antennaria neglecta	Field pusseytoes
	Antennaria racemosa	Raceme pusseytoes
	Apocynum androsaemfolium	Spreading dogbane
	Arnica cordifolia	Heartleaf arnica
	Aster spp.	Aster
	Aralia nudicaulis	Wild sarsaparilla
	Arenaria spp.	Sandwort
	Balsamorhiza sagittata	Arrowleaf balsamroot

(Forbs continued)

Calchortis apiculatus	Sego lily
Campanula rotundifolia	Harebell
Castilleja spp.	Indian paintbrush
Chrysopsis villosa	Hairy golden aster
Cornus canadensis	Bunchberry dogwood
Collinsia parviflora	Blue-eyed Mary
Collonia tinctoria	Yellow-staining collomia
Crepis atrabarba	Slender hawksbeard
Dodecatheon conjugens	Sailorcaps shooting star
Eriognum spp.	Wild buckwheat
Filago arvensis	Filago
Fragaria vesca	Woods strawberry
Fragaria virginiana	Strawberry
Galium boreale	Northern bedstraw
Geum triflorum	Prairiesmoke avens
Gypsophila paniculata	Baby's breath
Habenaria elegans	Hillside rein-orchid
Heuchera cylindrica	Alumroot
Hieracium albertinum	Western hawkweed
Hieracium albiflorum	White-flowered hawkweed
Hieracium canadense	Canada hawkweed
Lonicera spp.	Honeysuckle
Lomatium spp.	Biscuitroot
Lupinus sericeus	Silky lupine
Madia exigua	Little tarweed
Melampyrum lineare	Cow-wheat
Microseris nutans	Nodding microseris
Microsteris gracilis	Microsteris
Mitella spp.	Mitrewort
tlonarda fistulosa	Wild bergamot
Myositis micrantha	Blue forget-me-not
Osmorhiza chilensis	Mountain sweetroot
Oxytropis spp.	Stemless-loco
Penstemon spp.	Penstemon
Perideridia gairdneri	Gairdneri's yampah
Phacelia linearis	Threadleaf phacelia
Phlox hoodii	Hood's phlox
Potentilla glandulosa	Sticky cinquefoil
Prunella vulgaris	Self-heal
Pteridium aquilinum	Bracken fern
Sedum stenopetalum	Wormleaf stonecrop
Smilacina stellata	Starry Solomon's seal
Spiranthes romanzoffiana	Ladies-tresses
Taraxacum officinale	Common dande1 i on
Tragopogon dubius	Yellow salsify
Trifolium agrarium	Yellow clover.
Trifolium microcephalum	Littlehead clover
Trifolium pratense	Red clover
Trifolium repens	White clover
Valeriana spp.	Valerian
Verbascum thapsus	Mullein

(Forbs continued)

Vicia americana	American vetch
Viola spp.	Violet

Shrubs

Acer glabrum	Rocky Mountain maple
Amelanchier alnifolia	Saskatoon serviceberry
Arctostaphylos uva-ursi	Bearberry
Berberis repens	Lou oregongrape
Ceanothus sanguineus	Redstem ceanothus
Ceanothus velutinus	Shiney-leaf ceanothus
Chimaphila umbellatum	Prince's pine
Cornus stolonifera	Red-osier dogwood
Holodiscus discolor	Creambush oceanspray
Juniperus communis	Common juniper
Juniperus scopulorum	Rocky tlountain juniper
Linnaea borealis	Twinflower
Pachistima myrsinites	Pachistima
Philadelphus lewisii	Mockorange
Physocarpos malvaceus	Ninebark
Prunus emarginata	Bittercherry
Prunus pensylvanica	Pin cherry
Prunus virginiana	Common chokecherry
Purshia tridentata	Antelope bitterbrush
Rosa gymnocarpa	Baldhip rose
Rosa nutkana	Nootka rose
Rosa woodsii	Woods rose
Rubus parviflora	Western thimbleberry
Rubus i daeus	Red raspberry
Salix spp.	Willow
Sambucus cerulea	Blue elderberry
Shepherdia canadensis	Buff aloberry
Spiraea betulifolia	Shiny-leaf spiraea
Synphoricarpos albus	Common snowberry
Vaccinium globulare	Big huckleberry
Vaccinium scoparium	Grouse huckleberry

Trees

Larix occidentalis	Western larch
Picea engelmannii	Englemann spruce
Pinus contorta	Lodgepole pine
Pinus ponderosa	Ponderosa pine
Populus trichocarpa	Black cottonwood
Populus tremuloides	Quaking aspen
Pseudotsuga menziesii	Douglas-fir
Thuja plicata	Western redcedar
Tsuga heterophylla	Western hemlock

[1] This is a partial list of common plants that were observed on t project area coincident with sampling of treatment units and oth field work.

Table 1. Percent ground cover[1] as determined by pace transect - Lower Stonehill Unit.

Species	Treatment				Control			
	1985	1986	1987	1988	1985	1986	1987	1988
Grasses								
Calamagrostis rubescens	5.5	4.0			4.5	3.0		
Festuca idahoensis	1.5	-			-	3.0		
Festuca scabrella	1.5	-			-	1.0		
Danthonia unispicata	-	.5			-	-		
Unknown spp.	2.0	-			-	-		
Forbs								
Fragaria virginiana	-	1.0			.5	.5		
Apocynum androsaemilfolium	.5	3.0			.5	.5		
Achillea millefolium	1.5	-			-	-		
Antennaria spp.	1.5	.5			1.0	-		
Sedum stenopetalum	1.5	-			.5	.5		
Mitella spp.	-	-			.5	-		
Arnica cordifolia	-	-			.5	-		
Alyssum alyssoides	-	1.0			-	-		
Penstemon spp.	2.0	-			-	-		
Unknown spp.	3.0	-			2.5	-		
Shrubs								
Symphoricarpos albus	-	-			-	2.5		
Spiraea betulifolia	1.0	4.5			3.5	5.5		
Berberis repens	1.0	2.5			3.0	4.0		
Actostaphylos uva-ursi	2.0	1.5			3.0	5.1		
Amelanchier ainifolia	-	-			.5	.5		
Vaccinium spp.	-	-			.5	-		
Rosa spp.	-	-			-	.5		
Purshia tridentata	-	-			1.5	4.0		
Linnaea borealis	-	-			.5	-		
Other								
lichens	2.5	3.0			4.5	4.0		
Moss	4.5	-			-	-		
Ground cover								
Bare ground	13.0	-			10.5	1.0		
Persistent litter	3.0	8.0			7.5	7.0		
Non-persistent litter	43.0	69.0			39.5	62.5		
Gravel	4.0	1.5			.5	1.5		
Cobble	.5	-			3.5	2.5		
Stone	4.0	-			10.0	.5		
Bedrock	1.0	-			1.0	-		

[1] Percent ground cover is based on number of basal hits by species divided by the total number of basal hits (200).

Table 2. Percent ground cover[1] as determined by pace transect - Rocky Gorge Unit.

Species	Treatment				Control			
	1985	1986	1987	1988	1985	1986	1987	1988
Grasses								
Calamagrostis rubescens	3.0	8.0			-	1.5		
Festuca scabrella	1.5	-			2.5	1.0		
Festuca idahoensis	-	-			.5	-		
Bromus inermis	1.0	-			.5	-		
Poa pratensis	1.5	-			-	-		
Agrostis interrupta	-	-			-	.5		
Bromus tectorum	-	.5			-	-		
Danthonia spicata	-	-			-	.5		
Koeleria cristata	-	-			-	1.0		
Stipa richardsonii	-	-			-	1.0		
Unknown spp.	.5	-			-	-		
Forbs								
Antennaria spp.	13.5	3.5			14.5	3.0		
Penstemon spp.	4.0	3.5			.5	1.5		
Arrenaria spp.	1.5	-			-	-		
Apocynum androsaemilfolium	.5	-			-	-		
Calchortis apicuiatus	.5	-			-	-		
Lupinus sericeus	-	-			-	3.0		
Trifolium agrarium	-	.5			-	-		
Vicia americana	-	-			-	1.5		
Monarda fistulosa	-	.5			-	.5		
Verbascum thapsus	-	-			-	.5		
Taraxacum officinale	-	.5			-	-		
Galium boreale	-	-			-	-		
Hieracium albertinum	-	4.0			.5	2.5		
Fragaria vesca	-	-			.5	-		
Achillea millefolium	-	1.0			-	.5		
Dodecantheon conjugens	.5	-			-	-		
Unknown spp.	8.5	-						
Shrubs								
Arctostaphyles uva-ursi	11.5	5.0			5.5	9.5		
Berberis repens	.5	1.0			.5	1.5		
Spiraea betulifolia	-	3.0			-	-		
Rosa spp.	-	.5			-	.5		
Linnaea borealis	3.0	-			-	-		
Amelanchier alnilfolia	-	-			-	.5		
Symphoricarpos albus	-	-			-	.5		
Other								
Lichen	2.0	8.0			10.0	11.0		

(Table 2. continued)

Moss	.5	-	3.5	-
Carex	-	-	.5	-
Ground cover				
Bare ground	11.5	-	6.5	.5
Persistent litter	3.0	.5	3.0	1.5
Non-persistent litter	32.5	60.0	43.0	55.5
Cobble	-	-	.5	-
Bedrock	-	-	.5	-

[1] Percent ground cover is based on number of basal hits by species divided by the total number of basal hits (200).

Table 3. 1985 tree densities (trees/acre) for Lower Stonehill treatment/control area.

TREATMENT	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Tota
Pseudotsuga menziesii	60.0	90.0								150
Pinus ponderosa	180.0	855.0	21.3							1056
Larix occidentalis							.9			
TOTAL	240.0	945.0	21.3				.9			1206

CONTROL	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Tot
Pseudotsuga menziesii	195.0	45.0	5.3							24
Pinus ponderosa	60.0	180.0	31.9	2.9						27
Larix occidentalis	15.0	210.0	10.6	2.9						23
Populus trichocarpa	240.0	15.0								25
Populus tremuloides		15.0								1
TOTAL	510.0	465.0	47.8	5.8						102

1. 1986 tree densities (trees/acre) for Lower Stonehill treatment/control area.

ATMENT	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Total
us ponderosa		510.0	10.6							520.0
AL		510.0	10.6							520.6

TROL	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Total
udotsuga menziesii	210.0									210.0
us ponderosa	135.0	240.0	105.0							480.0
ix occidentalis	15.0	15.0								30.0
ulus trichocarpa	270.0	15.0								285.0
AL	630.0	270.0	105.0							1005.0

Table 5. 1985 tree densities (trees/acre) for Rocky Gorge treatment/control area.

	TREATMENT	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Tot
S|	Pseudotsuga menziesii	285.0	135.0								31
P|	Pinus ponderosa	180.0	285.0								46
E|	Pinus contorta	600.0	1020.0								162
C|	Larix occidentalis	60.0	165.0								22
I|	Populus tremuloides	225.0	15.0								24
E|	Populus trichocarpa	600.0	15.0								61
S|											
|	TOTAL	1950.0	1530.0								348

	CONTROL	Size classes (DBH) (inches) .1	1-4	6	8	10	12	14	16	>18	Tot
S|	Pseudotsuga menziesii	345.0	30.0								48
P|	Pinus ponderosa	15.0	75.0								9
E|	Pinus contorta	645.0	990.0								163
C|	Larix occidentalis	45.0									4
I|	Populus tremuloides	15.0									1
E|	Populus trichocarpa	30.0									3
S|											
|	TOTAL	1095.0	1200.0								229

1986 tree densities (trees/acre) for Rocky Gorge treatment/control area.

TMENT	Size classes (DBH) (inches)									
	.1	1-4	6	8	10	12	14	16	>18	Total
dotsuga menziesii	870.0					1.3				871.3
s ponderosa	135.0	15.0					.9			150.9
s contorta	540.0	15.0								555.0
x occidentalis	120.0									120.0
lus tremuloides	15.0									15.0
lus trichocarpa	735.0									735.0
L	2415.0	30.0				1.3	.9			2447.2

ROL	Size classes (DBH) (inches)									
	.1	1-4	6	8	10	12	14	16	>18	Total
dotsuga menziesii	435.0							.7		435.7
s ponderosa	255.0	135.0				1.3				391.3
s contorta	465.0	240.0								705.0
lus trochocarpa	90.0									90.0
;	1245.0	375.0				1.3		.7		1622.0