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WILDLIFE INVENTORY
AND
HARD ROCK MINING IMPACT ANALYSIS
OF THE WEST CABINET MOUNTAINS AND
LAKE CREEK VALLEY, LINCOLN COUNTY, MONTANA

Montana Department of Fish, Wildlife and Parks
Ecological Services Division

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TABLE OF CONTENTS

	Page
List of Tables -----	iii-v
List of Figures -----	vi-vii
Introduction -----	1
Description of Area -----	2
Location -----	2
Topography -----	4
Climate -----	4
Geology -----	6
Soils -----	6
Vegetation -----	7
Scree -----	7
<i>Pseudotsuga menziesii</i> (PSME) Series -----	9
<i>Abies grandis</i> (ABGR) Series -----	9
<i>Thuja plicata</i> (THPL) Series and <i>Tsuga</i> <i>heterophylla</i> (TSHE) Series -----	9
<i>Abies lasiocarpa</i> (ABLA) Series -----	9
Description of Mine Project -----	10
Methods -----	12
Results -----	14
Mammals -----	14
Big Game -----	14
Ungulates -----	14
Moose -----	15
Elk -----	19
Mule Deer -----	22
White-tailed Deer -----	24
Bighorn Sheep -----	24
Mountain Goat -----	26
Carnivores -----	33
Black Bear -----	33
Grizzly Bear -----	36
Mountain Lion -----	37
Furbearers and Predators -----	41
Small Mammals -----	44
Birds -----	51
Waterfowl -----	51
Raptors -----	61
Forest Grouse -----	63
Shorebirds -----	69
Other Birds -----	69
Amphibians -----	70

Table of Contents (continued)

	Page
Assessment of Wildlife Impacts -----	72
Comprehensive Review -----	72
Mine Construction and Operation -----	72
Expanding Human Population -----	73
Identified Wildlife-Mining Conflicts -----	75
Moose -----	75
Elk -----	75
Mule Deer -----	75
White-tailed Deer -----	75
Bighorn Sheep -----	76
Mountain Goat -----	76
Bears -----	76
Mountain Lion -----	76
Furbearers and Predators -----	78
Small Mammals -----	78
Waterfowl -----	78
Raptors -----	79
Forest Grouse -----	79
Shorebirds -----	80
Other Birds -----	80
Amphibians -----	80
Recommendations -----	80
Short-term Management Recommendations -----	82
Utility Corridor -----	83
Mine Site and Tailing Impoundment -----	83
Expanding Human Population -----	84
Long-term Management Recommendations -----	84
Literature Cited -----	86
Appendix	

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Forest habitat types in which wildlife observations were recorded, 1977 and 1978 -----	8
2. Percentage of moose, elk and deer sign observed at different aspects, elevations, slopes, habitat types, topographies, configurations and distances from cover and roads -- October 1977 through April 1978 -----	16
3. Moose, elk, mule deer and white-tailed deer sex and age classification -- monthly summary 1977 and 1978 -----	20
4. Mountain goat sex and age classification and average groups size -- monthly summary 1977 and 1978 -----	27
5. Black bear observations and bear sign -- monthly summary 1977 and 1978 -----	34
6. Carnivore observations and sign -- occurrence in cover and habitat types -----	43
7. Small mammal observations -- occurrence in cover and habitat types -----	45
8. Small mammal trapline results -- spring and fall 1977 -----	49
9. Bird species observed each month -----	52
10. Bird species occurrence in cover and habitat types, 1977 and 1978 -----	57
11. Duck broods observed during 1977 -----	60
12. Osprey nests located during 1977 and 1978 including first observation dates, site description and comments -----	64
13. Blue grouse sex and age classification -- monthly summary -----	65
14. Ruffed grouse sex and age classification -- monthly summary -----	66
15. Amphibian and reptile observations -- occurrence in cover and habitat types -----	71

LIST OF TABLES (continued)

APPENDIX

<u>Table</u>	<u>Page</u>
1. Browse transect information collected on redstem ceanothus (<i>Ceanothus sanguineus</i>), 1977 --	A-1
2. Moose, elk, mule deer and white-tailed deer summary of habitat type and seasonal use, 1977 - 1978 -----	A-2
3. Moose, elk, mule deer and white-tailed deer summary of elevation and seasonal use, 1977 - 1978 -----	A-3
4. Moose, elk, mule deer and white-tailed deer summary of aspect and seasonal use, 1977 - 1978 -----	A-4
5. Moose, elk, mule deer and white-tailed deer summary of topography, configuration and seasonal use, 1977 - 1978 -----	A-5
6. Moose, elk, mule deer and white-tailed deer summary of distances from cover and nearest road and seasonal use, 1977 - 1978 -----	A-6
7. Moose observations recorded during 1977 and 1978 -----	A-7
8. Elk observations recorded during 1977 and 1978 -----	A-8
9. Mule deer observations recorded during 1977 and 1978 -----	A-11
10. White-tailed deer observations recorded during 1977 and 1978 -----	A-14
11. Mountain goat observations and sign recorded during 1977 and 1978 -----	A-18
12. Black bear observations recorded during 1977 and 1978 -----	A-26
13. Bear sign observed during 1977 and 1978 -----	A-28
14. Mountain lion observations and sign recorded from 1974 through 1978 -----	A-31

LIST OF TABLES - APPENDIX (continued)

<u>Table</u>	<u>Page</u>
15. Small mammal trapline site information -----	A-36
16. Blue grouse observations 1977 - 1978 -----	A-38
17. Ruffed grouse observations 1977 - 1978 -----	A-41
18. Ruffed grouse drumming routes conducted during spring 1977 and 1978 -----	A-45

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Location of mine and facilities on the study area -----	3
2. East exposure of Mount Vernon. Cliff face is known as the Spires. Bull Lake in foreground-----	5
3. Mount Vernon with Bull Lake in foreground	5
4. Portions of the Stanley Creek drainage cleared for mine facilities construction -----	11
5. Tailing impoundment site along Lake Creek. Keeler Mountain in background -----	11
6. Ungulate winter use areas identified during 1977-1978 and federal lands designated by the U.S. Forest Service as well-suited big game winter range -----	17
7. Locations of moose observed on the study area, 1977 - 1978 -----	18
8. Locations of elk observed on the study area, 1977 - 1978 -----	21
9. Locations of mule deer observed on the study area, 1977 - 1978 -----	23
10. Locations of white-tailed deer observed on the study area, 1977 - 1978 -----	25
11. Locations of mountain goat sign and observations on the study area, 1977 - 1978 -----	28
12. Mountain goat concentration areas in the West Cabinet Mountains, 1977 - 1978 -----	29
13. Observed seasonal use of aspects by mountain goats -----	30
14. Mean and mode elevations at which mountain goats were observed, 1977 - 1978 -----	32
15. Locations of black bear observations and bear sign on the study area, 1977 - 1978 -----	35

LIST OF FIGURES (continued)

<u>Figure</u>	<u>Page</u>
16. Locations of mountain lion sign and observations on the study area, 1974 - 1978 -----	38
17. Young female mountain lion being measured prior to release -----	40
18. Locations of furbearer and predator sign and observations on the study area, 1977 - 1978 --	46
19. Marten observed in Ross Creek drainage -----	47
20. Locations of raptors observed on the study area, 1977 - 1978 -----	62
21. Locations of blue grouse, ruffed grouse and spruce grouse observed on the study area, 1977 - 1978 -----	67
22. Adult female mountain goat feeding in meadow -	77

INTRODUCTION

More metal and mineral products are produced in western North America than any other region of similar size in the world. The domestic demand for minerals has increased at an astounding rate; in fact, more metal and mineral products have been used in the United States since World War II than were used in the entire previous history of the world. The present major mining activity in the West centers upon the copper mines of Arizona, New Mexico, Utah, Nevada and Montana. Copper is number one in economic importance in metal mining west of the Rocky Mountains (SEAM 1977).

Over the years American mining companies have exploited the raw mineral reserves of partially developed countries, but the current foreign climate has made prospecting and development of these reserves uneconomical or politically unavailable so the developers are returning to the States and will be putting more pressure on public lands to produce minerals in the coming years. Montana is feeling this pressure as domestic mineral promoters are strongly encouraging exploration and development of the state's mineral resources. Northwest Montana's metalliferous mineral deposits have not been thoroughly explored or developed but the area is targeted as having a great potential for future production (Johns 1970).

Little documentation is available concerning the effects of hard rock mining upon wildlife (Hudson 1978). Resources to research this relationship have not been available due to the unlikelihood of voluntary implementation of research recommendations by mining companies. "Pertinent data for rehabilitating mined land in ways that will promote wildlife, aesthetics, erosion control, and water quality are virtually nonexistent" (National Academy of Sciences -- taken from Sheridan 1977).

The General Mining Law of 1872 is at the root of the problem. Efforts to reform or repeal this piece of legislation have met with repeated obstacles. The 1872 law does not control environmental degradation even if the losses are severe and it does not balance the nation's need for minerals against other needs in a manner consistent with multiple use philosophy (NPRC 1978). These points, along with the fact that mineral production will increase in the United States, pose serious consequences for wildlife.

In 1976 ASARCO Inc. submitted a notice of intent to the Kootenai National Forest (KNF) to conduct mining operations on National Forest land and they applied for a hard rock operating permit with the Montana Department of State Lands

(DSL). The magnitude of the mine development prompted the KNF and DSL to prepare an environmental impact statement (EIS) on the project. The EIS would be the first ever prepared on a hard rock mine development in Montana and only the fourth in the United States. The Montana Department of Fish, Wildlife and Parks was enlisted by the DSL to survey and inventory wildlife species of the mine development area pursuant to requirement of the Montana Environmental Policy Act.

Objectives of the study were to:

1. Determine the density, relative abundance and occurrence of wildlife utilizing the area to be influenced by mining activities;
2. Identify species which would have particular vulnerabilities to the project;
3. Predict impacts to all wildlife species from the development;
4. Provide immediate recommendations to alleviate, avoid or reduce impacts pursuant to data collected during the baseline study and available literature; and
5. Obtain the necessary background information to develop long-term wildlife monitoring programs which would establish cause-effect relationships between wildlife responses and mine-related activities.

The final objective would ultimately provide resource managers with the opportunity to implement recommendations which would have long-term beneficial consequences for wildlife in this particular mine area and for mines slated for other parts of Montana or the nation.

DESCRIPTION OF AREA

Location

The West Cabinet Mountains study area encompassed approximately 416 square km (160 square mi) in northwest Montana about 24 km (15 mi) south of Troy in Lincoln County. The study area boundaries were roughly defined by the Lincoln-Sanders County line and the Montana-Idaho state line on the south and west, while the northern boundary followed the separation between Townships 30 and 31 and the eastern boundary followed Highway 202 (recently renumbered to 56) (Figure 1). About 2 percent of the study area is under

Figure 1. Location of mine and facilities on the study area.

State, Burlington Northern, Kennecott Copper and ASARCO ownership, while St. Regis, private and federal interests account for 9, 11 and 78 percent of the land ownership, respectively. The ASARCO copper-silver mine, known as the Troy Project, is in the southern half of the area. The study area includes the Ross Creek Giant Cedars Scenic Area and a portion of the proposed Scotchman Wilderness Area.

Topography

The broad alluvial Lake Creek and Bull River valleys bisect the West from the East Cabinet Mountains. The last continental glacier of the Pleistocene epoch rose to the 1,370 m (4,500-foot) level and extended to the gentle divide between the Lake Creek and Bull River valleys which drain in opposite directions to the Kootenai and Clark Fork rivers, respectively. The smoothed mountain bases and deep alluvial sediments of the Lake Creek Valley are testimony to the continental glacier while the cirque basins and hanging valleys of the peaks are products of alpine glaciation.

Over a dozen peaks in the West Cabinets rise from the 700 m (2,300-foot) valley floor to over 1,820 m (6,000 feet). The lowest topographical point in Montana (557 m or 1,828 feet) occurs immediately north of the study area where the Kootenai River leaves the state.

Mount Vernon (Figure 2), the site of the mine development, is located 11 km (7 miles) from the Montana-Idaho border. The Mount Vernon-Spar Peak ridge lies to the west of Mount Vernon (cover photo shows Mount Vernon in the foreground, Spar Peak in the center background and the mountains of Idaho in the distance), while Ross Creek skirts the mountain to the south and empties into Bull Lake which borders the mountain on the east (Figure 3). Lake Creek drains north out of Bull Lake and is fed by Stanley Creek which flows from the north face of Mount Vernon.

Climate

The Pacific maritime air mass controls the climate of the Cabinet Mountains although on occasion an arctic air mass will push over the Continental Divide to influence winter weather. Temperatures vary from -32° to 41° C (-25° to 105° F) at Troy, resulting in a mean annual daily temperature of 5.9° C (42.6° F) (National Weather Service, Troy Ranger Station).

Precipitation levels range from just under 100 cm (40 inches) near Bull Lake to near 500 cm (200 inches) at the high elevation ridges, which occur primarily in the form of

Figure 2. East exposure of Mount Vernon. Cliff face, known as the Spires, is critical winter range for mountain goats.

Figure 3. Mount Vernon with Bull Lake in foreground.

snow. Up to 1,780 cm (700 inches) of snow may fall at these higher elevations contributing to the 3.7 m (12-foot) snow pack in some areas. Variable winds, fog, intense thunderstorms, gentle rains and hot humid days characterize the summer climate of the area.

Geology

The Bull River-Lake Creek Valley is a down-dropped fault block flanked on the east and west by two major north-south trending faults. Dramatic rock pinnacles and cliff terrain are evidence of these and lesser faults along the east face of Mount Vernon (known as the Spires) and along Spar and Ross creeks. In general, mineralization has occurred along the fault structures and fracture zones of the area (Johns 1970). Strata-bound copper occurrences of known and potentially high economic benefit are known to occur in Star Gulch, near Ross Point, Spar Peak and on Mount Vernon. Gold reserves are being developed in Rock Creek and copper deposits near Seven Point Mountain, Waloven Creek, Taylor and Chicago Peaks in the East Cabinet Mountains are being studied for mineral development. Both Ross Point and Chicago Peak are undergoing exploratory drilling operations.

The U.S. Forest Service delineates areas within the Forest according to mineral activity classification sub-units (MACS) which are based on available geological, geotechnical, geophysical, structural information and upon recorded and reported mineral-related activities (KNF, Keeler Planning Unit 1978). Within the study area four MACS have been identified. MAC 1 has the highest potential for the discovery of economically disseminated copper-silver deposits. MAC 1 encompasses the majority of the West Cabinet Mountain range from the Clark Fork River north to Grouse Mountain, Copper Mountain, Lime Butte and Carr Draw (KNF, Keeler Planning Unit 1978 and Bull Lake-Napolean Planning Unit mailer 1977). Copper, gold, zinc, lead and silver deposits have been located in the study area and a few have been developed, although increasingly refined mining technology and mounting public demand will likely increase exploration and development of the Cabinet Mountains' mineral resources.

Soils

Soils associated with the continental and alpine glaciation contain 40-65 percent rock. Soils developed at the higher elevations are sandy loam in texture and are composed of up to 80 percent angular rock. The Lake Creek and Bull River valleys have very deep, complex soils composed of layered and intermixed gravel, sand and silt. After the continental glacier retreated, a layer of wind-blown silt and volcanic ash settled on north slopes from the peaks to

the valley floors and on south slopes above 1,370 m (4,800 feet). These soils are highly productive but are also highly erodible if the vegetation is removed. In general, the soils of the study area are rich and support an extensive and diverse vegetative cover.

Vegetation

The maritime-influenced climate has a strong effect on the flora of the area creating some of the most luxuriant and diverse vegetation within the state. The majority of the study area would be densely timbered without human disturbance, but about 20 years ago extensive logging operations were initiated at upper elevations to curtail the spread of spruce bud worm infections while lower elevation private lands were being developed for summer and year-round dwellings.

Five vegetation type series which include 20 habitat types as described by Pfister et al. (1977) were used by wildlife on the study area. Table 1 lists the scientific name, corresponding abbreviation and common name of these series and habitat types. The scientific name abbreviation is used throughout this report.

Scree

Scree is broadly defined by Pfister et al. (1977) as any slope covered with loose rock fragments. Such sites are not considered habitat types because they are topoedaphic climaxes rather than vegetative climaxes. Unstable substrates affect vegetative succession although the adjacent habitat type influences plant species composition. On the study area scree slopes were found associated with all series.

Pseudotsuga menziesi (PSME) Series

Seven habitat types within this series were recognized at elevations generally below 1,460 m (4,800 feet). This series and the THPL and TSHE series occupied the lowest elevations on the area. The PSME/AGSP habitat type is not common on the study area. It represents the dry end of the spectrum and is located at or below 1,400 m (4,600 feet) on dry ridges or warm aspects. Located on all aspects except north, the PSME/PHMA habitat type occurs on steep slopes. The PSME/VAGL habitat type is rare on the study area, being found primarily on cool, steep west slopes. The PSME/LIBO habitat type occurs on gently sloping moist sites on most aspects except south. PSME/SYAL is found on warm slopes and benches and on rocky soils on the study area. Neither the PSME/SYAL nor PSME/LIBO habitat types are common on the study area. The PSME/CARU habitat type was found only occasionally on the study area, on southerly exposures, as was the PSME/ARUV habitat type.

Table 1. Forest habitat types in which wildlife observations were recorded during 1977 and 1978.

<i>Pseudotsuga menziesii</i> SERIES		
PSME/AGSP	<i>Pseudotsuga menziesii</i> / <i>Agropyron spicatum</i>	Douglas-fir/bluebunch wheatgrass
PSME/PHNA	<i>Pseudotsuga menziesii</i> / <i>Physocarpus malvaceus</i>	Douglas-fir/ninebark
PSME/VAGL	<i>Pseudotsuga menziesii</i> / <i>Vaccinium globulare</i>	Douglas-fir/blue huckleberry
PSME/LIBO	<i>Pseudotsuga menziesii</i> / <i>Lirnaea borealis</i>	Douglas-fir/twin flower
PSME/SYAL	<i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i>	Douglas-fir/snowberry
PSME/CARU	<i>Pseudotsuga menziesii</i> / <i>Calamagrostis rubescens</i>	Douglas-fir/pinegrass
PSME/ARUV	<i>Pseudotsuga menziesii</i> / <i>Arctostaphylos uva-ursi</i>	Douglas-fir/kimmikinnick
<i>Abies grandis</i> SERIES		
ABGR/CLUN	<i>Abies grandis</i> / <i>Clintonia uniflora</i>	grand fir/queencup beadlily
ABGR/XETE	<i>Abies grandis</i> / <i>Xerophyllum tenax</i>	grand fir/beargrass
<i>Thuja plicata</i> SERIES and <i>Tsuga heterophylla</i> SERIES		
THPL/OPHO	<i>Thuja plicata</i> / <i>Oplopanax horridum</i>	western red cedar/devil's club
THPL/CLUN	<i>Thuja plicata</i> / <i>Clintonia uniflora</i>	western red cedar/queencup beadlily
TSHE/CLUN	<i>Tsuga heterophylla</i> / <i>Clintonia uniflora</i>	western hemlock/queencup beadlily
<i>Abies lasiocarpa</i> SERIES		
ABLA/CLUN	<i>Abies lasiocarpa</i> / <i>Clintonia uniflora</i>	subalpine fir/queencup beadlily
ABLA/CACA	<i>Abies lasiocarpa</i> / <i>Calamagrostis canadensis</i>	subalpine fir/bluejoint
ABLA/MEFE	<i>Abies lasiocarpa</i> / <i>Menziesia ferruginea</i>	subalpine fir/mensiesia
TSME/MEFE	<i>Tsuga mertensiana</i> / <i>Menziesia ferruginea</i>	mountain hemlock/menziesia
ABLA/XETE	<i>Abies lasiocarpa</i> / <i>Xerophyllum tenax</i>	subalpine fir/beargrass
TSME/XETE	<i>Tsuga mertensiana</i> / <i>Xerophyllum tenax</i>	mountain hemlock/beargrass
ABLA/LUHI	<i>Abies lasiocarpa</i> / <i>Luzula hitchcockii</i>	subalpine fir/wood-rush
TSME/LUHI	<i>Tsuga mertensiana</i> / <i>Luzula hitchcockii</i>	mountain hemlock/wood-rush

Abies grandis (ABGR) Series

Two habitat types within this series were located on the study area. This series is bounded on drier sites by the PSME series, on more moist sites by the THPL and TSHE series, and on cooler sites by the ABLA series. ABGR/CLUN occurs primarily on easterly aspects between 1,160 m (3,800 feet) and 1,400 m (4,600 feet). The ABGR/XETE habitat type only occurs on well-drained, cool sites, generally on or near ridgetops.

Tsuga heterophylla (TSHE) Series and *Thuja plicata* (THPL) Series

Although they are separate series the THPL and TSHE habitat types occur in such interwoven fashion that they are usually discussed simultaneously. The TSHE/CLUN habitat type is the most common type found on the study area and is distributed on all moist aspects below 915 m (3,000 feet). This habitat type is primarily restricted to this portion of the state since it occupies areas having a very moist ocean-influenced climate. Where TSHE and THPL occur together, TSHE is dominant except where the water table is high and then TSHE and THPL act as co-climax species within the THPL/OPHO habitat type. This type occurs in shaded creekbottoms on all aspects except south. The THPL/CLUN habitat type occurs on slightly warmer and drier sites than TSHE/CLUN. The ABGR series borders the TSHE and THPL series on slightly drier sites while the PSME series occurs on significantly drier sites. The ABLA series borders the TSHE and THPL series on colder sites.

Abies lasiocarpa (ABLA) Series

This series is divided into lower subalpine, upper subalpine and timberline habitat types. All but two of the habitat types in this series (as given in Table 1) occur within the lower subalpine category. The ABLA/CLUN habitat type is rather restricted. Due to the westerly location of the study area, this habitat type receives competition from other habitat types more able to compete under the maritime climatic conditions (THPL, TSHE and ABGR). ABLA/CLUN is the warmest and driest ABLA habitat type on the study area. The ABLA/CACA habitat type occurs on very restricted, poorly-drained sites, usually along creeks, in seeps, or in basins at the head of drainages. ABLA/MEFE is probably the most common habitat type in this series on the study area. It is common above 1,525 m (5,000 feet) on all aspects except south. It is bordered by ABLA/CLUN, ABGR/CLUN or TSHE/CLUN below and by ABLA/LUHI above. Where *Tsuga mertensiana* (TSME) is successfully reproducing within this series it receives the primary designation in the habitat type name. Where TSME is successfully reproducing (and the habitat type would otherwise be

ABLA/MEFE) on moist sites the habitat type is TSME/MEFE. This habitat type is known to occur on the South Fork of Ross Creek-South Branch of Dry Creek ridge and on the northeast slopes of Mount Vernon. On drier sites where TSME is successfully reproducing the habitat type is TSME/XETE and where TSME is not present it is ABLA/XETE. The TSME/XETE habitat type was found only on the northeast slope of Mount Vernon. The ABLA/LUHI and TSME/LUHI habitat types are classified as upper subalpine habitat types. The ABLA/LUHI habitat type is widely distributed on most ridges within the study area above 1,700 m (5,600 feet). The TSME/LUHI habitat type occurs adjacent to but in the same areas as the TSME/MEFE habitat type. Although timberline habitat types do occur in the Cabinet Mountains, they were not common on the study area, and no observations of wildlife were noted in these types. The *Larix lyallii*-*Abies lasiocarpa* (LALY-ABLA, alpine larch-subalpine fir) habitat type occurred in the few sites where granitic boulders formed the walls of cirque basins or peak summits.

Description of Mine Project

ASARCO plans to extract 48 million tons of copper and silver ore over a 16-year period from the Mount Vernon mine, making it the second largest silver mine in North America. During the life of the mine, a total of 2,930,000 tons of tailing and 60,000 tons of copper-silver concentrate will be produced annually. Copper occurs at concentrations of 0.74 percent, while silver occurs at 1.54 ounces per ton of ore.

A 3-year construction phase will preface the 16-year production phase. Adits will be driven into the north side of the mountain at the head of Stanley Creek to provide access to the ore body which is located at the 1,340 m (4,400 feet) elevation (Figure 4). The ore will be extracted utilizing an underground room and pillar method whereby 76 percent of the ore can be removed. Ore will be fed to a primary crushing mill where it will be reduced to less than 2 cm (0.75 inch) size, then moved via conveyor belt to the secondary crushing mill located at the 1,040 m (3,400 feet) elevation on Mount Vernon. At that point it will be further reduced to the consistency of fine granulated sugar and subjected to a "froth floatation" process wherein the copper and silver are mechanically and chemically separated from the tailing. The mineral concentrate will be dried and then transported by truck to Troy where it will be shipped via railroad to a smelter in Tacoma, Washington. The tailing will be moved to a tailing thickener where excess liquid is removed. The thickened tailing will then be transported for 10.5 km (6.5 miles) in a slurry pipeline to the Lake Creek Valley (700m or 2,300 ft below) where it will be distributed in

Figure 4. Portions of the Stanley Creek drainage cleared for mine facilities construction.

Figure 5. Tailing impoundment site along Lake Creek. Keeler Mountain in background.

a tailing impoundment covering 1.73 square km (440 acres) to a depth of 30 m (100 feet) (Figure 5). Water decanted from the tailing will be returned to the mill site in a return water pipeline system which will be buried in and along Stanley Creek. Both the tailing slurry pipeline and the return water pipeline will follow Stanley Creek. In addition to the mine and mills, other facilities which will be associated with the development include: mill water reservoirs, fresh water wells, offices, warehouse, shop, vehicle scale, parking lots (will accommodate 200+ vehicles), shower and change rooms, sewage treatment plant, 3 km (2 miles) of new road, 7.7 km (4.8 miles) of existing seasonal or abandoned road upgraded to a 7.6 m (25 feet) wide all-weather road, 115 kv transmission line, power substations, fuel and water storage tanks.

A work force of up to 320 people will be employed during construction and mine development. Eventually, 310 people will be employed during the production phase, which will involve 24-hour operations, 7 days a week for at least 16 years. Technical information for all facilities may be found in the MDSL/KNF Troy Project Environmental Impact Statement (1978).

METHODS

Wildlife data from the West Cabinet Mountains study area were collected from April 1977 through July 1978. Observations were made with the use of a spotting scope and binoculars and were recorded on a portable cassette tape recorder. The area was inventoried during 29 aerial, numerous driving and over 40 walking excursions. Twenty-two fixed-wing flights were conducted in a 180 Cessna, three were made in a 150 Super Cub and three helicopter flights were made in a Bell B-2. All observed wildlife was recorded during flights but emphasis was placed upon mountain goats and one radio-equipped mountain lion. Helicopter flights included a spring mountain goat inventory, osprey nesting survey and beaver cache count. Drivable roads on the study area were covered at least once. Ground trips were concentrated in the southern half of the area. A jet boat survey of Bull Lake and a float trip down Lake Creek were conducted to note wildlife associated with water; the primary emphasis was upon waterfowl. Three big game browse transects were established and measured according to techniques described by Cole (1960). Pellet group counts were made in conjunction with transect surveys by recording all ungulate pellets 1 year old or less which occurred within 1.8 m (6 feet) either side of the transect line for 91 m (300 feet).

Five spring and 8 fall small mammal traplines were checked for a total of 1,755 trap-nights. Four ruffed grouse drum routes were conducted a total of 22 times.

The scientific name of each species observed on the study area is given in tables in the text. Scientific names of other species mentioned but not noted on the area are provided in the text. The following information was recorded for each observed animal: date, composition, section, township and range, area, cover type, habitat type, elevation, aspect, topography, configuration, distance to cover and distance to road. Exact observation dates were noted for all big game and forest grouse. Seasonal occurrence was given for all other species. January, February and March composed the winter season; April, May and June composed the spring season; July, August and September composed the summer season; October, November and December composed the fall season. Composition of an observation included the number, age and sex of individuals. Exact locations were noted by Government Land Office coordinates: quarter-quarter section (S), township (T), and range (R). The name of the nearest geographical entity (creek, mountain, etc.) was recorded for each observation. Six cover types were recognized on the study area including: water, shore, shrubs, cutting units, open areas and forest. Open areas included artificial openings (pasture, croplands, and residential area) and natural openings (talus, meadows, sidehill parks and burns). Forested areas were classified as habitat types (see vegetation section in Description of Area). All elevations in the tables are given in meters. Slope exposure information is coded as 1 of 9 aspects in the tables (eg: 1=N, 5=S, 9=flat). A topography designation for each observation or instance of sign was defined as 1 of 6 categories including: ridge (1), upper slope (2), mid slope (3), lower slope (4), bench or flat (5), and creekbottom (6). Configuration referred to the lay of the land and was coded in 4 categories: convex (1), straight (2), concave (3) and undulating (4). In assessing the habitat type, aspect, topography and configuration parameters for a given observation, the size of the area considered was approximately 375 square meters (0.093 acres) (the plot size used in determining habitat type according to Pfister et al. 1977). Cover was defined as vegetation in which an animal is able to conceal itself. Distance to cover was estimated in 1 of 5 categories: 0-10 m (1), 10-50 m (2), 50-100 m (3), 100-200 m (4), and over 200 m (5). The same categories were used in estimating distance to the nearest drivable road.

Contact was made with local Fish, Wildlife and Parks personnel, trappers, sportsmen and houndsmen to obtain past and current wildlife occurrence information for the study

area. Region One Fish, Wildlife and Parks data files and other pertinent literature were reviewed for background and incorporation.

RESULTS

Mammals

Big Game

Ungulates

Ungulates observed on the study area during the April 1977 through July 1978 report period include: moose, elk, mule deer, white-tailed deer, bighorn sheep and mountain goat. Observations and sign of these ungulates were recorded during walking, driving and aerial surveys. Although the major emphasis of the aerial surveys was directed toward locating and classifying mountain goats, the majority of elk and moose observations were also recorded from the air.

Three ungulate browse transects were established to meet contract requirements. Browse transects on ungulate winter range have been used to document yearly trends in browse utilization (Cole 1960) and, therefore, they were thought to provide an insight into the carrying capacity of the range in relation to existing ungulate populations. However, several researchers (Mackie and Lonner 1977, and Jorgensen et al. 1977) indicate that standard browse transect methods are of limited value in this respect.

Appendix 1 presents location information of the Copper Mountain, Keeler Mountain and Ross Creek browse transects. Aerial and ground reconnaissance during this investigation revealed that the Copper Mountain transect was utilized primarily by deer and moose, the Keeler Mountain transect was utilized by moose and elk and the Ross Creek transect was utilized by deer and elk.

In order to establish habitat selection by wildlife, it would be necessary to determine the availability of each habitat component (percentage of the study area at different elevations, aspects, habitat types). It would also be necessary to systematically and regularly inventory each of the habitat components to determine wildlife utilization. Time constraints and diversity of wildlife on the study area did not allow this type of analysis. However, ungulate habitat utilization between different species can be established if it is assumed that the likelihood of observing each species is equal. Moose, elk, mule deer and white-tailed deer habitat use data were collected from

April 1977 through July 1978 and are compared in Appendices 2 through 6.

In order to understand the overall ecology of ungulates in a particular area, several years of data are necessary to assess herd productivity, status and well-being. In the West Cabinet Mountains and particularly in the area included in the study area, limited information was available concerning ungulates. This investigation was conducted for 16 months and due to time constraints, the paucity of previous information and the diversity of wildlife in the area, refined life histories and population dynamics could not be addressed.

Ungulate sign which were noted during fall and winter were fresh and were representative of areas which ungulates used during these seasons (Table 2). Based on the distribution of moose, elk, and deer sign, there were no apparent areas used exclusively by elk or deer. Figure 6 shows federally controlled lands which the Kootenai National Forest has designated as well-suited big game winter range. This designation is based on five criteria including: elevation, aspect, habitat type, snow depth and known use areas. Distribution of ungulates during this study does not necessarily correspond with KNF boundaries of well-suited big game winter range because criteria restraints were not imposed and land ownership boundaries were disregarded.

Moose

Moose distribution in Montana has expanded considerably in the last 25 years, although this may be a reflection of the increasing knowledge concerning moose. Moose are common in the northwest portion of the state (Stevens 1971). Fifteen moose observations were recorded during the report period and 189 instances of moose sign (tracks and pellet groups) were also recorded. Information was collected for each moose observed from April 1977 through March 1978 (Appendix 2). Moose sign noted during October 1977 through March 1978 is summarized in Table 2 and was used to develop the map of ungulate winter distribution (Figure 6). Distribution of moose observed during the report period is plotted in Figure 7.

Environmental parameters recorded at each moose observation site are given in Appendices 2 through 6. Spring observations and sign indicate that moose were using the Lake Creek Valley although there appeared to be a movement to higher elevations by mid-May. A dead moose was found at the proposed lower plant site on Stanley Creek and another was observed along the east shore of Bull Lake during spring. Sign was noted at the site of the proposed tailing impound-

Table 2. Percentage of moose, elk and deer sign observed at different aspects, elevations, slopes, habitat types, topographies, configurations and distances to cover and roads -- October 1977 through April 1978.

<u>ASPECT</u>	<u>MOOSE (189)</u>	<u>ELK (120)</u>	<u>DEER* (1013)</u>	<u>ELEVATION</u>	<u>MOOSE (189)</u>	<u>ELK (120)</u>	<u>DEER (1013)</u>
N	0	0	5	610- 760 m	19	64	41
NE	73	6	5	761- 910	39	10	34
E	4	13	19	911-1060	41	5	18
SE	4	17	24	1061-1220	1	0	2
S	6	2	5	1221-1370	0	3	3
SW	0	1	3	1371-1520	0	0	1
W	1	18	13	1521-1680	0	8	1
NW	0	4	13	1681-1830	0	10	0
NONE	12	39	13	1831-1980	0	0	0
<u>HABITAT TYPE</u>							
<u>SLOPE</u>							
0- 9	27	70	49	PSME Series	1	1	14
10- 25	72	27	26	THPL Series	2	4	8
26- 50	1	3	25	TSHE Series	96	77	77
over 50	0	0	0	ABLA Series	1	18	1
<u>TOPOGRAPHY</u>							
<u>TOPOGRAPHY</u>				<u>CONFIGURATION</u>			
Ridge	1	1	1	Convex	2	0	2
Upper Slope	0	10	4	Straight	41	32	37
Mid Slope	57	10	38	Concave	4	6	8
Low Slope	24	21	22	Undulating	53	62	53
Bench	14	55	26				
Creek	4	3	9				
<u>DISTANCE TO COVER</u>							
<u>DISTANCE TO COVER</u>				<u>DISTANCE FROM ROAD</u>			
0- 10 m	9	47	64	0- 10 m	3	18	19
10- 50	22	13	18	10- 50	0	0	1
50-100	19	29	16	50-100	1	0	1
100-200	19	2	0	100-200	1	0	1
over 200	31	9	2	over 200	95	82	78

*Ungulate sign which could not be identified to species is included with deer data. Sign includes tracks, pellet groups and beds.

Figure 6. Ungulate winter use areas identified during 1977-1978 and federal lands designated by the U.S. Forest Service as well suited big game winter range.

Figure 7. Locations of moose observed on the study area, 1977-1978.

ment near Camp Creek, along the north shore of Bull Lake, along lower Stanley Creek and on Mount Vernon. During the winter months, 12 of the 15 observations were recorded.

Ninety-eight percent of all recorded winter moose sign was noted in the TSHE or THPL series while slightly more than half of all winter moose sign was noted below 910 m (3,000 feet) (Table 2). Stanley Creek was the only portion of the study area which appeared to be used exclusively by moose during the winter months. Moose ranged from Stanley Creek on to the south face of Keeler Mountain, which they shared with elk. A significant omission on the KNF winter range map (Figure 6) is the Stanley Creek drainage which is heavily used by moose. This oversight may be due to the criteria established by the KNF which do not consider moderate elevations, north aspects or snow depths that moose are able to utilize. In delineating ungulate winter range, field reconnaissance is essential.

Elk

Historically elk were widely distributed throughout Montana but with settlement of the state, herds are increasingly limited to the mountains of western Montana (Rognrud and Janson 1971). During the report period 195 elk observations were recorded on the study area (Appendix 8 and Figure 8).

During April and May elk were observed in the Stanley Creek drainage and on Keeler Mountain and with two exceptions from June through October, elk were observed in the high elevation basins in the Ross Creek drainage. From January through March, elk were again observed on the Camp Creek floodplain, near Bull Lake and on Keeler Mountain. All elk observed during the April through July 1978 period were seen in Ross Creek. During the summer one elk each was observed on Stanley Mountain and on the Camp Creek flats near the site of the proposed tailing pond. During April elk sign was noted along Stanley Creek and in May elk were observed moving up this drainage. Elk calving areas were not noted on the area although Stearns-Roger (1975) indicate that possible calving areas occur on the west face of Stanley Mountain, along Stanley Creek, along upper Ross Creek or on the south slope of Mount Vernon.

Sex and age classification of the 195 elk observations and the environmental parameters at the sites at which they were observed are presented in Table 3 and Appendices 2 through 6. Review of the data concerning each environmental parameter will familiarize the reader with the nature of the terrain in which elk were observed on a seasonal basis.

Table 3. Moose, elk, mule deer and white-tailed deer sex and age classification monthly summary 1977 and 1978.

	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Total	Percent
MOOSE																		
Male			1							2							3	20
Female										1							2	13
Uncl		1									5	3					9	60
Calf											1						1	7
Total		1	1							3	6	3					15	
Percent		7	7							20	39	20						
ELK																		
Male	2	2	7	5	1	29	9			2		2	1				51	26
Female					8	40	1			2							58	30
Uncl				1	1	12	9				2		8			5	38	19
Uncl Ad	5			1		5						2		4		7	24	12
Calf			3		5	9	5			2	2					12	24	12
Total	7	2	10	7	15	95	24			4	2	4	9			6	195	
Percent	4	1	5	4	8	49	12			2	1	2	4					
MULE DEER																		
Male		6	3	1	3	8	1								1	6	29	31
Female	5	19	7	1	9	6	2					1		2		4	55	59
Uncl			1		1	2											5	5
Fawn		4			1												5	5
Total	5	29	11	2	14	16	3					1		2	1	10	94	
Percent	5	31	12	2	15	17	3					1		2	1	11		
WHITETAIL																		
Male			4	3	1	2	2	7		2			5	3			19	16
Female	17	20	2	1	1	2	2			1			3			2	61	51
Uncl	2	16						2		2		1	5	5			33	28
Fawn					1	1	2			1			1				6	
Total	19	36	6	4	3	5	6	9		6		1	14	8		2	119	
Percent	16	30	5	3	2	4	5	8		5		1	12	7		2		5

Figure 8. Locations of elk observed on the study area, 1977-1978.

Elk and moose were more observable from the air than either species of deer. The relative abundance of elk as compared to deer was likely a factor of this observability (Table 3). Nearly 70 percent of the elk were observed from August through October. Observability of elk at this time was related to rutting behavior, the use of higher elevations which provide a cooler climate and the availability of succulent vegetation (Joslin 1975). Since the ABLA habitat types are found at higher elevations and have a relatively sparse forest canopy which afforded greater observability, 84 percent of the elk were observed in this series (Appendix 2).

Mule Deer

Mule deer occur throughout Montana and are found in more diverse habitats than any other native ungulate (Egan 1971). Ninety-four mule deer observations and over 1,300 instances of deer sign (tracks, pellet groups, beds, etc.) were recorded. Information collected for each mule deer observed from April 1977 through July 1978 is presented in Appendix 9. Deer sign collected during October 1977 through March 1978 is summarized in Table 2 and was used to develop the map of ungulate winter distribution (Figure 6). Distribution of mule deer observed during the study is plotted in Figure 9.

Sex and age classification of mule deer observed during the report period according to month is given in Table 3. Summer fawn:doe ratios were not calculated for either species of deer because the secretive behavior of these animals combined with the dense vegetational cover of the area appeared to influence observability of fawns. Approximately 95 percent of the observed adults were classified to sex. Nearly 60 percent of all mule deer observations were recorded during the May through July period. Environmental parameters at each observation site are presented in Appendices 2 through 6.

During April and May mule deer were observed along Keeler Creek, Stanley Creek and Ross Creek. Ten does, four of which were accompanied by fawns of the previous year, were noted in Stanley Creek during May and early June, and were thought to be utilizing the area for fawning although no fawns of the year were observed. The area at and below the proposed lower plant site in particular received use by female mule deer during the fawning period. As June progressed the elevations at which mule deer were observed increased and Mount Vernon appeared to be the route used to gain access to the ridge between Mount Vernon and Spar Peak. Although Stanley Creek and Mount Vernon were used throughout the summer, nearly 80 percent of the mule deer observations were made above 910 m (3,000 feet). The paucity of fall and winter mule deer

Figure 9. Locations of mule deer observed on the study area, 1977-1978.

observations do not allow interpretation of seasonal habitat use. It is probable that mule deer were using the higher elevations (which the investigator did not frequent during the winter months) because they were not observed as commonly as white-tailed deer, elk or moose.

White-tailed Deer

White-tailed deer concentrations in Montana have always been greatest in the northwest portion of the state but recently whitetails have increased their range along major river systems east of the Continental Divide (Allen 1971). One hundred-nineteen whitetail observations were recorded during the report period. Information collected for each whitetail observed from April 1977 through July 1978 is presented in Appendix 10. Distribution of white-tailed deer observed during the study is plotted on Figure 10.

Sex and age classification of white-tailed deer observed each month is given in Table 3. Over 70 percent of all white-tailed deer were classified. Sixty-five percent of all white-tail observations were made during April and May. Environmental parameters at each observation site are presented in Appendices 2 through 6. Over 95 percent of the whitetail observations were recorded below 910 m (3,000 feet), primarily along Keeler Mountain, Grouse Mountain, Stanley Mountain and Highway 56. Distribution of white-tailed deer did not appear to change significantly during the spring, summer, fall and winter periods. Eighty percent of all whitetail observations were noted within the TSHE-THPL Series, observed use of which was significantly greater than by the other ungulate species. The north slopes of Stanley and Keeler mountains were used extensively by deer during the late fall and winter. Both sites are important deer wintering areas which were omitted from the KNF winter range map (Figure 6).

Bighorn Sheep

Historically bighorn sheep were numerous in Montana, but with domestic livestock range competition, contraction of disease from domestic sheep, and hunting, wild sheep decreased markedly. Evidence indicates that bighorn sheep are not native to the West Cabinet Mountains. In 1969 and in 1975, bighorns were released by the Montana Department of Fish and Game on Berray Mountain, 11 aerial km (7 mi) from Mount Vernon. Two female bighorns, both wearing color-coded plastic neck bands, were observed on the south aspect of Mount Vernon within 500 m of the south adit on three occasions during May 1977. Identification of these collars indicated that these sheep were part of the Berray Mountain transplant. These observations were made on the road at 1,460 m (4,800 ft) in the

Figure 10. Locations of white-tailed deer observed on the study area, 1977-1978.

ABLA/CLUN habitat type. One of these marked sheep was also observed on Mount Vernon on May 25, 1977. Bighorn sheep have not been observed on the study area since that date.

Local residents and sportsmen reported observing bighorn sheep on Mount Vernon in the fall of 1975. One of the neck-banded sheep observed by the investigator was also observed by E. Vance (pers. comm.) on the North Fork of the Bull River on January 1, 1976, and by G. Brown (pers. comm.) on Ibex Peak on May 29, 1976.

Mountain Goat

In Montana 12 native and 4 introduced mountain goat herds have been recognized (Casebeer et al. 1950). There have been a number of other relatively recent introductions. The West Cabinet Mountains support a native herd whose approximate range extends from Drift Creek on the north to the West Fork of Blue Creek on the south and from the east face of Mount Vernon west to Scotchman Peak No. 2 in Idaho (Figure 11).

Mountain goat observations and sign on the study area tended to be clumped in four concentration areas. The general locations of each concentration area (which have been named Mount Vernon-Spar Peak, Savage Mountain, Sawtooth Mountain and Ross Point) are illustrated in Figure 12. Some observations and sign were located outside the concentration areas suggesting that travel occurs between outlined areas. Additional field investigations will be necessary to determine the degree to which mountain goats travel between these areas and whether the concentration area boundaries should be altered.

Mountain goat observations and sign information collected from April 1977 through July 1978 are presented in Appendix 16. Two hundred seventy-nine mountain goat observations were recorded during 21 aerial and 17 successful ground trips. Sex and age classification of the mountain goats observed each month is given in Table 4. Goats were identified as unclassified adults or unclassified goats when some or all of the characteristic features could not be assessed.

Spring was the only season for which 2 years of data were collected. A combination of these data reveals that half of all observed goats were seen on a due east aspect, reflecting the observability of the Mount Vernon-Spires area (57% of all observations, see Figure 13). All spring observations occurred on one of the four concentration areas. Information collected during July 1978 was pooled

Table 4. Mountain goat sex and age classification and average group size - monthly summary 1977 and 1978.

	Average Group Size	Unclassified Adult	Unclassified Goat	Male	Female	Juvenile	Kid	TOTAL
April	8.0(2) ¹	6	10	-	-	1	-	17
May	3.0(1)	2	-	2	1	-	-	5
June	3.6(8)	12	3	-	9	2	7	33
July	13.0(1)	-	3	1	5	-	5	14
August	5.5(4)	13	-	2	5	2	4	26
September	4.5(12)	42	1	3	5	3	12	66
October	3.8(5)	9	6	-	3	-	3	21
November	4.2(6)	7	2	3	6	4	4	26
December	-	-	-	-	-	-	-	-
January	-	-	-	-	-	-	-	-
February	7.0(1)	4	1	-	3	-	3	11
March	2.5(2)	5	-	1	-	1	-	7
April	7.0(1)	2	-	-	2	-	3	7
May	3.3(6)	14	3	-	4	-	4	25
June	4.5(2)	9	-	-	-	1	2	12
July	2.0(2)	5	-	1	2	-	1	9
TOTAL	4.4(53)	130	29	13	45	14	48	279

¹Average group size (number of groups - singles not included).

Figure 11. Locations of mountain goat sign and observations on the study area, 1977-1978.

Figure 12. Mountain goat concentration areas in the West Cabinet Mountains, 1977-1978.

Figure 13. Observed seasonal use of aspects by mountain goats. Length of bars and numbers indicate percentages of each season's observations on each aspect; (n) = number of goat observations each season.

with summer 1977 data. Summer observations on the northwest aspect were more than double the number of observations of goats made on any other aspect. The majority of observations made during this season were in the Ross and Spar creek drainages. Fall observations were nearly equally distributed on west, northwest and southwest aspects, reflecting observations made on Ross Point, Spar Peak and Sawtooth Mountain. Fall observations, however, were more diversely distributed than during any other season. A total of 18 observations was made during winter months; use of all aspects except southwest was noted. The Mount Vernon-Spar Peak concentration area accounted for 15 of the 18 observations while the remainder were noted on Ross Point.

During 15 aerial trips 219 mountain goat observations were recorded, while another 60 observations were noted during 17 ground trips. Average group size is given in Table 4. A group consisted of at least two animals. Fluctuations in group size may reflect behavioral traits related to the availability of forage. During April, goats were on winter range; in May and June, following snowmelt, animals appeared to disperse onto newly available range and females were seeking solitude for parturition (Brandborg 1955); in July females with kids and yearlings congregated (Brandborg 1955) which was the nature of the group of 13 observed on July 19; from August through October the groups dispersed, possibly in response to forage desiccation. During winter goats were primarily limited to areas having good snow shedding capabilities.

Disappearance of snow in the spring, vegetation desiccation in the fall and snow accumulation in the winter may influence group size and habitat use. Although not all portions of the study area were censused equally, Figure 13 reflects the number of goats using each aspect by month and provides a measure of goat concentration.

Figure 14 presents mean elevation distribution of observed mountain goats. The elevational mode expresses the elevation at which goats were observed most often during each month. According to the mode, goats were observed at the lowest elevations in May, reaching the highest elevations during September. The double mode observed during June may reflect different groups of goats which use different parturition areas. The Mount Vernon-Spires and Ross Point areas are the lowest mountain goat habitats within the study area. The Mount Vernon-Spires area was documented parturition range. During the parturition period mountain goats were observed at the high elevations on Sawtooth Mountain, but kidding was not documented.

Figure 14. Mean and mode elevations at which mountain goats were observed, 1977-1978. X = mean or average and O = mode or most common elevation at which mountain goats were observed each month.

The October through March data reflect goat movements to lower elevations; the lowest elevational mode was noted during February. The combination of aspect and elevation data suggests that goats distributed themselves in response to the first occurrence of highly nutritious spring vegetation. Goats not only follow the green-up around the mountain from west and south to east and north, but also from low to high elevations. During the warmer summer months and the advent of vegetation desiccation, mountain goats were observed primarily on cool east and north aspects at the highest elevations available. As snow began to accumulate goats moved down and onto the Spires and Ross Point wintering areas where snow shedding abilities and forage availability dictate mountain goat occurrence.

The Spires area of Mount Vernon and Ross Point have good snow shedding capabilities and are therefore important winter range. Mountain goat winter occurrence, based on information gathered during the October through April 1977-1978 period is presented in Figure 6. Figure 6 also shows the federally controlled lands which the KNF has designated as well suited big game winter range. Mountain goat winter range was not recognized by the KNF because their criteria did not allow consideration of the type of terrain which mountain goats utilize.

Although mountain goats were observed on Sawtooth Mountain during March 1976 (G. Brown, pers. comm.) the possible use of the Mount Vernon and Ross Point areas during the winter by goats which use higher areas during spring and summer cannot be determined without the aid of marked animals. Weather information indicates that up to 18 m (58 ft) of snow falls on the West Cabinet Mountain ridges. Although goats have been known to use high elevation winter ranges in other areas (Lentfer 1955), severe winter conditions in this area may dictate migration to lower country having snow shedding abilities such as the Mount Vernon and Ross Point areas. Mountain goat nannies have a strong instinct to return to the same winter range year after year (Kuck 1977).

Carnivores

Black Bear

Black bear observations and bear sign recorded on the study area are plotted in Figure 15. Table 5 shows that 88 percent of the observations occurred in the spring period (April through June). Bear sign included scats (69), tracks (2), diggings (6), marking trees (1), hair (1) and den (1). Bears are usually found in cool moist areas later in the summer (Tisch 1961) and the summer of 1977 was unusually

Table 5. Black bear observations and bear sign - monthly summary 1977 and 1978.

	Observations		Sign		Total No.
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	
April	1	4 ¹	1	1	2
May	9	36	13	16	22
June	3	12	11	14	14
July	-	-	23	29	23
August	1	4	20	25	21
September	2	8	2	3	4
October	-	-	9	11	9
May	9	36	1	1	10
TOTAL	25	24 ²	80	76	105

¹ Percent of total observations

² Percent of total observations and sign

Figure 15. Locations of black bear observations and bear sign on the study area, 1977-1978.

warm and dry. If bears were using limited, shady, moist microsites, they would have been particularly difficult to observe during this period. Thirteen of the 25 bears were observed from the air. In 84 percent of the observations, the bears were above 910 m (3,000 feet). Four bears were observed below this elevation in April and May. Greer and Craig (1971) indicate that bears emerge from dens and seek sprouting vegetation at low elevations, often along road sides which have been seeded for erosion control.

Twelve bears were observed in the subalpine fir series, 12 in the cedar-hemlock series and 1 was seen in the Douglas-fir series (Appendices 12 and 13). The majority of mining activities are proposed for the TSHE/CLUN habitat type. This habitat type would likely receive substantial spring use by bears seeking early green-up because of its wide distribution at low elevations on the study area.

Since bear sign was not necessarily recent, Table 5 may not represent the month in which the sign was left. Bear sign appeared to be evenly distributed at all elevations and was most commonly observed in the ABLA (34 instances), TSHE-THPL (29 instances) and ABGR series (11 instances). Although these figures partially reflect the amount of time the author spent in a series and the distribution of a series on the study area, it should be noted that ABGR habitat types are not widely distributed over the study area nor did the author spend a disproportionate amount of time in this series, suggesting that bears may be selecting this series for some of their needs. All 11 instances of sign recorded in the ABGR/CLUN habitat type were noted on Stanley Mountain.

Information collected by personnel of Olson-Elliott & Associates (1977) indicated that the study area sustains a high level of grizzly bear (*Ursus arctos horribilis*) food items. Since black bears consume the majority of plant species listed as grizzly bear food items by Mealey (1977), the study area is also considered to have a high level of black bear food items. Grizzly bear food availability in the Mount Vernon area as assessed by Olson-Elliott & Associates (1977) indicates that the area has a high food habitat quality rating (Mealey 1977) for a diverse group of habitats. Although food availability is not likely to be limiting for black bears, critical spring range may concentrate bears in vulnerable situations which often occur along road rights-of-way where green-up first occurs.

Grizzly Bear

During the period of data compilation for the Troy Project Environmental Impact Statement, all threatened and endangered species received special review by the KNF and

U.S. Fish and Wildlife Service. The grizzly bear warranted special investigation because of its occurrence in the Cabinet Mountains and because identified critical grizzly bear habitat was present within the project area boundary. The KNF contracted Olson-Elliott & Associates to evaluate the quantity and quality of grizzly bear habitat in the Mount Vernon area and to cover the area in search of grizzly sign.

Grizzly bear are uncommon native inhabitants of the Cabinet Mountains. No grizzly bear observations or definitive grizzly sign were noted during field reconnaissance; however, one grizzly was reportedly observed in the Middle Fork of Ross Creek during summer 1978 by KNF personnel (B. Dahl, pers. comm.). One large freshly excavated bear den was discovered in the Middle Fork of Ross Creek during October 1977 (Olson-Elliott & Associates 1977). A male grizzly was illegally shot near Troy during fall 1977. Locations of grizzly bear sign in the West Cabinet Mountains are given in reports by Olson-Elliott & Associates (1977); Erickson (1977) and Ruediger (1977).

Olson-Elliott & Associates (1977) concluded that the West Cabinet Mountains study area has high values for food habitat quality, cover habitat quality, space habitat quality and behavior quality. Additional information collected during the contract study may be obtained from the MDSSL/KNF Troy Project Environmental Impact Statement (1978). No effort was expended during the comprehensive wildlife inventory project to specifically search for grizzly sign.

Mountain Lion

Mountain lion observations and sign recorded on the study from 1974 through 1978 are presented in Appendix 14. A total of 83 instances of lion use on the study area is given. These include: sign (tracks, scrapes and scats) and observations (dead, treed or marked lions and locations of one radio-equipped individual).

The distribution of mountain lion observations and sign is given in Figure 16. The locations of 29 observations are shown although these represent a maximum of 21 individual lions utilizing the study area over a 5-year period.

Forty-seven instances of lion use were collected by E. Vance (pers. comm.), a local houndsman and cooperator in the MDFWP mountain lion tagging program. Lions were tracked and treed by trained dogs, tranquilized, and then marked with neoprene rope collars each having a colored numbered pendant.

Figure 16. Locations of mountain lion sign and observations on the study area, 1974-1978.

Results of the mountain lion tagging program indicated that several females shared the Stanley Creek area from 1975 through 1978. During the winter of 1975-76 a marked female lion (A99), a marked male lion and another female with kittens of the year were present. During the 1976-77 winter, A99 was again trapped and another female with kittens of the year was present. During the 1977-78 winter the area was again used by a female with kittens of the year. This information shows that the Stanley Creek area produced a minimum of 3 litters of kittens in 3 years and provided habitat for an unknown number of other lions. Female lions sharing a portion of their home range with other female lions was noted in Idaho by Hornocker (1970). He indicates that in the population stability of mountain lions, an area which is mutually used by adult females constitutes a key portion of their range. In this instance the Stanley Creek area was the key grounds. In 1975 and 1976 a total of eight different mountain lions was known to have used to Stanley Creek area or its tributaries (Appendix 14).

One mountain lion was captured and fitted with a radio-transmitter collar during this study (Figure 17). This female lion kitten was captured in January 1978, 37 days after she and a sibling had been orphaned (Joslin and Brown 1978). A family group consisting of one adult and two kittens had moved from Stanley Mountain north along the road at the base of Keeler Mountain and had ascended Keeler Mountain on December 5 (E. Vance pers. comm.). On December 16 the author noted one adult and two kitten tracks along Keeler Creek. An adult female lion was shot by a hunter on December 17 approximately 0.5 km (0.33 mi) from the previous day's location. Three weeks elapsed before the author learned of the kill. Information from local residents finally led to the capture of one of the orphaned kittens in Camp Creek. The presumed sibling was found dead along Lake Creek 2 months later.

At the time of capture the kitten had vague body spots and appeared larger than its 7 to 9 kg (15 to 20 pound) weight would suggest. There are no established criteria to age mountain lion kittens although Greer (1976) describes kittens in three age groups based on dental information as follows: Kit A = all teeth deciduous, Kit B = permanent incisors in place/permanent canines erupting, Kit C = permanent canines half erupted. The left lower permanent canine was observed erupting on February 22, while the right lower canine did not erupt for approximately two more weeks. Both lower deciduous canines were shed in March. The upper permanent canines erupted in late March forcing the deciduous upper canines out in early April. The evidence (teeth, body spots, weight) indicates that at the time of capture the kitten was a Kit B and at the time of release it was a Kit C.

Figure 17. Young female mountain lion kitten being measured prior to release.

The kitten was housed and fed at the Libby Field Station until its release on May 10. Early in May the cat was fitted with a radio-transmitter collar and the following measurements were taken: weight 19.5 kg (43 lbs); tattoo number L8 (black both ears); zoological length (tip of nose to base of tail) 99.1 cm (39 inches); total length 149.9 cm (59 inches); neck circumference at base of skull 30.5 cm (12 inches); chest girth 55.9 cm (22 inches); front foot pad width 4.5 cm (1.75 inches), width toes 6.3 cm (2.5 inches), tip toe to back of pad 6.3 cm (2.5 inches); hind foot length 22.9 cm (9 inches), width pad 3.8 cm (1.5 inches), width toes 5.3 cm (2.1 inches), tip toe to back of pad 7.0 cm (2.75 inches).

The lion was released at the north end of Keeler Mountain near the spot where its mother had been killed. It stayed in the Keeler Creek drainage less than one month, then crossed the Lake Creek Valley where it travelled throughout the north end of the Cabinet Mountains Wilderness Area for at least 6 months. A total of 13 radio locations were obtained. January 24, 1979, was the last date on which the radio signal was located.

During a study in Idaho, Hornocker (1970) indicated that about 70 percent of the mountain lion's diet consisted of deer and elk, while snowshoe rabbit comprised 5.5 percent. Mountain goat, bighorn sheep, small mammals and coyote occurred occasionally in 198 mountain lion droppings collected during the Idaho study. During the present survey, mule deer, white-tailed deer and elk were observed in the Stanley Creek drainage. The remains of a male white-tailed deer which had been killed by a lion were noted along Lake Creek in January 1978. Snowshoe rabbit were frequently seen along the Stanley Creek road and mountain goat occur on Mount Vernon. Beaver colonies along Stanley and Lake creeks are thought to be frequented by lions (E. Vance and V. Blanchard, pers. comm.) as evidenced by the number of lions which are caught in beaver traps.

As important to a mountain lion as its prey species is the type of terrain in which the prey occurs. Mountain lions often use steep, rocky, brushy country to facilitate their hunting techniques. The occurrence of this type of terrain along Ross Creek, Stanley Mountain, Keeler Mountain, Grouse Mountain and Camp Creek makes the Lake Creek area an important hunting grounds for mountain lions.

Furbearers and Predators

The designation furbearer or predator is given to certain wildlife species for management purposes by the Montana Legislature. Those species which are not so designated are

simply referred to as unclassified. Furbearers include those species which have a valuable hide and are protected by law. On occasion pelts of predators and unclassified animals have had higher fur value than furbearers (Mitchell et al. 1971).

Contact was made with two individuals who had trapped in the Lake Creek area to obtain insights about past and current abundance and occurrence information for certain species on the study area.

Beaver were observed along the northeast shore of Bull Lake and caches, cuttings, dams, lodges, slides, canals and tracks were observed along Lake and Stanley creeks. Three beaver colonies occur at the mouth of Stanley Creek and in the past, two colonies were present below the junction of Stanley and Fairway creeks (V. Blanchard, pers. comm.). The number of colonies occurring along Lake Creek is not known, although a helicopter reconnaissance during November 1977 revealed a minimum of 30 caches (K. Knocke, pers. comm.), 13 dams, 1 lodge, as well as numerous cuttings, canals and slides. Trappers indicate that the beaver population in the area is steady and may be increasing. The beaver in Montana is classified as a furbearer and Mitchell et al. (1971) indicate that in the past beaver have accounted for up to 61 percent of the income to Montana trappers.

Muskrat were observed along Lake Creek near the mouth of Stanley Creek and two muskrat dens were located along the north edge of Bull Lake. Muskrats are particularly susceptible to water level fluctuations (Errington 1963) and they appear to have suffered a population decline since 1976 due to low water levels during both winter and summer (V. Blanchard and D. Cloin, pers. comm.). The muskrat is also classified as a furbearer in Montana and has provided up to 17 percent of the Montana trappers' average annual income (Mitchell et al. 1971).

Coyote observations included tracks (47) and scats (6). These were noted at all elevations in all terrestrial cover types and in the THPL/OPHO, THPL/CLUN, TSHE/CLUN, ABLA/CLUN, ABLA/MEFE and ABLA/XETE habitat types (Table 6). The coyote is classified as a predator in Montana.

Red Fox (*Vulpes fulva*) occur only rarely in this portion of the state (H. Burrell, pers. comm.) and none were observed on the study area. Red fox are a nongame or unclassified species in Montana.

The wolf (*Canis lupus irremotus*) occurred in the West Cabinet Mountains about 30 years ago (V. Blanchard, pers. comm.). Blanchard had observed wolves in the North Fork

Table 6. Carnivore observations and sign - occurrence in cover and habitat types.

COMMON NAME	SCIENTIFIC NAME	COVER TYPES																				
		WATER	SHORE	SHRUBS	CUTTING UNIT	OPEN AREAS	FOREST	PSEUDOTSUGA MENZIESII	PSME/PHMA	PSME/AGSP	ABIES GRANDIS	ABGR/CLUN TSUGA-THUJA	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES LASIOCARPA	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI
Coyote	Canis latrans	x	x	x	x	x	x					x	x	x			x	x	x	x	x	x
Black bear	Ursus americanus	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x
Marten	Martes americana				x		x					x		x				x				
Mink	Mustela vison	x																				
Long-tailed weasel	Mustela frenata		x																			
Striped skunk	Mephitis mephitis					x	x							x								
Bobcat	Lynx rufus			x	x	x	x							x								
Mountain lion	Felis concolor	x			x	x	x		x			x	x	x	x	x						x

of the Keeler Creek drainage in the 40's. Another trapper who worked the Bull River Valley noted wolf tracks near one of his bobcat sets in the early 70's, and felt that an occasional wolf still occurred in the Cabinet Mountains Wilderness Area (D. Cloin, pers. comm.).

The raccoon (*Procyon lotor*) is classified as a nongame species and although raccoon or raccoon sign were not observed by the investigator, trappers indicated that they are present but rare.

Observations or sign of mammals observed on the study area which belong to the weasel family included: marten (Figure 19), mink, long-tailed weasel and striped skunk. Hoffman and Pattie (1968) indicate that other species which belong to this family and which occur in this region of the state include fisher (*Martes pennanti*), river otter (*Lutra canadensis*), wolverine (*Gulo luseus*) and badger (*Taxidea taxus*).

Cover type and habitat types in which these mammals were observed are given in Table 6. Locations of furbearer and predator sign and observations are shown in Figure 18.

According to local trappers weasel and skunk are abundant, the marten population is steady and fisher or fisher sign had not been observed on the area. One trapper had caught two river otter in Lake Creek several years ago and had seen otter sign within the last two years along this drainage. Neither trapper had trapped wolverine but both believed they were present and both reported that badger occur along the Bull Lake-Lake Creek flats. The long-tailed weasel and the striped skunk are classified as predators and the marten, fisher, mink, river otter and wolverine are classified as furbearers in Montana. The badger is a nongame species.

Bobcat and lynx are classified as furbearers. One bobcat was observed running across the Copper Creek road. Eight instances of bobcat sign (tracks) were noted in the TSHE/CLUN habitat type from December 1977 to July 1978 (Table 6). Although no confirmed lynx observations were made during this study by the investigator, a local houndsman (E. Vance, pers. comm.) had noted lynx tracks in the area during 1977 and Hoffman and Pattie (1968) indicate that lynx do occur in this portion of the state.

Small Mammals

Table 7 includes observations or sign of 14 small mammal species noted on the study area. Most observations were collected incidental to other activities although 5 species were captured using 13 snap-trap trap lines.

Table 7. Small mammal observations - occurrence in cover types and habitat types.

COMMON NAME ¹	SCIENTIFIC NAME	COVER TYPES					HABITAT TYPES												
		WATER	SHORE	SHRUBS	CUTTING UNIT	OPEN AREAS	FOREST	PSEUDOTSUGA MENZIESII	PSME/PHMA	PSME/AGSP	TSUGA-THUJA	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES LASIOCARPA	ABLA/XETE	ABLA/MEFE	ABLA/LUHI	ABLA/CACA
Masked Shrew	<i>Sorex cinereus</i>				x	x	x					x	x	x		x			
Vagrant Shrew	<i>Sorex vagrans</i>				x		x					x	x	x		x			
Pika	<i>Ochotona princeps</i>					x													
Snowshoe rabbit	<i>Lepus americanus</i>				x		x		x			x	x	x					
Columbian Ground Squirrel	<i>Spermophilus columbianus</i>				x	x	x											x	
Golden-mantled Ground Squirrel	<i>Spermophilus lateralis</i>					x													
Red-tailed Chipmunk	<i>Eutamias ruficaudus</i>						x							x		x	x	x	
Red Squirrel	<i>Tamiasciurus hudsonicus</i>				x		x					x	x	x		x	x		
Northern Pocket Gopher	<i>Thomomys talpoides</i>					x	x												
Beaver	<i>Castor canadensis</i>	x	x	x															
Deer Mouse	<i>Peromyscus maniculatus</i>				x														
Bushy-tailed Woodrat	<i>Neotoma cinerea</i>					x													
Heather Vole	<i>Phenacomys intermedius</i>						x												
Gapper's Red-backed mouse	<i>Clethrionomys gapperi</i>				x		x					x							
Muskrat	<i>Ondatra sibirica</i>	x	x																

¹ Common and scientific names according to Wright, 1976.

Figure 19. Marten observed in Ross Creek drainage.

Small mammal trap lines were set according to techniques adapted from Calhoun (1956). Five lines were established during the spring period while the same 5 lines and an additional 3 lines were set during fall (September) for a total of 1,755 trap nights. Locations and descriptions of each line are given in Appendix 15. Results of the spring and fall trapping are presented in Table 8. Five trap lines were established at proposed mine facility sites including the tailing pond, well and substation, clarification pond, lower mill and upper mill sites. Plans for the clarification pond were deleted by ASARCO so that site represented a TSHE/CLUN habitat type. The other four sites had been logged to various degrees. Three additional lines established during September were located in habitat types proposed for mining disturbance. Trapping success was in all cases better during the fall than during the spring.

Deer mice were the most frequently captured species at all five spring trapping locations and at four of the eight fall trapping locations (Table 8). Of the six species captured in trap lines, deer mice comprised 43.5 percent of the catch. During both spring and fall, the upper mill site trap line showed the highest trapping success, with deer mice comprising 58 and 30 percent of the catch for each season, respectively. The THPL/OPHO site had the second highest trapping success, with deer mice comprising 50 percent of the total catch. The THPL/OPHO habitat type is present along portions of the tailing slurry pipeline route.

Gapper's red-backed mouse was the second most commonly captured species, comprising 28 percent of the total catch. It was the most commonly captured species at the following locations: upper mill site during both the spring and fall, the lower mill site during the spring and the ABLA/MEFE site (trapped only during fall). Trapping success at the THPL/OPHO habitat type site revealed it to be as important as each of the previously mentioned sites although it was second to the deer mouse in numbers captured. A single heather vole was captured at the upper mill site during the spring trapping period. Masked shrews and vagrant shrews were captured at all eight trapping locations. More masked shrews were captured than vagrant shrews although this may have been a factor of trap susceptibility or trap location. Similar to the other four species captured in trap lines, shrews were more likely to be captured during fall than the spring. The greatest number of shrews were captured at the upper and lower ore milling sites. In general, greater numbers of small mammals were captured at moist sites than at dry sites.

Table 8. Small mammal trapline results - spring and fall 1977.

Trapline Name ¹	Date	<i>Peromyscus maniculatus</i>		<i>Clethrionomys gapperi</i>		<i>Sorex spp.</i>		<i>Phenacomys intermedium</i>		Total Animals	Total Percent Success ²
		Male	Female	Male	Female	Male	Female	Male	Female		
Tailing Pond Site	04/29-05/01	2	-	-	-	-	1	-	-	3	2.22
Well and Substation Site	04/30-05/02	1	1	-	-	-	-	-	-	2	1.48
Clarification Pond Site	05/04-05/06	2	-	-	-	-	1	-	-	3	2.22
Lower Mill Site	05/05-05/07	-	3	4	1	-	1	-	-	9	6.67
Upper Mill Site	05/05-05/07	9	5	5	3	-	1	-	1	24	17.78
Subtotals		14	9	9	4	-	4	-	-	41	6.07
TOTALS		23		13		4		1			

Trapline Name ¹	Dates Run	<i>Peromyscus maniculatus</i>		<i>Clethrionomys gapperi</i>		<i>Sorex vagrans</i>		<i>Sorex cinereus</i>		<i>Eutamias ruficaudus</i>		Total Animals	Total Percent Success
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female		
Tailing Pond Site	09/13-09/15	3 ³	1	-	1	-	-	-	-	1	1	7	5.19
Well and Substation Site	09/10-09/12	1	2	-	-	-	1	-	-	-	-	4	2.96
Clarification Pond Site	09/08-09/10	4	-	-	-	-	-	-	-	-	-	4	2.96
Lower Mill Site	09/08-09/10	2	3	1	1	1	2	2	7	1	-	20	14.81
Upper Mill Site	09/08-09/10	7	1	8	1	1	-	2	7	-	-	27	20.00
THPL/OPHO	09/12-09/14	8	4	5	4	-	-	1	1	1	-	24	17.78
TSHE/CLUN	09/13-09/15	-	1	-	-	-	2	-	1	2	-	6	4.44
ABLA/MEFE	09/12-09/14	3	4	3	6	1	-	-	1	1	2	21	15.56
Subtotals		28	16	17	13	3	5	5	17	6	3	113	10.46
TOTALS		44		30		8		22		9			

¹See Appendix 15 for site information and location of each trapline.²Number of small mammals captured divided by number of trap nights x 100.³Sex of one animal not determined.

The only confirmed observation of a hoary marmot (*Marmota caligata*) in the Cabinet Mountains was made at the existing north adit of the proposed ASARCO mine during summer, 1976 by W. Ruediger (pers. comm.) and G. Brown (pers. comm.) on separate occasions. Hoary marmots were not observed during this study although limited time was spent at the adit site.

Golden-mantled ground squirrels were associated with talus rock on the south side of Mount Vernon. Columbian ground squirrels were widely distributed but were most often observed in cutting units, particularly clearcuts near the Camp Creek floodplain (site of tailing pond) and the Stanley Creek clearcuts, a portion of which is proposed for the utility corridor route and the well field and mill water sump. The redtail chipmunk was universally distributed throughout the study area and the very similar yellow pine chipmunk (*Eutamias amoenus*) may also occur (Hoffman and Pattie 1968). Chipmunks were observed in cutting units and in the TSHE/CLUN, ABLA/MEFE, ABLA/LUHI and ABLA/CACA habitat types and were captured in small mammal trap lines at the tailing pond site, lower mill site, THPL/OPHO, TSHE/CLUN and ABLA/MEFE trapping sites. Red squirrels were universally distributed through the habitat types and in selectively logged cutting units. Northern pocket gophers were not observed but their diggings were identified in open areas or in the PSME/PHMA, PSME/AGSP and ABLA/LUHI habitat types.

Two porcupines were observed in an open area on Middle Mountain (G. Brown, pers. comm.) within the ABLA series and evidence of feeding porcupines on conifers in the valley bottom within the TSHE/CLUN habitat type were noted. One bushytail woodrat was observed on the open rocky ridgetop of Savage Mountain.

Eighty percent of the 45 observations of snowshoe rabbit were made in the Stanley Creek drainage. In all instances they were observed along the road in the TSHE/CLUN habitat type near thick brush. During winter, snowshoe rabbit tracks occurred throughout the study area, with concentrations in Stanley Creek and at the mouth of Keeler Creek.

Pika occurred above 1,580 m (5,200 ft) wherever scree areas composed of large rocks provided suitable habitat. The rocky pass between Stanley Creek and Emma Gulch was the lowest elevation (1,100 m or 3,600 ft) at which pika were noted.

Birds

All avian species observed on the study area were recorded by date, cover type, habitat type and location. The scientific names and monthly occurrence of 112 species of birds observed on the study area from April 1977 through July 1978 are given in Table 9. Cover type and habitat type utilization for each species is given in Table 10.

Waterfowl

Twenty species of waterfowl were observed on the study area and included ducks, geese, swans, loons, herons and grebes. Several ponds and marshes surrounding Bull Lake and Lake Creek were surveyed for waterfowl and Lake Creek was floated with a rubber raft on July 11, 1977, from the mouth of Bull Lake, 16 km (10 mi) north to the bridge near Felix Creek. Bull Lake was inventoried on July 14 with a jet boat. Swamps and marshes surrounding Bull Lake and Lake Creek were surveyed for waterfowl broods and observations were also recorded incidental to other activities.

Waterfowl habitat on the study area is primarily confined to Bull Lake and Lake Creek where 90 percent of the waterfowl observations occurred. Observations were also recorded on Stanley Creek and on the ponds and marshes located in the main Lake Creek Valley. Waterfowl utilization was also noted on the pond near Camp Creek which will be inundated by the tailing impoundment.

Brood information was collected on three of the nine species of ducks observed (Table 11). Of the 20 duck broods recorded, 11 were common merganser, 8 common goldeneye and 1 mallard. Ring-necked ducks and blue-winged teal may have also nested on the study area because lone drakes of these species were observed as late as June. Observations of lone drakes during the nesting season usually indicate that the drakes have recently deserted incubating hens (Dzubin 1969). Ducks observed primarily during spring and fall migration included: pintail, green-winged teal, cinnamon teal, American wigeon, Barrow's goldeneye, hooded merganser and bufflehead. Although broods were not observed, these species have been known to breed in this region of the state (Skaar 1975).

Waterfowl, other than ducks, which were observed during the report period included: common loon, red-necked grebe, horned grebe, western grebe, pied-billed grebe, whistling swan, Canada goose and great blue heron. These species were observed during spring and fall migration except the great blue heron which was observed from April through November and again in March. A great blue heron rookery consisting

Table 9. Bird species observed each month.

COMMON NAME	SCIENTIFIC NAME	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Common Loon	<i>Gavia immer</i>											X	
Red-necked Grebe	<i>Podiceps grisegena</i>				X							X	
Horned Grebe	<i>Podiceps auritus</i>				X							X	
Western Grebe	<i>Aechmophorus occidentalis</i>										X	X	
Pied-billed Grebe	<i>Podilymbus podiceps</i>		X									X	
Great Blue Heron	<i>Ardea herodias</i>		X	X	X		X	X	X	X		X	
Whistling Swan	<i>Olor columbianus</i>				X								X
Canada Goose	<i>Branta canadensis</i>			X	X								
Mallard	<i>Anas platyrhynchos</i>		X	X	X	X	X	X	X		X	X	
Pintail	<i>Anas acuta</i>				X								
Green-winged teal	<i>Anas crecca</i>				X		X	X					
Blue-winged teal	<i>Anas discors</i>						X				X		
Cinnamon teal	<i>Anas cyanoptera</i>				X						X	X	
American Wigeon	<i>Mareca americana</i>				X						X	X	
Ring-necked Duck	<i>Aythya collaris</i>				X			X			X	X	
Common Goldeneye	<i>Bucephala clangula</i>				X	X	X	X					
Barrow's Goldeneye	<i>Bucephala islandica</i>			X	X	X	X	X				X	
Common Merganser	<i>Mergus merganser</i>				X			X	X			X	
Hooded Merganser	<i>Lophodytes cucullatus</i>										X		X
Bufflehead	<i>Bucephala albeola</i>										X		
Goshawk	<i>Accipiter gentilis</i>						X		X				
Sharp-shinned Hawk	<i>Accipiter striatus</i>					X			X				
Cooper's Hawk	<i>Accipiter cooperii</i>				X								
Red-tailed Hawk	<i>Buteo jamaicensis</i>				X	X	X		X	X			
Rough-legged Hawk	<i>Buteo lagopus</i>								X				
Bald Eagle	<i>Haliaeetus leucocephalus</i>		X		X				X			X	
Marsh Hawk	<i>Circus cyaneus</i>			X	X								
Golden Eagle	<i>Aquila chrysaetos</i>					X			X				

Table 9 (continued)

COMMON NAME	SCIENTIFIC NAME	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Osprey	<i>Pandion haliaetus</i>				x	x	x	x	x	x			
Merlin	<i>Falco columbarius</i>							x	x				
American Kestrel	<i>Falco sparverius</i>					x	x	x	x	x			
Blue Grouse	<i>Dendragapus obscurus</i>			x		x	x	x	x		x		
Spruce Grouse	<i>Canachites canadensis</i>					x	x	x	x			x	
Ruffed Grouse	<i>Bonasa umbellus</i>	x			x	x	x	x	x	x	x	x	x
American Coot	<i>Fulica americana</i>				x								
Killdeer	<i>Charadrius vociferus</i>				x								
Common Snipe	<i>Capella gallinago</i>			x			x	x					
Spotted Sandpiper	<i>Actitis macularia</i>				x	x			x				
California Gull	<i>Larus californicus</i>								x	x			
Rock Dove	<i>Columba livia</i>				x								
Mourning Dove	<i>Zenaida macroura</i>				x	x	x	x	x				
Great Horned Owl	<i>Bubo virginianus</i>					x							
Great Gray Owl	<i>Strix nebulosa</i>	x							x		x		
Saw-whet Owl	<i>Aegolius acadicus</i>								x				
Barred Owl	<i>Strix varia</i>						x	x	x				
Common Nighthawk	<i>Chordeiles minor</i>												
Calliope Hummingbird	<i>Stellula calliope</i>							x					
Black-chinned Hummingbird	<i>Archilochus alexandri</i>							x	x				
Rufous Hummingbird	<i>Selasphorus rufus</i>					x	x	x	x				
Belted Kingfisher	<i>Megasceryle alcyon</i>				x	x		x	x	x		x	

Table 9 (continued)

COMMON NAME	SCIENTIFIC NAME	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Common Flicker	<i>Colaptes auratus</i>				x	x	x	x	x	x	x		
Pileated Woodpecker	<i>Dryocopus pileatus</i>	x				x	x	x	x				
Lewis' Woodpecker	<i>Asyndesmus lewis</i>					x	x	x	x				
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>				x	x	x	x	x				
Hairy Woodpecker	<i>Dendrocopus villosus</i>	x				x	x	x	x			x	
Downy Woodpecker	<i>Dendrocopus pubescens</i>												
Empidonax Flycatchers	<i>Empidonax</i> spp.						x						
Olive-sided Flycatcher	<i>Nuttallornis borealis</i>					x	x		x				
Violet-green Swallow	<i>Tachycineta thalassina</i>						x	x					
Tree Swallow	<i>Iridoprocne bicolor</i>				x	x		x					
Bank Swallow	<i>Riparia riparia</i>			x	x			x					
Rough-winged Swallow	<i>Stelgidopteryx ruficollis</i>				x	x	x	x	x				
Barn Swallow	<i>Hirundo rustica</i>					x	x	x					
Steller's Jay	<i>Cyanocitta stelleri</i>						x		x	x	x	x	x
Gray Jay	<i>Perisoreus canadensis</i>	x	x			x	x	x	x	x	x		
Clark's Nutcracker	<i>Nucifraga columbiana</i>	x				x	x	x	x	x	x		x
Common Raven	<i>Corvus corax</i>	x				x	x	x	x	x	x	x	
Common Crow	<i>Corvus brachyrhynchos</i>	x	x	x	x	x	x	x	x	x	x	x	x
Black-capped Chickadee	<i>Parus atricapillus</i>	x	x		x	x	x	x	x	x		x	x
Mountain Chickadee	<i>Parus gambeli</i>	x			x	x	x	x	x	x		x	x
Chestnut-backed Chickadee	<i>Parus rufescens</i>	x					x						
Dipper	<i>Cinclus mexicanus</i>			x	x	x	x	x	x	x		x	
Red-breasted Nuthatch	<i>Sitta canadensis</i>	x				x	x						

Table 9 (continued)

COMMON NAME	SCIENTIFIC NAME	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Brown Creeper	<i>Certhia familiaris</i>			x							x		
Winter Wren	<i>Troglodytes troglodytes</i>			x		x						x	
American Robin	<i>Turdus migratorius</i>			x	x	x	x	x	x	x			
Varied Thrush	<i>Ixoreus naevius</i>			x		x	x				x		
Townsend's Solitaire	<i>Myadestes townsendi</i>				x	x	x	x					
Hermit Thrush	<i>Catharus guttatus</i>					x	x						
Swainson's Thrush	<i>Catharus ustulatus</i>					x	x						
Veery	<i>Catharus fuscescens</i>				x	x	x						
Mountain Bluebird	<i>Sialia currucoides</i>			x	x	x	x	x	x	x			
Golden-crowned Kinglet	<i>Regulus satrapa</i>	x		x		x	x						
Ruby-crowned Kinglet	<i>Regulus calendula</i>					x					x		
Water Pipit	<i>Motacilla spinoletta</i>						x						
Bohemian Waxwing	<i>Bombycilla garrulus</i>						x						
Cedar Waxwing	<i>Bombycilla cedrorum</i>							x					
Starling	<i>Sturnus vulgaris</i>					x	x	x	x				
Red-eyed Vireo	<i>Vireo olivaceus</i>							x					
Yellow Warbler	<i>Dendroica petechia</i>						x	x					
Yellow-rumped Warbler	<i>Dendroica coronata</i>				x		x						
Townsend's Warbler	<i>Dendroica townsendi</i>					x	x		x				
Common Yellowthroat	<i>Geothlypis trichas</i>						x						
MacGillivray's Warbler	<i>Oporornis tolmiei</i>				x								
American Redstart	<i>Setophaga ruticilla</i>							x					
Western Meadowlark	<i>Sturnella neglecta</i>								x				
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>					x				x			
Red-winged Blackbird	<i>Agelaius phoeniceus</i>				x								
Brewer's Blackbird	<i>Euphaga cyanocephalus</i>				x	x							

Table 9 (continued)

COMMON NAME	SCIENTIFIC NAME	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Western Tanager	<i>Piranga ludoviciana</i>						X		X				
Evening Grosbeak	<i>Hesperiphona vespertina</i>												
Pine Grosbeak	<i>Pinicola enucleator</i>	X				X	X						
Gray-crowned Rosy Finch	<i>Leucosticte tephrocotis</i>								X				
Pine Siskin	<i>Spinus pinus</i>				X	X			X				
Red Crossbill	<i>Loxia curvirostra</i>						X						
Dark-eyed Junco	<i>Junco hyemalis</i>				X	X	X	X	X	X	X	X	
Tree Sparrow	<i>Spizella arborea</i>				X								
Chipping Sparrow	<i>Spizella passerina</i>					X	X	X	X				
Fox Sparrow	<i>Passerella iliaca</i>				X								
Lincoln's Sparrow	<i>Melospiza lincolni</i>								X				
Song Sparrow	<i>Melospiza melodia</i>				X	X	X	X					
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>						X						

Table 10. Bird species occurrence in cover and habitat types, 1977 and 1978.

COMMON NAME	COVER TYPES					HABITAT TYPES																					
	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS	FOREST	<i>PSEUDOTSUEA MENZIESII</i> ¹	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	<i>ABIES GRANDIS</i>	ABGR/CLUN	<i>THUJA-TSUGA</i>	THPL/OPHO	THPL/CLUN	TSHE/CLUN	<i>ABIES LASIOCARPA</i>	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI	
Common Loon	x																										
Red-necked Grebe	x																										
Horned Grebe	x																										
Western Grebe	x																										
Pied-billed Grebe	x																										
Great Blue Heron	x	x															x		x								
Whistling Swan	x																										
Canada Goose	x																										
Mallard	x																										
Pintail	x																										
Green-winged Teal	x																										
Blue-winged Teal	x																										
Cinnamon Teal	x																										
American Wigeon	x																										
Ring-necked Duck	x																										
Common Goldeneye	x																										
Barrow's Goldeneye	x																										
Common Merganser	x																										
Hooded Merganser	x																										
Bufflehead	x																										
Goshawk						x		x												x							
Sharp-shinned Hawk						x														x							
Cooper's Hawk						x														x							
Red-tailed Hawk				x	x		x	x				x	x							x						x	
Rough-legged Hawk				x		x														x							
Bald Eagle				x	x															x							
Marsh Hawk		x		x																x							
Golden Eagle																					x						
Osprey	x					x								x													
Merlin				x	x																x			x			
American Kestrel				x	x	x							x							x						x	
Blue Grouse			x			x		x			x		x		x					x		x	x	x	x	x	
Spruce Grouse						x																					
Ruffed Grouse			x			x		x	x		x						x	x	x				x		x		
American Coot	x																										
Killdeer		x																									
Common Snipe		x																									
Spotted Sandpiper		x																									
California Gull	x				x	x																x					
Rock Dove						x														x							
Mourning Dove					x																						
Great Horned Owl						x		x												x							
Barred Owl						x														x							
Great Gray Owl						x														x							
Saw-whet Owl						x																					
Common Nighthawk					x						x									x							

Table 10 (continued)

COMMON NAME	COVER TYPES										HABITAT TYPES															
	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS	FOREST	PSEUDOTSUGA MENTLESSI	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	ABIES GRANDIS	ABGR/CLUN	THUJA-TSUGA	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES LASiocarpa	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI
Calliope Hummingbird			x																							
Black-chinned Hummingbird						x																				x
Rufous Hummingbird			x	x		x													x				x	x		
Belted Kingfisher	x						x																			
Common Flicker				x		x							x					x						x	x	
Pileated Woodpecker				x	x	x											x		x					x		
Lewis' Woodpecker				x																						
Yellow-bellied Sapsucker				x		x											x		x							
Hairy Woodpecker				x		x							x					x							x	
Downy Woodpecker						x												x	x							
Empidonax Flycatchers						x													x							
Olive-sided Flycatcher				x															x							
Violet-green Swallow				x	x																					
Tree Swallow	x			x	x																					
Bank Swallow				x	x																					
Rough-winged Swallow	x			x	x																					
Barn Swallow	x			x	x																					
Steller's Jay			x	x		x									x		x		x							x
Gray Jay				x		x									x						x					
Clark's Nutcracker						x															x					x
Common Raven			x	x	x	x											x		x		x	x				
Common Crow			x	x	x	x						x							x							x
Black-capped Chickadee				x		x									x		x	x	x							
Mountain Chickadee						x									x							x	x		x	
Chestnut-backed Chickadee						x													x							
Dipper	x	x				x											x		x							
Red-breasted Nuthatch						x													x		x	x				
Brown Creeper						x													x							
Winter Wren			x			x											x		x							
American Robin			x	x	x	x			x										x							x
Varied Thrush						x				x							x		x			x	x		x	
Townsend's Solitaire			x	x		x													x							x
Hermit Thrush						x					x													x		
Swainson's Thrush			x	x		x			x								x		x							
Veery			x			x													x							
Mountain Bluebird				x	x																					
Golden-crowned Kinglet						x				x													x			
Ruby-crowned Kinglet						x				x													x			

Table 10 (continued)

COMMON NAME	COVER TYPES ¹						HABITAT TYPES																				
	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS	FOREST	PSEUDOTSUEA	MENZIESII	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	ABIES GRANDIS	ABGR/CLUN	THUJA-TSUGA	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES LASIOCARPA	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI
Water Pipit		x	x																								
Bohemian Waxwing		x																									
Cedar Waxwing		x																									
Starling				x	x																						
Red-eyed Vireo						x																					
Yellow Warbler		x						x																			
Yellow-rumped Warbler			x		x											x				x							x
Townsend's Warbler					x											x											
Common Yellowthroat		x																									
MacGillivray's Warbler					x															x							
American Redstart					x															x							
Western Meadowlark					x																						
Yellow-headed Blackbird		x																									
Red-winged Blackbird		x																									
Brewer's Blackbird					x																						
Western Tanager						x		x																			x
Evening Grosbeak						x						x								x							
Pine Grosbeak						x														x			x				
Gray-crowned Rosy Finch					x	x																					x
Pine Siskin					x	x							x			x											x
Red Crossbill						x																					
Dark-eyed Junco			x		x							x			x	x			x								x
Tree Sparrow		x																									
Chipping Sparrow						x							x			x							x				x
Fox Sparrow		x	x		x													x									
Lincoln Sparrow		x																		x							
Song Sparrow		x				x														x							
White-crowned Sparrow		x																									

¹ Observation recorded at series level if exact habitat could not be determined or if species was universally distributed throughout series.

Table 11. Duck broods observed during 1977

DATE	SPECIES	BROOD SIZE	LOCATION				T	R	AREA	
			$\frac{1}{4}$	$\frac{1}{4}$	S					
6-12	Common Goldeneye	2	NW	SE	20		29N	33W	Swamp	NE edge Bull Lake
6-12	Common Goldeneye	4	NE	SE	20		29N	33W	Swamp	NE edge Bull Lake
6-12	Common Goldeneye	1	NE	SE	20		29N	33W	Swamp	NE edge Bull Lake
6-16	Common Goldeneye	10	NE	SW	4		28N	33W	Swamp	NE edge Bull Lake
6-16	Common Goldeneye	7	NE	NE	31		30N	33W	Pond	N of Camp Creek
6-19	Common Goldeneye	3	NE	SW	20		29N	33W	Swamp	E edge of Bull Lake
6-19	Common Goldeneye	3	NE	SW	20		29N	33W	Swamp	E edge of Bull Lake
7-11	Common Merganser	6	SW	SW	20		30N	33W	Lake	Creek near Twin Creek
7-11	Common Merganser	5	SW	NW	20		30N	33W	Lake	Creek at Keeler Creek
7-11	Common Merganser	6	SE	SW	17		30N	33W	Lake	Creek at Keeler Creek
7-11	Common Merganser	6	SE	NW	17		30N	33W	Lake	Creek N of Keeler Cr.
7-11	Common Merganser	7	NW	NW	17		30N	33W	Lake	Creek S of Copper Cr.
7-11	Common Merganser	6	SE	SE	7		30N	33W	Lake	Creek N of Copper Cr.
7-11	Common Merganser	7	NE	NW	8		30N	33W	Lake	Cr. N of Chase Cut-off
7-11	Common Merganser	8	SW	SE	5		30N	33W	Lake	Cr. S. of Felix Cr.
7-13	Common Goldeneye	6	NE	SW	4		28N	33W	South	end of Bull Lake
7-13	Common Merganser	9	SW	NW	29		29N	33W	Middle	of Bull Lake
8-12	Common Merganser	8	NE	NE	19		29N	33W	West	shore of Bull Lake
8-12	Mallard	4	SW	SW	20		29N	33W	West	shore of Bull Lake
8-12	Common Merganser	6	SW	NE	19		29N	33W	West	shore of Bull Lake

of five nests was discovered along Crowell Creek north of Bull Lake. Two nests were inactive or had been abandoned while three nests contained a total of 8 young and 2 adults when observed during a July 13 helicopter flight. All of the above species, except the whistling swan, breed in this region of the state according to Skaar (1975).

Raptors

Fifteen species of raptors were observed during the report period and included accipiters, falcons, harriers, eagles, buteos, owls and ospreys. Observations of raptors (Figure 20) were made incidental to other activities except for the osprey, for which efforts were directed specifically towards locating and monitoring nests.

The osprey was the most commonly observed raptor during the study followed by observations of the red-tailed hawk (22), the American kestrel (15) and the merlin (14). These species were observed during the summer (breeding) period (Table 9). Although definitive breeding evidence was collected only for the osprey, Skaar (1975) indicates that hard evidence of breeding (active nest or dependent young) has been collected for the red-tailed hawk and kestrel and circumstantial evidence (territorial males or pairs) has been collected for the merlin in this part of the state. The red-tailed hawk, merlin and kestrel were observed primarily in open areas or cutting units (Table 10). These species may not have been more abundant than the forest dwelling raptors, but they were easier to observe. Raptors observed in the study area whose habitat is confined primarily to dense forest included: goshawk, sharp-shinned hawk, saw-whet owl and great gray owl. Raptors which were observed in the timber but were not necessarily confined to timber included: Cooper's hawk, great horned owl and barred owl. There have been less than 10 sightings of the barred owl in Montana (Skaar 1975) and the 2 observed during this study were road kills found along Keeler Creek.

The bald eagle was classified as an endangered species in February 1978 by the U.S. Fish and Wildlife Service. Three sightings of the bald eagle were made during April and November, 1977 and February, 1978. These birds were observed near Bull Lake and their occurrence there is probably related to migrating waterfowl which use the lake prior to freeze-over and after break-up. The golden eagle was observed on two occasions in the South Fork of Ross Creek near the head of Dry Creek (Figure 20). The marsh hawk and rough-legged hawk were also observed but their use of the area is probably limited to spring and fall migration. Evidence suggests the occurrence of peregrine falcons (*Falco peregrinus*) in the area (Skaar 1975 and Robbins et. al. 1966).

Figure 20. Locations of raptors observed on the study area, 1977-1978.

Osprey observations were primarily confined to Lake Creek and Bull Lake. It was estimated that 48 observations were of a minimum of 13 individuals. Table 12 gives the locations of 9 osprey nests noted on the study area. Nests 1, 2 and 3 were each attended by a pair of adults who incubated and successfully hatched young during 1977. Nests 1 and 3 fledged 2 young each during the first week in August. Nest 2 was abandoned in early July shortly after logging activities commenced in the immediate area. The fate of these birds is unknown, but no adults or young osprey were observed at or near this nest after July. Osprey were not observed on Nest 4 by the investigator but reports indicate this nest was attended by a pair early in the season. The birds on this nest were reported by locals to have been shot. Ospreys were reported during previous years on Nest 5, but this nest was not attended during 1977. Nests 6, 7 and 8 by their location and construction indicate previous use by osprey but none were observed near the nest in 1977. Nest 9 was located during March 1978 and was in good repair. During 1978, no young were observed in Nest 1, 3 young were hatched in Nest 3, 2 young were hatched in Nest 6 and 3 young were hatched in Nest 9. Nest 2 was attended by a pair in April but no young were observed in the nest during July. Nest 4 fell from the tree and the tree containing Nest 7 fell. Nest 5 was unoccupied and Nest 8 was not observed during 1978.

Forest Grouse

Members of the family Tetranonidae which were observed on the study area included: blue grouse, ruffed grouse and spruce grouse. These grouse are all native to Montana and are generally limited to the mountainous regions of the state. Observations and sign of blue grouse and ruffed grouse recorded during the study are contained in Appendices 16 and 17. The distribution of these observations and the observations of spruce grouse are presented in Figure 21. The blue grouse and ruffed grouse data are summarized in Tables 13 and 14, respectively.

The three observations of spruce (Franklin's) grouse occurred near Camp Creek in the area to be inundated by the tailing impoundment. The overall geographic distribution of the spruce grouse is a transcontinental band generally conforming to the boreal coniferous forest (Aldrich 1963). In Montana, spruce grouse are more limited in their range than either the blue or ruffed grouse and are generally found in the denser forest types such as subalpine fir, Engelmann spruce or lodgepole pine (*Pinus contorta*) in western Montana (Mussehl et al. 1971).

Table 12. Osprey nests located during 1977 and 1978 including first observation dates, site description and comments.

NEST NO.	DATE LOCATED	SITE DESCRIPTION	COMMENTS
1	5-18-77	East shore of Bull Lake along Highway 202. Top of partially dead larch (<i>Larix occidentalis</i>) tree.	Productive nest - two young fledged first week of August, 1977. Productive nest attended by pair throughout July, 1978. Not observed from air during 1978.
2	6-16-77	Crowell Creek. Tree standing in creek bed. Top of topped Douglas-fir (<i>Pseudotsuga menziesii</i>). Within 0.4 km of Bull Lake.	Nest failure - young abandoned in early July, 1977, coincident with initiation of logging activity beneath nest. Nest failure - pair observed in April, single adult seen in July, no young in nest in late July, 1978.
3	6-15-77	Freeman Ridge, across from Felix Creek. Top of giant snag. Within 0.4 km of Lake Creek.	Productive nest - two young fledged first week of August, 1977. Productive nest - three young in nest in July, 1978.
4	6-19-77	Swanson Creek. Top larch snag. Next to swamp, 0.8 km from Lake Creek.	Unoccupied nest, may have had osprey pair earlier in spring, 1977. Pair is reported to have been shot off nest. Nest fell out of tree, 1978.
5	7-14-77	Noggle Creek. Top of larch snag. Near ponds, about 1.5 km from Bull Lake.	Unoccupied nest during 1977 and 1978.
6	7-14-77	West shore of Bull Lake near Emma Gulch. In dead larch snag.	Unoccupied nest, 1977. Productive nest - two young in nest in July, 1978.
7	4-9-77	East shore of Bull Lake near Crowell Creek. In broken spruce (<i>Picea</i>) snag.	Unoccupied nest, 1977. Tree fallen, 1978.
8	5-16-77	Little Spar Lake. Top of dead unidentified tree.	Unoccupied nest, 1977. Observed from the air. No osprey were observed from the ground in this area. Not observed in 1978.
9	3-12-78	Northwest of Schoolhouse Lake. Top of dead larch snag.	Fate of this nest unknown during 1977. Productive nest - three young in nest in July, 1978.

Table 13. Blue grouse sex and age classification monthly summary.

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Males	-	-	-	-	1	1	-	1	-	1	-	-	4
Females	-	-	-	-	-	5	1	4	-	-	-	-	10
Adults	-	-	1	-	1	-	2	11	-	2	-	-	17
Unclassified	-	-	-	-	-	-	-	-	-	1	-	-	1
Number Broods	-	-	-	-	-	-	1	6	-	-	-	-	7
Number Young	-	-	-	-	-	-	1	24	-	-	-	-	25
Average Brood Size	-	-	-	-	-	-	1.0	4.0	-	-	-	-	3.6
TOTAL	-	-	1	-	2	6	4	40	-	4	-	-	57

Table 14. Ruffed grouse sex and age classification monthly summary.

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Males	-	-	-	10	9	7	-	3	4	1	-	-	28
Females	-	-	-	4	2	2	2	3	-	-	-	-	13
Adults	-	-	-	4	3	-	1	1	1	-	-	-	10
Unclassified	3	-	-	-	-	-	-	-	4	7	3	5	22
Number Broods	-	-	-	-	-	1	1	6	-	-	-	-	8
Number Young	-	-	-	-	-	3	8 ¹	36	3	-	-	-	50
Average Brood Size	-	-	-	-	-	3.0	5.0	6.0	-	-	-	-	5.9
TOTAL	3	-	-	18	14	6	11	43	12	8	3	5	123

¹ Three young found dead on road. Not counted as brood.

Figure 21. Locations of blue grouse, ruffed grouse and spruce grouse observed on the study area, 1977-1978.

Blue grouse are present in 12 western states and 4 Canadian provinces (Aldrich 1963). The overall range of the species is closely associated with the distribution of true fir and especially Douglas-fir (Beer 1943). In Montana they are found in the coniferous forests of the west and in isolated mountain ranges east of the divide (Mussehl et al. 1971). In contrast to the ruffed grouse, which are generally sedentary year-round (Gullion 1967), blue grouse usually move to higher elevations in fall, spend the winter there, and return to lower areas in spring to breed and raise young (Zwickel et al. 1968, Mussehl 1960 and Bendell and Elliott 1967).

During the report period, 57 observations of blue grouse were recorded (Table 13). Eighty-three percent of blue grouse observations were recorded at 1,280 m (4,200 ft) and above, with all observations between 914 m (3,000 ft) and 1,830 m (6,000 ft). Blue grouse were found in 12 habitat types. Sixty-one percent of the observations occurred in subalpine fir habitat types (ABLA/XETE, ABLA/LUHI, ABLA/MEFE and ABLA/CACA) and 22 percent in Douglas-fir habitat types (PSME/SYAL, PSME/PHMA and PSME/AGSP).

The ruffed grouse is the most widely distributed of all native American Tetraonidae (Aldrich 1963). They are currently residents of 38 states and 13 Canadian provinces or territories (Gullion 1977). In Montana, ruffed grouse are found primarily west of the Continental Divide and in the scattered mountains and associated drainages of Central Montana east of the divide (Mussehl et al. 1971).

Although ruffed grouse are widely distributed, the unifying criterion is that successional or climax vegetation stages include deciduous trees, especially of the genera *Betula* and *Populus* (Johnsgard 1973). Gullion (1969) indicates that on a continent-wide basis, the highest population densities of ruffed grouse correspond to the distribution patterns of aspens (*Populus* spp.). Aspen is important winter and summer food for adults and provides valuable brooding habitat. On the study area 3 species of *Populus* were noted including quaking aspen (*Populus tremuloides*), black cottonwood (*Populus trichocarpa*) and plains cottonwood (*Populus deltoides*). Other deciduous trees present on the study area which may be used by ruffed grouse included water birch (*Betula occidentalis*), paper birch (*Betula papyrifera*), willows (*Salix* spp.), mountain alder (*Alnus sinuata*) and thinleaf alder (*Alnus incana*).

Drumming counts have been used effectively for obtaining indices of male ruffed grouse (Dorney et al. 1958). Appendix 18 contains results of 4 drumming routes conducted on the study area along Stanley, Keeler and Ross creeks. These

routes were conducted on clear mornings when wind speeds were less than 4.8 km per hour (3 mph). Routes were usually started 1/2 hour before sunrise and consisted of 4-minute listening stops (Petraborg et al. 1953). All routes included 15 stops which were 400 m (1/4 mi) apart. Information from this study indicates that routes conducted during the last 10 days in April and the first 10 days in May will cover the peak of drumming activity in the Lake Creek Valley.

During the study period, 123 observations of ruffed grouse were made (Table 14). Ruffed grouse were observed more consistently at lower elevations than blue grouse. Ninety-two percent of the ruffed grouse observations occurred at 830 m (2,800 ft) and below, with all observations occurring between 604 m (2,000 ft) and 1,460 m (4,800 ft). Although ruffed grouse were more numerous than blue grouse, they were found in fewer habitat types. Eighty-two percent of the ruffed grouse observations occurred in the TSHE/CLUN habitat type and 15 percent occurred in three Douglas-fir types (PSME/PHMA, PSME/CARU and PSME/LIBO).

Shorebirds

Five species of shorebirds were observed during the study. Observations of shorebirds were made incidental to other observations. Monthly occurrence is given in Table 9. The spotted sandpiper was the most commonly observed shorebird on the study area and was found utilizing most lakes, ponds and streams. Dependent young of spotted sandpipers were also observed indicating that breeding does occur on the study area. Other shorebirds observed during the study included: common snipe, American coot, killdeer and California gull. The common snipe was observed during the summer months and although breeding records were not established on the study area, they are known to breed in this region of the state (Skaar 1975), as are the coot, killdeer and California gull.

Spotted sandpipers and killdeers were observed foraging on the mudflats of a pond near Camp Creek. This area is located on the site of the proposed tailing impoundment.

Other Birds

Birds of the order Passeriformes (perching or song birds) constituted 56 of the 69 birds observed in this category. The other 13 species included: woodpeckers, hummingbirds, belted kingfisher, rock dove, mourning dove and common nighthawk. The monthly occurrence of these birds and the cover types and habitat types in which they were observed are given in Tables 9 and 10, respectively.

Bird observations were collected incidental to other activities; therefore, the number of species observed should be considered a minimum figure. Birds commonly observed in the forest cover type on the study area included: gray jay, varied thrush, golden-crowned kinglet, dark-eyed junco and chipping sparrow. Birds which were regularly observed in cutting units were: Lewis' woodpecker, olive-sided flycatcher and mountain bluebird. Birds which were consistently observed in either the shrub or forest cover type were: song sparrow, Steller's jay, Swainson's thrush and black-capped chickadee. Species which did not appear to be limited to a specific cover type included: rufous hummingbird, common flicker, common raven and common crow. Dippers were observed along most streams and the winter wren was commonly observed in dense forests along streams.

Nearly all observations of mountain bluebirds were made at the site of the proposed tailing pond where the open area, abundance of perches and availability of old woodpecker holes or natural cavities for nesting (Jackman and Scott 1975) provide critical habitat. Woodpeckers were also commonly observed in this area and along Stanley Creek where feeding and nesting trees were common. A commensalistic relationship exists between mountain bluebirds and woodpeckers because old woodpecker holes are usually used for nesting purposes by mountain bluebirds (Jackman and Scott 1975). Power (1966) notes that "Highly specialized nesting requirements have produced a relatively unadaptable species whose population has declined as a result of environmental changes of recent decades".

Amphibians and Reptiles

Observations of herpetofauna were collected incidental to other activities and were recorded according to month, cover type and habitat type. Four species of reptiles and four species of amphibians were observed on the study area and are presented in Table 15.

The tailed frog is classified as a "nongame species of special interest or concern" by the MDFWP (Flath 1977). This species is restricted to well forested areas in the vicinity of cold mountain streams having a rocky streambed (Stebbins 1954). The tailed frog was observed in Stanley Creek in the immediate vicinity of the mine main entrance on August 2, 1977.

Except for the rubber snake, all observed herpetofauna were confined to moist areas. The rubber snake was located at 1,220 m (4,000 ft) on top of Stanley Mountain in the ABGR/CLUN habitat type.

Table 15. Amphibian and reptile observations - occurrence in cover types and habitat types.

COMMON NAME	SCIENTIFIC NAME	COVER TYPES					HABITAT TYPES			
		WATER SHORE	SHRUBS	OPEN AREAS	CUTTING UNITS	FOREST	TSUGA-THUJA THPL/OPHO THPL/CLUN TSHE/CLUN	ABIES GRANDIS ABGR/CLUN	ABIES LASIOCARPA ABLA/CACA	
Tailed Frog	<i>Ascaphus truei</i>	x								
Western Toad	<i>Bufo boreas</i>	x				x	x x			
Pacific Tree-Frog	<i>Hyla regilla</i>			x x x			x x			
Spotted Frog	<i>Rana pretiosa</i>	x	x			x				x
Painted Turtle	<i>Chrysemys picta</i>	x								
Rubber Snake	<i>Charina bottae</i>					x		x		
Common Garter Snake	<i>Thamnophis sirtalis</i>					x	x			
Western Garter Snake	<i>Thamnophis elegans</i>					x	x			

The wood frog (*Rana sylvatica*) was not observed during this study period but was noted on the area by Stearns-Roger (1975) and constitutes a unique observation because this species is not considered to be present in this area (Stebbins 1966).

A total of nine species of herpetofauna have been documented on the study area to date and Flath (pers. comm.) indicates that the very rare Coeur d'Alene salamander (*Plethodon vandykei*) has been collected from the vicinity of Lake Creek. Stebbins (1966) indicates that the leopard frog (*Rana pipiens*), western skunk (*Eumeces skiltonianus*), northern alligator lizard (*Gerrhonotus coeruleus*), racer (*Coluber constrictor*) and gopher snake (*Pituophis catenifer*) may also occur in this area.

ASSESSMENT OF WILDLIFE IMPACTS

Comprehensive Review

Developments impose a variety of inimical consequences upon wildlife from a multitude of sources. Due to legal constraints, wildlife impact analysis is usually limited to the construction and operation of a development; the secondary, yet most serious, effect of expanding human population is left unaddressed. This study focused primarily on mine related impacts. It did not address associated ancillary developments, but it is necessary to at least identify these factors.

Mine Construction and Operation

The Mount Vernon mine facilities include three general components: the actual mine site complex, the utility corridor, and the tailing impoundment area (additional description and location of facilities are presented in Description of Mine Development). Wildlife impacts generally refer to one of the above three components.

Direct and indirect wildlife mortality factors are involved in mine construction and operation. Direct losses include death of animals which do not have the capabilities of long-ranged movement and are thus destroyed in the construction phase. Another cause of direct mortality involves wildlife/ore-hauling truck collisions. Most deaths are accidental although malicious destruction does occur (Colorado Department of Wildlife, from Klimstra et al. 1979).

Indirect wildlife attrition results from habitat destruction or deterioration which in turn affects the quantity and quality of habitat. Food and cover will be reduced or

eliminated and movements of wildlife hampered with vegetation alteration or removal. Most of the length of Stanley Creek will experience construction activity which will affect much of the stream riparian zone. A well-used wildlife movement corridor will be crossed by construction and ultimately bisected by the utility corridor. Most large wildlife species are displaced when construction begins. Displaced animals generally do not survive; there is usually no place else to move because if suitable habitat does exist, then it is usually at or near carrying capacity with the same species which is attempting to emigrate (Thompson 1977). If human activity causes wildlife to permanently avoid an area even though suitable habitat might be available, the avoidance is equivalent to a permanent reduction in carrying capacity (Thompson 1977). It is impossible to predict the extent of animal losses which may result from restricted access (RAB and F&WB 1979). In addition to reduced carrying capacity on over crowded ranges, construction and operation activity may create stress for wildlife. Stress is a nebulous but insidious type of impact which results from behavioral changes induced by mine facility structures or human activities. For example, slurry pipelines, haul roads and fences may create actual and psychological barriers to normal movements.

Expanding Human Population

The construction phase of any development involves the largest influx of workers and construction populations are typically associated with more severe impacts on wildlife than the permanent workforce. Extensive secondary land use change due to ancillary human activities throughout the area surrounding a new mine will typically cause more significant impacts than the area directly involved with the mining process (Klimstra et al. 1979).

Direct wildlife mortality results from increased hunting pressure and increased poaching and vehicle/wildlife collisions. Hunting should not be "viewed as inimical to the welfare of wildlife; a harvestable surplus of animals is always available if hunting is properly controlled" (RAB and F&WB 1979), but Klimstra et al. (1979) points out:

Any human population is accompanied by additional hunting/fishing pressure, but the decided preference of mining personnel for these forms of outdoor recreation activities causes additional increases beyond what would normally be expected for that incremental increase in population. . . In the Gillette, Wyoming area, the mean number of recreation days per day of hunting season increased over 240 percent from 1971 to 1977 for antelope and by 143 percent for mule deer hunting but the human population increased by only 112 percent.

The problems of poaching and road-kills are aggravated when mine roads cross wildlife movement zones and when shift changes coincide with wildlife early morning and evening feeding periods. The magnitude of the wildlife-vehicle collision problem is pointed out by the British Columbia Resources Analysis Branch and Fish and Wildlife Branch (RAB and F&WB 1979) who indicate that "over 1.5 million deer are believed to be killed annually on highways in North America together with uncounted millions of smaller species". Road-killed deer, raptors and small mammals have been located on roads in the Mount Vernon mine area, and these losses will likely increase with increasing numbers of vehicles on local roads. According to Klimstra (1979):

In a comparison of population and vehicle registration trends in mining impacted areas of northwest Colorado, population growth rates have been 47 percent and 19 percent in 2 counties over a 5-year period. During that same period registrations for recreational trucks increased over 558 percent in 1 county and 383 percent in the other.

Indirect wildlife mortality may result from the following stress inducing factors: subdivisions, domestic animal harassment and noise. Subdivisions and other conflicting land uses constitute a direct, often expansive loss of wildlife habitat which, perhaps more seriously, "could break up the continuity of winter ranges to the extent that what remains will not support animals" (RAB and F&WB 1979). The DSL-KNF EIS (1979) cites that approximately 47.75 square km (11,800 acres) of land in the direct impact area (including the Troy area) are under private ownership and will most likely experience rapid land use changes. Established residential areas throughout the Lake Creek Valley are likely to expand; these sites include: the areas at the mouths of Camp, Crowell, Felix, Copper, Twin, Falls and Lake creeks; east shore of Bull Lake and the west side of Lake Creek from Copper Creek north to Highway 2. Domestic animal harassment can significantly contribute to herd losses of wildlife (Klimstra et al. 1979) while at the same time the public will not tolerate large predatory species of wildlife and will demand increased predator control (RAB and F&WB 1979). Wildlife may acclimate to constant noise, but "habituation is least likely to occur and long-term displacement is more likely when disturbances are irregular or erratic. Such is the case with sporadic traffic on primitive mountain roads" (Thompson 1977). Ultimately, the burden of wildlife impacts from development of the Mount Vernon mine will come to rest with the Montana Department of Fish, Wildlife and Parks (MDFWP) who will be responsible to deal with: industrial pollution problems, public enquiries, habitat management procedures, nuisance animal control and other demands which an increasing human population will generate.

Identified Wildlife-Mining Conflicts

Moose

The Stanley Creek drainage (site of the mine) was extensively used by moose during the winter and moose were year-long residents of the Lake Creek flats at the site of the tailing pond. Moose will realize serious adverse impacts as a result of mining activities since these activities occur coincident with known moose winter use areas.

Elk

Stanley Mountain, the mouth of Stanley Creek, the north end of Bull Lake and the lower section of Camp Creek as it enters Lake Creek all receive substantial winter use by elk. These areas will receive direct adverse impacts from mine development, and the surrounding areas will receive secondary human impacts. Stanley Creek was used by elk as a migration corridor to gain access to the Mount Vernon ridge. Movement along Stanley Creek will likely be pre-empted because of mine development.

Mule Deer

Mule deer use of the study area included the Mount Vernon ridge. The probability of mule deer losses through poaching, increased hunter access, collisions with vehicles or stress will be increased if access to the Mount Vernon ridge by either the Stanley Creek or Ross Creek road is improved or if use of either of these roads is increased by mine company personnel. Stanley Creek appears to be used as a travel route by mule deer during spring and fall. Disruption of travel by deer along traditional routes and displacement of mule deer from regularly used areas may result in a lowered carrying capacity. Mule deer will be particularly vulnerable to mining activities during spring and winter. Mule deer use of the lower mill site during spring by females suggests that this area is used as a fawning ground. Numerous tracks, pellet groups and beds of deer, presumed to be mule deer, were noted during December on the slope immediately above the upper mill site.

White-tailed Deer

Areas receiving substantial white-tailed deer use included Ross Creek; south, west and north shore of Bull Lake; Stanley Mountain; Keeler Mountain; Lake Creek; Camp Creek; Grouse Mountain; and along Highway 202 between Felix Creek and Twin Creek. The utility corridor and tailing impoundment may constitute a real if not psychological barrier to movement of whitetails and contribute to direct habitat loss.

Habitat disruption and restricted movement may have the effect of concentrating whitetails on more limited areas, resulting in over utilization of the remaining habitat and an overall reduction in carry capacity of the valley.

Bighorn Sheep

Two neck-banded bighorn ewes were observed on several occasions on the south side of Mount Vernon near the south adit. It is not known whether Mount Vernon has assumed an essential role in the life requirements of these sheep which were planted on Berray Mountain in 1975 by the Montana Department of Fish and Game.

Mountain Goat

Mountain goats are particularly vulnerable to human developments because they exhibit strong homing tendencies (Kuck 1977), limited pioneering abilities (Geist 1971) and phlegmatic personalities. The only two known winter concentration areas for mountain goats in the West Cabinet Mountains of Montana are Mount Vernon and Ross Point. If access for miners is allowed to the ridge between Mount Vernon and Spar Peak via either the Stanley Creek or Ross Creek road, then mountain goats may experience habitat inaccessibility, behavioral modifications from human interactions or poaching pressure. Information concerning mountain goats in the West Cabinet Mountains collected over a 3-year period will be presented in a separate report.

Bears

Spring green-up may concentrate bears in vulnerable situations such as along road rights-of-way where vegetation first emerges (Jonkel 1976). The haul road will be regularly plowed and in use 24 hours per day so the shoulders of the road would green-up early because the road margin will be free of snow. The attraction of bears to the road for spring feeding may result in casualties from vehicle collisions, as well as result in increased legal and illegal mortalities. The mine would have the potential of attracting both grizzly and black bears if food refuse accumulates or if road margins are seeded with legumes (a palatable food item).

Mountain Lion

The Stanley and Keeler creek drainages and associated Lake Creek bottom were extensively used by mountain lions. Lions regularly cross Stanley Creek enroute between deer winter ranges, so the utility corridor which follows the

Figure 22. Adult female mountain goat feeding in meadow.

creek may create a barrier to movement. Secondary impacts to lions may occur from reductions of their prey species (deer, beaver, rabbit, ground squirrels, etc.). Reduction of these primary consumers may occur from habitat destruction resulting in displacement and attrition, as well as hunting, trapping and poisoning. In addition, mortality from mountain lion hunting would probably increase.

Furbearers and Predators

Furbearers and predators will experience habitat losses from construction of all mine facilities. Water withdrawals from Stanley Creek (or ground water which feeds Stanley Creek) for utilization in the mining operation may reduce flows in the creek and have an adverse effect upon beaver, muskrat, otter and other mammals using these watercourses. In addition, pollution of Stanley Creek or Lake Creek as a result of seepage or erosion from the tailing impoundment or a break in the slurry tailing pipeline could cause direct mortality to furbearers or indirect losses through damage to food sources.

Small Mammals

Small mammals are a diverse group of species playing an important role at the base of the food web. Alteration of their habitat may have far reaching impacts upon the variety of predators which rely upon them for survival. The 14 small mammal species observed during this study all exhibit small home ranges. They live out their lives within the limited confines of these ranges and are, therefore, subject to direct mortality if they occur at mine facilities sites.

Waterfowl

Waterfowl which utilize Stanley Creek and Lake Creek (below its confluence with Stanley Creek) may suffer adverse impacts if the safety features designed for the slurry pipeline or tailing impoundment fail and pollution of these drainages results. Waterfowl which use Stanley Creek will likely be displaced during the construction of the mine road, pipeline and transmission line. A pond on the tailing impoundment site was used by mallards, common goldeneye (brood of 7), green-winged teal and blue-winged teal. These species as well as others which may use the pond will be displaced and this area permanently lost with regard to its feeding and brood rearing capabilities. The tailing pond is not likely to receive waterfowl use because natural shoreline habitat will not be present. Residues from reagents and the tailing deposition process would preempt future production of macroinvertebrates (important waterfowl food) or aquatic vegetation (important waterfowl food and cover).

Raptors

Of the 15 species of raptors observed on the study area, the osprey would have the greatest potential for receiving adverse impacts as a result of mining and related developments. Threats to raptor nesting success and consequent population stability include shooting, pesticide-induced reproductive failure, heavy metal contamination, nest molestation and habitat alteration (Johnson and Melquist 1973). At least three of these possibilities exist with mining development on the study area. Shooting of raptors has already been reported from the area and in Idaho "shooting is almost certainly the primary cause of mortality in osprey populations" (Johnson and Melquist 1973). Increased use of the Lake Creek Valley because of human population growth would likely add to this type of loss. Heavy metals from the mine development may escape into the environment, which was the case in Idaho where Mink et al. (1971) indicated that despite the construction of settling ponds in the Coeur d'Alene River mining area, heavy metal (cadmium and zinc) levels remained high, both from seepage and from erosion of old tailings. The effects upon osprey reproduction of heavy metal contamination from zinc, lead, iron and copper in the Coeur d'Alene River is under investigation (Johnson and Melquist 1973).

Habitat utilized by both forest and open country raptors would be lost in the vicinity of mine facilities and the tailing impoundment. The clearcut area of the tailing impoundment currently provides a food source of ground squirrels and other small mammals which are used by red-tailed hawks and American kestrels. Two barred owls and a great horned owl were found dead on roads--apparent victims of vehicle collisions. This type of loss would be expected to increase with increasing vehicle traffic in the Lake Creek Valley.

Forest Grouse

Adverse consequences for ruffed grouse will occur with the widening of the haul road, maintenance clearing and construction of the tailing pipeline and transmission line, disturbance and construction at the well field and sump site as well as inundation and maintenance of the tailing pond area. Although artificial openings such as those created through logging and fire may provide additional habitat for ruffed grouse, few areas will be opened and allowed to re-vegetate into shrubby habitat during this development.

Blue grouse are not likely to be impacted from mine activities unless the road from Stanley Creek over Mount Vernon to Ross Creek is used. Blue grouse were regularly observed

on the south aspect of Mount Vernon on the road and on the ridge between Mount Vernon and Spar Peak. If the south adit were activated or the south side road were used regularly, blue grouse may receive increased poaching and hunting pressure.

Shorebirds

Mine developments which may adversely alter or diminish breeding and feeding habitat of shorebirds on the study area involve the tailing impoundment, tailing pipeline and return water system. Spotted sandpipers and killdeer were recorded using the mudflats along a pond at the tailing impoundment site. Common snipe and gulls may also use this area although they were not noted specifically at this site. Shorebirds may incur impacts similar to those which could be expected for waterfowl.

Other Birds

Mine facilities will occur in TSHE/CLUN and THPL/OPHO habitat types in which 45 of the 69 bird species in this category were observed. Birds occurring at the mine facility sites will initially be displaced, but most birds, because of their territorial behavior, will not allow settling of displaced birds in saturated habitats, so this "floating" component is predisposed to very high mortality rates (Klimstra et al. 1979). The mountain bluebird, for example, is a relatively unadaptable species because it has specialized nesting requirements. Several pair of nesting bluebirds were documented at the site of the tailing impoundment. Power (1966) notes that mountain bluebirds have "highly specialized nesting requirements which has produced a relatively unadaptable species whose population has declined as a result of environmental changes of recent decades".

Amphibians and Reptiles

The relatively rare tailed frog was located in Stanley Creek in the immediate vicinity of a proposed mine adit. Water removals from Stanley Creek, erosion from mine patios, mine water discharges, or creek alterations during the course of mine developments would adversely affect this species in this area. Tree frogs were found at the tailing impoundment site and will be lost from this area.

RECOMMENDATIONS

Recommendations are the intended product of baseline wildlife inventories. Technically, this wildlife inventory investigation was conducted to fulfill the intent of the Montana Environmental Policy Act which is to:

Encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the state

All agencies of the state are required to comply with the intent of MEPA as outlined in the Act, by identifying and developing methods and procedures, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making as well as economic and technical considerations. It is a matter of interest and concern to establish at what point the decision making process has been completed. It is not within the scope of this paper to address this question, but it is the responsibility of the Montana Department of Fish, Wildlife and Parks to pursue the best interest of the wildlife resources of this state. Decision making should be a continuing process which proceeds beyond implementation of a development. Environmental impact statements are predictive tools which are necessary in making a "go or no go" decision, but because they are predictive, they are fallible. Circumstances will arise for which impacts were not predicted, so the decision making tool must be available at any time. We must go one step further in protecting Montana's wildlife resource by documenting whether the potentialities outlined in the EIS do in fact occur; and if they do, to determine what mechanisms are responsible for their occurrence, then determine how the mechanisms might be modified to reduce or eliminate the negative impact.

The objectives of this study were to identify the wildlife species of the project area, determine their relative abundance and distribution and identify those species which were most vulnerable (by virtue of location or behavioral characteristics) to project implementation. Once these objectives were met, the next step was to define the particular species-mine facilities conflicts and then provide immediate recommendations to avoid, or alleviate detrimental consequences for the identified species. The objectives have been met, the potential impacts have been identified and immediate recommendations are provided below. These immediate recommendations are preventative measures to help maintain the status quo but it is possible to impose measures having beneficial long-term consequences by using biological monitoring programs to help us understand individual species needs and ultimately employ techniques to promote the long-term survival of sensitive species where they are threatened by human developments. We currently have the

foundation to propose recommendations to alleviate identified potential impacts, but what is needed is a long-term commitment to understand the relationship between wildlife and hard rock mining activities, which in turn would prove beneficial for the wildlife resource while at the same time allowing development of the land's mineral resources for human needs. No attempt has been made here to discuss feasibility of implementing mitigating or compensating measures. The primary purpose here, therefore, is to point out opportunities which exist to help offset immediate detrimental effects upon wildlife resources of the Mount Vernon mine impact area and provide recommendations for the long-term benefit of wildlife through biological monitoring programs.

We attempt to mitigate wildlife losses because wildlife have intrinsic and extrinsic values. In addition to the obvious monetary value of wildlife, including recreation to hunters, cash income to trappers, guides and those who operate service and supply industries which hunters patronize, there are also scientific, recreational and aesthetic values which as yet we are not able to calculate but which are just as real to those who benefit as are the more obvious cash returns. Information providing equations to calculate the overall value of wildlife by converting each extrinsic and intrinsic value to dollars is being developed and revised, but the spectrum of methods and base from which they are computed vary widely. It is a fact that the monetary returns from all phases of wildlife utilization and enjoyment enrich someone's pocketbook; the cash flow pattern simply has not been worked out. The actual monetary values of wildlife were not estimated during this study but it must be acknowledged that they do exist. A balanced approach is needed to maintain and promote all resource values so that once conflicts are identified, attempts may be made to reduce wildlife losses and improve their chances when future developments occur.

Short-term Management Recommendations

Short-term recommendations are preventative measures which are designed to maintain the status quo or help reduce its decline. They do not promote the long-term well-being of wildlife in an increasingly human-influenced environment. Recommendations are most functionally addressed on a facility-by-facility basis but the total impact of a given development is much greater than the sum of individual impacts. In addition, negative consequences of human activity are disproportionately magnified when more than one development is initiated in a given area (a certainty in the Lake Creek Valley). The measures suggested below are itemized according to specific features,

Utility Corridor

Mass transit facilities could be employed and use mandated, to substantially reduce wildlife-vehicle collisions and poaching pressure. Such systems have been investigated elsewhere and have proved effective.

Shift changes could be scheduled to avoid early morning and late evening wildlife periods (of course, these periods will change seasonally).

A maximum speed limit should be imposed on haul roads and warning signs posted at areas of regular wildlife use.

Company roads should be limited to official business use.

Wildlife movement at known crossing areas could be facilitated by not creating difficult-to-cross barriers. Snow berms could be broken at key crossings, fences should not be installed and the slurry tailing pipeline could be constructed high enough to allow passage beneath of the tallest wildlife or low enough to allow crossing over by young.

Clearing of vegetation should be kept to a minimum along the right-of-way, which would facilitate movement across the corridor.

Necessary vegetation clearing should not employ the use of herbicides which introduce toxins into the environment and which could have broader consequences for all wildlife forms because their use would be commensurate with the Stanley Creek water course and associated riparian zone.

Road margins could be seeded with unpalatable native vegetative species which would reduce wildlife use of roadsides for feeding purposes.

A ban on firearms could be imposed on company property to discourage poaching and legal hunting pressure upon wildlife which would otherwise add to the stress already imposed by facility structures and the presence of humans.

Mine Site and Tailing Impoundment

Garbage disposal facilities could be constructed and operated to discourage use by bears and other wildlife.

The tailing impoundment could be constructed to discourage its use by all birds (particularly waterfowl and shorebirds) by not planting shrubs or trees in the immediate area of the impoundment banks.

Parking facilities could be designed to use as little ground as possible by promoting efficient parking patterns.

Boundaries could be established around mine and tailing sites (either actual in the form of fences or technically on paper and enforced by the project manager) within which all human activities would be confined and thus reduce the tendency of development to sprawl and encroach further upon wildlife habitat.

Expanding Human Population

The use of all-terrain vehicles could be confined to areas specifically set aside for their use.

Educational campaigns could be launched to inform the general public, contractors and employees associated with the mine about the requirements of wildlife, thus promoting a personal interest and pride in their resource and avoiding unnecessary damaging activities (importance of snags for cavity nesters, harassment and attrition of wildlife emanating from free-ranging domestic animals, harmful construction side effects).

Private land could be zoned to acknowledge wildlife needs (wintering areas, traditional parturition sites).

Wildlife habitat could be optimized in areas not directly affected by mining activities to realize the greatest wildlife return possible from those areas.

Areas of important wildlife use which occur on private lands could be purchased to permanently ensure wildlife needs at those sites.

A sincere integrated approach to land use allocations throughout the valley could be taken through cooperation commitments from resource management agencies.

There are undoubtedly other temporal, spatial or operational measures which might be implemented but knowledge of these measures may only come to light if there is an opportunity to identify them through a long-term commitment to understanding particularly vulnerable species needs.

Long-term Management Recommendations

The purpose in implementing biological monitoring programs is to actually benefit wildlife through an understanding of their needs which otherwise would not have been discovered. Long-term biological monitoring would not be

necessary if an area of development were eventually allowed to revert back to a natural state, but that circumstance will never occur in this era of intensive technology and ever increasing demands for natural resources. So, the only way in which we can hope to benefit or even sustain our wildlife resources is to also become technology intensive, so that wildlife may exist in association with human developments.

Key wildlife species on the West Cabinet Mountains-Lake Creek Valley study area are mountain goat, osprey, moose, mountain lion and mountain bluebird. Comprehensive monitoring programs could be developed for each. Any monitoring program would establish set techniques and time periods with which and during which monitoring would be carried out. Such programs are cost and energy effective because baseline information has already been collected and informational needs have been identified.

The Montana Department of Fish, Wildlife and Parks is charged with collecting quantitative wildlife information which it in turn must provide to State agencies responsible for making the decisions to issue various permits to developers. Time, finances and effort will, in the long-run, be conserved if the Department is encouraged to follow through on a project to answer the impact questions and develop pertinent measures which will reduce or avoid conflicts with future developments. The Mount Vernon mine is only one large mine being developed in Montana today; there will be other mines of the same or larger magnitude planned for tomorrow. If we do not answer the questions which have been raised during this development we will find it necessary to address the same questions when the next development gets underway -- again without concrete answers. It is senseless to exploit one natural resource at the expense of another when care and wise management decisions could produce benefits from both.

LITERATURE CITED

- Aldrich, J. W. 1963. Geographic orientation of American Tetraonidae. J. Wildl. Mgmt. 27:529-545.
- Allen, E. O. 1971. White-tailed deer. Pp. 69-79. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Fish and Game Dept. Fed. Aid Proj. W-3-C.
- Beer, J. 1943. Food habits of the blue grouse. J. Wildl. Mgmt. 7:32-44.
- Bendell, J. F. and P. W. Elliott. 1967. Behavior and the regulation of numbers in blue grouse. CWS Rpt. Ser. No. 4. 76p.
- Blanchard, V. personal communication. Trapper and resident of Troy, Montana.
- Brandborg, S. M. 1955. Life history and management of the mountain goat in Idaho. Idaho Dept. Fish and Game, Wildl. Bull. 2. 142p.
- Brown, G. personal communication. Montana Dept. Fish, Wildlife and Parks Region One wildlife biologist.
- Burrell, H. personal communication. Mont. Dept. Fish, Wildlife and Parks Region One game warden.
- Calhoun, J. B. (Ed.) 1956. 1951 annual report -- North American census of small mammals; Population dynamics of vertebrates, Compilations of research data. Administrative pub. Release No. 5, U.S. Dept. H.E. and W., Inst. Mental Health, Bethesda 4, Md.
- Casebeer, R. L., M. J. Rognrud and S. M. Brandborg. 1950. Rocky mountain goat in Montana. Fed. Aid Proj. Bull. No. 5. 107p.
- Cloin, D. personal communication. Trapper and resident of Libby, Montana.
- Cole, G. F. 1960. Key browse survey method. Proc. Ann. Conf. Western Assoc. State Game and Fish Comm. 39:181-186.
- Dahl, B. personal communication. Kootenai National Forest Troy District Ranger.

- Dorney, R. S., D. R. Thompson, J. B. Hale, and R. F. Wendt. 1958. An evaluation of ruffed grouse drumming counts. J. Wildl. Mgmt. 22:35-40.
- Dzubin, A. 1969. Assessing breeding populations of ducks by ground counts. Pp. 178-230 In: Saskatchewan wetland seminar. CWS Rpt. Ser. No. 6. Dept. of Indian Affairs and Northern Dev., Ottawa.
- Egan, J. L. 1971. Mule deer. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Fish and Game Dept. Fed. Aid Proj. W-3-C.
- Erickson, A. W. 1977. Cabinet Mountains grizzly bear management study. U.S.D.A. Forest Service Contract No. 730-14-76. Kootenai National Forest. 26p.
- Errington, P. L. 1963. Muskrat populations. Iowa State Univ. Press, Ames, Iowa. 665p.
- Flath, D. L. 1977. Montana nongame species of special interest or concern. Montana Dept. of Fish and Game. Helena, Montana.
- _____. personal communication. Montana Dept. Fish, Wildlife and Parks nongame biologist.
- Geist, V. 1971. Mountain sheep - a study in behavior and evolution. Univ. of Chicago Press. Chicago and London. 383p.
- Greer, K. 1976. Field record for captured lion. Montana Dept. of Fish and Game. Research Lab. Bozeman, MT
- Greer, K. and V. Craig. 1971. Bear hunting in Montana. Montana Fish and Game Dept. Helena, Montana. 7p.
- Gullion, G. W. 1967. The ruffed grouse in northern Minnesota. Univ. of Minn. 20p.
- _____. 1969. Aspen-ruffed grouse relationships. Abstract of paper presented at 31st Midwest Wildlife Conference. St. Paul, Minnesota.
- _____. 1977. Forest manipulation for ruffed grouse. Misc. Journal. Ser. Paper No. 1651. Minnesota Agriculture Experiment Station. St. Paul, Minnesota.
- Hoffman, R. S. and D. L. Pattie. 1968. A guide to Montana mammals: identification, habitat, distribution and abundance. Univ. of Montana Forest and Conservation Experiment Station. Univ. of Montana. Missoula, MT.

- Hornocker, M. G. 1970. An analysis of mountain lion predation upon mule deer and elk in the Idaho primitive area. Wildl. Monogr. No. 21. 39p.
- Hudson, T. R. 1977. Hard rock mining: modern industry under an ancient law. Natural Resources Council of America. Washington, D.C. 102p.
- Jackman, S. M. and J. M. Scott. 1975. Literature review of 23 selected forest birds of the Pacific Northwest. Region 6 U.S.D.A. Forest Service. 382p.
- Johns, W. M. 1970. Geology and mineral deposits of Lincoln and Flathead Counties, Montana. Bureau of Mines and Geology. Bull. 79. 182p.
- Johnsgard, P. A. 1973. Grouse and quail of North America. Univ. of Nebraska Press. Lincoln. 553p.
- Johnson, D. R. and W. E. Mequist. 1973. Unique, rare and endangered raptorial birds of northern Idaho -- Nesting success and management recommendations. Univ. of Idaho U.S.D.A. Forest Service Publ, No. R1-73-021. 42p.
- Jonkel, C. J. Border Grizzly Project Annual report. School of Forestry, Univ. of Montana. Missoula. 111p.
- Jorgensen, H. E., J. G. Miller and L. Eddleman. 1977. Evaluation and development of range survey concepts, methods and criteria. Job Proj. Rept. Fed. Aid Proj. W-120-R08. Montana Dept. of Fish and Game. 12p.
- Joslin, G. L. 1975. Behavior and environmental selection by elk (*Cervus canadensis nelsoni*) during summer and fall in the First and Second Yellow Mule drainages, Madison County, Montana. M.S. Thesis Montana State Univ., Bozeman. 65p.
- _____ and G. Brown. 1978. Capture and reintroduction of a mountain lion kitten. Montana Dept. of Fish and Game. In house report. 7p.
- Klimstra, W. D., S. G. Martin, R. T. Moore, J. J. Skinner, R. G. Streeter, J. Tate, Jr. and T. L. Terrel. 1979. Energy mining impacts and wildlife management: which way to turn. Presented at: 1979 North American Wildlife and Natural Resources Conf., Toronto, Ontario. 47 p.
- KNF 1977. Kootenai National Forest Bull Lake-Napolean Planning Unit mailer. 43p.
- _____. 1978. Kootenai National Forest Keeler Planning Unit. 98p.
- Knocke, K. personal communication. Mont. Dept. of Fish, Wildlife and Parks Region One wildlife biologist.

- Kuck, L. 1977. The impacts of hunting on Idaho's Pahsimeroi Mountains goat herd. First International Mountain Goat Symposium. Idaho Dept. of Fish and Game. Pp. 114-125.
- Lentfer, J. N. 1955. A two-year study of the Rocky Mountain goat in the Crazy Mountains, Montana. J. Wildl. Mgmt. 19(4):417-429.
- Mackie, R. J. and T. N. Lonner. 1977. Evaluation and effectiveness of the key browse survey method. Annual Wyoming Shrub Ecology Workshop. Buffalo.
- MDSL/KNF 1978. Montana Department of State Lands and Kootenai National Forest Draft Environmental Impact Statement. Proposed plan of mining and reclamation Troy Project ASARCO INC. Lincoln Co., Montana. Vol. 1. 458p.
- Mealey, S. P. 1977. Method for determining grizzly bear habitat quality and estimating consequences of impacts on grizzly bear habitat quality. Final Draft. U.S. Forest Service. Region One. 36p.
- Mink, L. L., R. E. Williams, and A. T. Wallace. 1971. Effects of industrial and domestic effluents on the water quality of the Coeur d'Alene Basin. Idaho Bur. Mines and Geol., Pamphlet 149. 102p.
- Mitchell, J., K. Greer and R. Weckwerth. 1971. Furbearers. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Fish and Game Dept. Fed. Aid Proj. W-3-C.
- Mussehl, T. W. 1960. Blue grouse production, movements and populations in the Bridger Mountains, Montana. J. Wildl. Mgmt. 24:60-68.
- _____, P. Schladweiler and R. Weckwerth. 1971. Forest Grouse. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Dept. of Fish and Game Fed. Aid Proj. W-3-C.
- NPRC 1978. Northern Plains Resource Council. Hard rock minerals policy: recommendations for replacing the General Mining Law of 1872. NPRC Publication.
- Olson-Elliott & Associates. 1977. Grizzly bear habitat study. U.S. Forest Service Kootenai National Forest Contract 262-50.
- Petraborg, W.H., E. G. White and V. E. Gunvalson. 1953. Roadside drumming counts a spring census method for ruffed grouse. J. Wildl. Mgmt. 17(3):292-295.

- Pfister, R. D., B. L. Kovalchik, S. F. Arno and R. C. Presby. 1977. Forest habitat types of Montana. Intermountain Forest and Range Experiment Station. Forest Service, U.S. Dept. of Agriculture, Ogden, Utah. 174p.
- Power, H. W. 1966. Biology of the mountain bluebird in Montana. Condor 68(4):351-371.
- RAB and F&WB 1979. Resources Analysis Branch (Ministry of the Environment) and Fish and Wildlife Branch (Ministry of Recreation and Conservation). Wildlife resources of the northeast coal study area 1976-1977. RAB Bull. 6. A technical supplement to the northeast coal study preliminary environmental report on proposed transportation links and townsites. 59p.
- Robbins, C. S., B. Brunn, and H. S. Zim. 1966. Birds of North America. Western Publishing Co. Inc. New York. 340p.
- Rognrud, M. and R. Janson. 1971. Elk. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Fish and Game Dept. Fed. Aid Proj. W-3-C.
- Ruediger, W. C. 1977. Inventory data - Bull Lake Planning Unit. Kootenai National Forest.
- _____. personal communication. Kootenai National Forest wildlife biologist.
- SEAM 1977. Surface Environment and Mining. Anatomy of a mine from prospect to production. General Technical Rept. INT-35. U.S.D.A. Forest Service Intermountain Forest and Range Experiment Station. Ogden, Utah. 69p.
- Sheridan, D. 1977. Hard rock mining on the public land. Council of Environmental Quality. U.S. Government Printing Office, Washington, D.C. 37p.
- Skaar, P. D. 1975. Montana bird distribution. P. D. Skaar. Bozeman, Mt. 56p.
- Stearns-Roger, Inc. 1975. Environmental baseline information of the Mount Vernon Region, Montana, for American Smelting and Refining Company. Denver, Colorado.
- Stebbins, R. C. 1954. Amphibians and reptiles of western North America. McGraw-Hill Book Co., New York. 536p.
- _____. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. 279p.

- Stevens, D. R. 1971. Shiras Moose. In: T. W. Mussehl and F. W. Howell (Eds.) Game Management in Montana. Montana Fish and Game Dept. Fed. Aid Proj. W-3-C.
- Thompson, L. S. 1977. Wildlife and land use change -- some considerations in assessing impact risk. Western Wild-lands Spring 1977. Pp. 19-24.
- Tisch, E. L. 1961. Seasonal food habits of the black bear in the Whitefish Range of Northwestern Montana. M.S. Thesis Montana State Univ., Missoula, Mt. 108p.
- Vance, E. personal communication. Cooperator in Montana Dept. of Fish, Wildlife and Parks mountain lion tagging program; houndsman and resident of Troy, Montana.
- Wright, P. D. 1976. Montana mammals. Montana Dept. of Fish and Game. 6p.
- Zwicker, F. D., I. O. Bass and J. H. Brigham. 1968. Autumn movements of blue grouse and their relevance to populations and management. J. Wildl. Mgmt. 32:456-468.

A P P E N D I X

Appendix 1. Browse transect information collected on redstem ceanothus (*Ceanothus sanguineus*) 1977

Transect Location	Habitat Type	Avg. Percent Leader Use	Hedging (percent)		Age Class % (resprout)		Pellet Groups	
			Little	Mod. Severe	Young	Mature	Deer	Elk
NW $\frac{1}{4}$ NW $\frac{1}{4}$ S18 T30N R33W Copper-Iron Creek Road (#384) 2.7Km N of Road Jct. 384 and 404. 38m W of Road N 40° from point of beginning.	PSME/PHMA	40	8	92	4	64(32)	32(24)	0 0
NW $\frac{1}{4}$ NW $\frac{1}{4}$ S12 T29N R34W Keeler Mtn. Road 1.1Km from Spar Lake Road. 9.75m W of road edge. S 15° W from point of beginning.	TSHE/CLUN	22	8	92	-	88	12	1 1
NE $\frac{1}{4}$ NE $\frac{1}{4}$ S8 T28N R33W Ross Creek Road 1.0Km from Ross Creek Bridge. 15.25m N of road edge. N 75° W from point of beginning	TSHE/CLUN	25	-	100	4	92	4	7 1

Appendix 2. Moose, elk, mule deer and white-tailed deer - summary of habitat type and seasonal use 1977-1978.

Habitat Type	MOOSE				ELK				MULE DEER				WHITE-TAILED DEER									
	Spr ¹	Sum	Fall	Wnt	Tot ²	%	Spr	Sum	Fall	Wnt	Tot	%	Spr	Sum	Fall	Wnt	Tot	%				
TSHE-THPL Series																						
THPL/OPHO	100		42	8	53		16	1	100	16	8	8	4	4	7	93	87	71	83	1	1	
TSHE/CLUN												69	18	42					10	8		
THPL/CLUN																						
ABGR Series																						
ABGR/CLUN																			3	3		
ABLA Series							28	5		9	5	10	4	4								
ABLA/CLUN							6			9	5	4	2	2								
ABLA/NEFE								74	100	119	61	11	24	15	16				1	1		
ABLA/CACA								8		10	5	10	4	4								
ABLA/XETE								3		4	2	2	14	10	11							
ABLA/LUHI								9		12	6	4	24	12	13							
PSME Series																						
PSME/PHMA			58	7	47		50			16	8								1	1		
PSME/VAGL												2		1	13	29	4	3				
PSME/LIHO																			2	2		
PSME/CARU																			5	4		
PSME/ARUV																			9	7		
TOTAL ²	3		12	15			32	129	24	10	195	48	42	3	1	94		86	14	15	7	119

¹ Percentage of observations recorded during spring.

² Total of observations in each category.

Appendix 3. Moose, elk, mule deer and white-tailed deer - summary of elevation and seasonal use 1977-1978.

Elevation ¹	MOOSE				ELK				MULE DEER				WHITE-TAILED DEER							
	Spr ²	Sum	Fall	Wnt	Tot ³	%	Spr	Sum	Fall	Wnt	Tot	%	Spr	Sum	Fall	Wnt	Tot	%		
610- 760	67		8	3	20	3			40	5	3	13	6	6	78	64	7	86	81	68
761- 910		33				6			30	5	3	35	17	18	17	14	53	14	25	21
911-1060		59	4	27					10	1	1	17	7	11	12	4	14	20	8	7
1061-1220	33			1	6	56			20	20	10	6	10	100	8	9	8	20	4	3
1221-1370												8		4	4					
1371-1520							13	8		14	7	6	5	5	5	1			1	1
1521-1680							22	61	25	92	47	13	19	100	17	18				
1681-1830								28	75	54	27	2	40	18	19					
1831-1980								3		4	2	19	8	9						
TOTAL ³	3		12	15		32	129	24	10	195	48	42	3	1	94	83	14	15	7	119

¹ Intervals span approximately 150 to 160m. 610m = 2,000 feet and 1,980m = 6,500 feet.

² Percent of observations recorded during spring.

³ Total observations in each category.

Appendix 4. Moose, elk, mule deer and white-tailed deer - summary of aspect and seasonal use 1977-1978.

Aspect	MOOSE						ELK						MULE DEER						WHITE-TAILED DEER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	Spr. ¹			Tot. ²			%			Spr			Fall			Wnt			Tot			%			Spr			Fall			Wnt			Tot			%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

¹ Percent of observations recorded during spring.

² Total observations in each category.

Appendix 5. Moose, elk, mule deer and white-tailed deer - summary of topography, configuration and seasonal use 1977-1978.

Topography	MOOSE				ELK				MULE DEER				WHITE-TAILED DEER					
	Spr ¹	Sum	Fall	Wnt	Tot ²	%	Spr	Sum	Fall	Wnt	Tot	%	Spr	Sum	Fall	Wnt	Tot	%
Ridge								6			7	4	2	6			3	3
Upper Slope							6	5	76		26	13	4	28	61		20	21
Mid Slope	33		92	12	80		84	34		40	77	39	38	53	33	100	40	43
Lower Slope							4	18			25	13	31	3		16	17	29
Bench Flat							6	2	12	60	12	6	25			12	13	64
Creek Bottom	67		8	3	20		35	12		48	25		10			3	3	21
TOTAL ²	3		12	15			32	129	24	10	195		48	42	3	1	94	83
Configuration																		
Convex	33			1	7		16				5	3	4			2	2	
Straight			75	9	60		19	15	8	28	14		29	60	33	100	42	45
Concave	33		8	2	13		34	63			91	47		6		2	2	1
Undulating	34		17	3	20		31	22	92	10	71	36	67	34	67	48	51	39
TOTAL ²	3		12	15			32	129	24	10	195		48	42	3	1	94	83

¹ Percent of observations recorded during spring.

² Total observations in each category.

Appendix 6. Moose, elk, mule deer and white-tailed deer - summary of distances from cover and nearest road and seasonal use 1977-1978.

Distance to Cover	MOOSE					ELK					MULE DEER					WHITE-TAILED DEER									
	Spr ¹	Sum	Fall	Wnt	Tot ²	%	Spr	Sum	Fall	Wnt	Tot	%	Spr	Sum	Fall	Wnt	Tot	%	Spr	Sum	Fall	Wnt	Tot	%	
0- 10m	67		41	7	47	34	96	8	60	143	73	96	67	33	75	80	66	71	100	29	82	69			
10- 50m		25		3	20	62	3	17		28	14	2	25	67	100	14	15	24	14	71	27	23			
50-100m						1	75		19	10		2			1	1	5			4	3				
100-200m	33		17	3	20							2			1	1	4	14		5	4				
Over 200m		17	2	13	4		40	5	3		2	4		3	3	1				1	1				
TOTAL ²	3	12	15		32	129	24	10	195		48	42	3	1	94	83	14	15	7	119					
Distance from Road																									
0- 10m	67		41	7	47	19			6	3	81	24		49	52	68	86	27	86	78	66				
10- 50m		25		3	20	6			2	1						20				17	14				
50-100m																2				2	2				
100-200m	33		17	3	20				40	4	2					6		7		6	5				
Over 200m		17	2	13	4	75	100	100	60	183	94	19	76	100	100	45	48	4	14	66	14	16	13		
TOTAL ²	3	12	15		32	129	24	10	195		48	42	3	1	94	83	14	15	7	119					

¹ Percent of observations recorded during spring.

² Total observations in each category.

Appendix 7. Moose observations recorded during 1977 and 1978.

DATE	COMPOSITION	LOCATION N S T R	AREA	SITE DESCRIPTION	ELEVATION	ASPECT ²	TOPOG ³	CONFIG ⁴	D-COVER ⁵	D-ROAD ⁵
5-13	1U ⁶	NE 17 29N 34W	Stanley Creek	TSHE/CLUN	1190	4	3	4	1	1
6-10	1M ⁶	NE 29 29N 33W	Bull Lake	TSHE/CLUN, marsh	730	9	5	1	4	3
1- 8	2M	SW SW 1 29N 34W	Keeler Mountain	TSHE/CLUN	1005	5	3	4	4	4
1-23	1F	NE 17 30N 33W	Highway 202	TSHE/CLUN	747	9	5	2	1	5
2-13	3A, 1C	SE 12 30N 34W	Copper Mountain	PSME/PHMA	792	5	3	2	1	5
2-13	2A	SW 24 29N 34W	Stanley Creek	TSHE/CLUN	914	3	3	2	5	5
3- 1	2A	SW 1 30N 34W	Copper Mountain	PSME/PHMA, burn	914	6	3	2	2	5
3-11	1A	NE 12 30N 34W	Copper Mountain	PSME/PHMA, burn	944	3	3	3	2	5
5-22	1F	NE 6 29N 33W	Camp Creek	TSHE/CLUN, meadow	701	6	6	3	1	5

1 Observations are abbreviated as follows: U = unclassified, M = male, F = female, C = calf and A = unclassified adult.

2 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.

3 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.

4 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.

5 Distance to cover and distance from road coded as follows: 1 = 0-10m, 2 = 10-50m, 3 = 50-100m, 4 = 100-200m and 5 = >200m.

6 Provided by personnel of Olson-Elliott & Associates, Helena, Montana.

Appendix 8. Elk observations recorded during 1977 and 1978.

DATE	COMPO- SITION ¹	LOCATION			AREA	SITE DESCRIPTION	SLOPE ²	ELEVATION	ASPECT ³	TOPOG ⁴	CONFIG- URATION ⁵	D-COVER ⁶	D-ROAD ⁶
		$\frac{1}{4}$	$\frac{1}{4}$	S T R									
4-18	2M	NE	NW	24 29N 34W	Stanley Cr. Rd.	TSHE/CLUN edge road	< 10	820	1	5	2	1	1
4-20	3A ⁷	SW	SW	30 30N 33W	Keeler Mountain	PSME/PHMA broken timber	25-50	1100	3	3	1	1	5
4-28	2A	SW	SW	30 30N 33W	Keeler Mountain	PSME/PHMA broken timber	25-50	1100	3	3	1	1	5
5-13	2M	SW	NW	36 30N 34W	Keeler Mountain	ABLA/CLUN grassy sidehill	10-25	1490	7	2	3	1	2
6-10	2F ⁷	NE 22 28N 34W			S. Fork Ross Cr.	ABLA Series, meadows	10-25	1460	3	3	4	1	5
6-16	1F	SW	NE	5 29N 33W	Dry Creek	TSHE/CLUN, clearcut, bog	10-25	730	9	4	4	5	5
6-18	4F3C	NW	NW	33 28N 34W	E. Fork Blue Cr.	ABLA Series, open	25-50	1580	5	3	4	2	5
7-19	5M	SE	NW	4 28N 34W	Spar Peak	ABLA/LUHI, shrubs	> 50	1830	5	3	4	1	5
7-24	1A	NW	NW	27 28N 34W	Sawtooth Mountain	ABLA/MEFE	> 50	1770	3	3	4	1	5
7-25	1U	NW	NW	34 28N 34W	S. Fork Ross Cr.	ABLA/CACA	< 10	1580	1	2	4	2	5
8-1	1M7F5C	SE	SE	7 28N 34W	W. Fork Blue Cr.	ABLA/MEFE	10-25	1830	7	3	4	1	5
8-2	1F	SE	SE	7 28N 34W	W. Fork Blue Cr.	ABLA/MEFE	> 50	1800	7	2	4	1	5
8-12	1U	SE	NW	18 29N 33W	Stanley Mountain	TSHE/CLUN	10-25	820	2	3	4	1	5
9-2	1M	SE	SW	28 28N 34W	E. Fork Blue Cr.	ABLA/XETE, pass	< 10	1800	4	1	3	1	5
9-2	2M6F1C	NW	SE	28 28N 34W	M. Fork Ross Cr.	ABLA/CACA, bog	10-25	1650	1	6	3	1	5
9-9	1M	NE	NE	15 56N 3E	Scotchman No. 2	ABLA/LUHI, talus	25-50	1920	3	2	2	2	5
9-9	2F1C	NW	NW	28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, timbered	10-25	1800	8	1	3	1	5

Table 8. (continued)

9-9	6M13F5C	NW SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, timbered	10-25	1680	1	4	3	1	5
9-9	1M	SW SW 9 28N 34W	N. Fork Ross Cr.	ABLA/LUHI, sidehill park	25-50	1860	1	2	2	1	5
9-9	2M1F	NW NE 16 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, timbered	25-50	1680	4	3	2	1	5
9-9	1A1F1C	NE NE 16 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, timbered	25-50	1680	6	3	2	1	5
9-15	1M2F1C	NW SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy, wet	10-25	1550	1	6	3	1	5
9-15	3A4U	SE SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	25-50	1680	7	3	3	1	5
9-15	3U	NW SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	< 10	1550	1	6	3	1	5
9-15	1F	NW NW 33 28N 34W	E. Fork Blue Cr.	ABLA/XETE, rocky	10-25	1800	4	1	3	1	5
9-27	1M4U3C	SE NE 8 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	10-25	1830	6	3	2	1	5
9-27	9M1F	SW SE 8 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	< 10	1650	4	6	3	1	5
9-27	2M	SW SW 9 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	< 10	1650	4	6	3	1	5
9-27	1M4F	NW NW 16 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	< 10	1650	4	6	3	1	5
9-27	1M	SE SE 20 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	10-25	1524	3	3	3	1	5
9-27	1A2F	NW NW 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, brushy	< 10	1490	2	6	5	1	5
9-27	1M2F	NW SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, creek	< 10	1520	2	6	3	1	5
9-27	1U	NW SE 28 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, creek	< 10	1520	2	6	3	1	5
9-27	2F	SE NW 3 28N 34W	N. Fork Ross Cr.	ABLA/CLUN	< 10	1490	3	6	3	1	5
10-11	1M1F	SE SE 20 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, shrubs timber	10-25	1555	3	5	2	1	5
10-27	4M5F9U	SW 8 28N 34W	M. Fork Ross Cr.	ABLA/MEFE	10-25	1706	2	2	4	3	5
10-27	1M	SW 8 28N 34W	M. Fork Ross Cr.	ABLA/MEFE, shrubs timber	10-25	1646	4	5	4	2	5

Table 8. (continued)

10-27	3M	NW 16 28N 34W	M. Fork Ross Cr.	ABLA/MEFE	10-25	1585	3	6	4	2	5
1-18	2F2C	NE 5 29N 33W	Camp Creek	TSHE/CLUN, clearcut	10	747	9	5	4	5	5
2-13	2U	SE 1 29N 34W	Keeler Mountain	TSHE/CLUN, timber	20-25	1219	4	3	4	1	5
3-6	2M1U	SW 32 29N 33W	Bull Lake	TSHE/CLUN, shrubs, timber	25-50	853	3	3	4	1	5
3-10	1A	NW 32 29N 33W	Bull Lake	TSHE/CLUN, timber	25-50	1005	2	3	4	1	5
4-24	1M8U	NE 1 28N 34W	Ross Creek	PSME/PHMA	25-50	1219	4	3	3	2	5
5-22	2A	NE 11 28N 34W	N. Fk. Ross Creek	PSME/PHMA	25-50	1219	6	3	2	2	1
5-22	2A	NW 12 28N 34W	N. Fk. Ross Creek	TSHE/CLUN	25-50	1097	4	3	2	2	1
7-12	3U	8 28N 34W	M. Fk. Ross Creek	ABLA/CLUN	10	1707	3	5	4	1	5
7-12	2U	8 28N 34W	M. Fk. Ross Creek	ABLA/CLUN	10-25	1890	5	1	4	2	5
7-14	2A	28 28N 34W	M. Fk. Ross Creek	ABLA/CLUN	10-25	1524	3	6	4	1	5
7-14	2A	8 28N 34W	M. Fk. Ross Creek	ABLA/XETE	10-25	1668	5	3	2	1	5
7-14	1A	21 28N 34W	M. Fk. Ross Creek	ABLA/MEFE	10	1585	2	6	3	3	5
7-14	2A	9 28N 34W	N. Fk. Ross Creek	ABLA/CLUN	25-50	1646	2	2	2	1	1

1 Composition abbreviations as follows: U = unclassified elk, A = unclassified adult, M = male, F = female and C = calf.

2 Slope in degrees.

3 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.

4 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.

5 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.

6 Distance to cover and distance to road coded as follows in meters: 1 = 0-10, 2 = 10-50, 3 = 50-100, 4 = 100-200 and 5 = >200.

7 Reported by personnel of Olson-Elliott & Associates, Helena Montana.

Appendix 9. Mule deer observations recorded during 1977 and 1978.

DATE	COMPOSITION ¹	LOCATION			AREA	HABITAT TYPE	ELEVATION	ASPECT ²	TOPOG ³	CONFIG- URATION ⁴	D-COVER ⁵	D-COVER ⁵
		¼	¼	S T R								
4-21	4F	SE	SW	6 28N 33W	Ross Creek	TSHE/CLUN	870	4	3	4	1	1
4-27	1F	NE	SE	23 30N 34W	N. Fork Keeler Creek	TSHE/CLUN	790	4	4	4	1	1
5-1	2F	NW	SE	18 30N 33W	Lake-Keeler Cr. Road	TSHE/CLUN	730	3	5	4	1	1
5-1	2F	NW	NW	25 29N 34W	Mount Vernon Road	TSHE/CLUN	1036	2	3	4	1	1
5-6	4M	NE	SW	13 29N 34W	Stanley Creek	THPL/OPHO	850	1	5	2	1	1
5-6	2F	NW	SW	24 29N 34W	Stanley Creek	TSHE/CLUN	1010	1	5	4	1	1
5-8	3F	NW	SE	32 31N 33W	Lake Creek Road	TSHE/CLUN	700	7	4	4	1	1
5-8	1F	NW	NW	7 29N 33W	Stanley Creek	TSHE/CLUN	760	4	4	4	1	1
5-15	1F1FN ⁶	SE	NW	13 29N 34W	Stanley Creek	TSHE/CLUN	950	7	3	4	1	1
5-15	1F1FN ⁶	NE	NW	24 29N 34W	Stanley Creek	TSHE/CLUN	1010	7	3	4	1	1
5-15	1F1FN ⁶	NW	NW	25 29N 34W	Stanley Creek	TSHE/CLUN	1160	8	4	4	1	1
5-15	1F1FN ⁶	NE	NW	35 29N 34W	Stanley Creek	TSHE/CLUN	1370	8	4	4	1	1
5-16	1M2F	NW	NW	8 28N 33W	Ross Creek	TSHE/CLUN	880	5	4	4	1	1
5-25	3F	SE	NE	23 30N 34W	N. Fork Keeler Creek	TSHE/CLUN	890	4	4	2	1	1
5-25	1M	SW	SW	36 29N 34W	Mount Vernon	ABLA/LUHI	1520	9	1	1	1	5
6-3	1F	NE	SW	34 29N 34W	Mount Vernon	ABLA/LUHI	1710	5	2	4	2	5
6-4	1F	SW	SW	31 29N 33W	Ross Creek	ABLA/XETE	1370	3	3	4	1	1

Appendix 9. (continued)

6-4	1F	NW NW 25	29N 34W	Stanley Creek	TSHE/CLUN	1010	2	3	4	1	1
6-5	1M	SW SW 5	28N 33W	Ross Creek-Mount Vernon	ABLA/CLUN	1100	5	3	2	1	1
6-11	1F	NW NW 24	29N 34W	Stanley Creek	TSHE/CLUN	1010	3	3	1	1	1
6-15	1U	SE SE 25	29N 34W	Mount Vernon	TSHE/CLUN	1400	2	3	2	1	5
6-18	3F1M	SW SW 27	28N 34W	S. Fork Ross Creek	ABLA/MEFE	1650	9	5	2	1	5
6-20	1M	NE NE 9	28N 34W	N. Fork Ross Creek	ABLA/MEFE	1680	3	3	4	1	5
7-20	1F	NE NW 6	28N 33W	Mount Vernon	TSHE/CLUN	1400	5	3	4	3	1
7-24	1M	NE NW 34	28N 34W	S. Fork Ross Creek	ABLA/MEFE	1590	2	3	4	5	5
8-1	1F	NW SE 6	28N 34W	Spar Peak	ABLA/LUHI	1800	7	2	4	1	5
8-2	1M	SE SE 5	28N 34W	Mid Fork Ross Creek	ABLA/XETE	1830	5	3	2	4	5
8-2	1F	SW 1	28N 35W	W. Fork Blue Creek	ABLA/MEFE	1830	3	3	3	1	5
8-3	1M	NW SW 5	28N 34W	Spar Creek	ABLA/XETE	1710	3	3	4	1	5
8-9	1F1FN	NE SW 34	30N 34W	Main Keeler Creek	ABLA/MEFE	1640	5	3	2	1	5
8-12	2F	SW SW 24	29N 34W	Stanley Creek	TSHE/CLUN	1010	3	3	4	1	1
8-12	1F	SW SW 24	29N 34W	Stanley Creek	TSHE/CLUN	1010	3	3	4	1	1
8-16	1F	NW SE 27	28N 34W	S. Fork Ross Creek	ABLA/CACA	1430	1	6	3	2	5
8-17	1F1U	SW SW 27	28N 34W	S. Fork Ross Creek	ABLA/CACA	1650	2	6	4	1	5
8-17	1F	NW NW 34	28N 34W	Sawtooth Mountain	ABLA/LUHI	1830	4	1	4	1	5
8-23	1M	NW 36	29N 34W	Savage Mountain	ABLA/CACA	1830	3	4	4	2	5
9-2	1M	SE NW 29	28N 34W	Mid Fork Ross Creek	ABLA Series	1890	9	1	2	1	5

Appendix 9. (continued)

9-2	1M2U	NW	NW	33	28N	34W	E. Fork Blue Creek	ABLA Series	1890	4	3	2	1	5
9-9	3M1F	NW	NE	4	28N	34W	Spar Peak	ABLA/LUHI	1830	2	2	2	2	5
9-12	2F	NW	SE	26	29N	34W	Mount Vernon	TSHE/CLUN	1220	3	3	2	1	1
9-12	2F	NE	NE	35	29N	34W	Mount Vernon	TSHE/CLUN	1190	1	3	2	1	1
9-15	3M1F	NW	NE	4	28N	34W	Spar Peak	ABLA/LUHI	1830	2	2	2	2	5
10-26	2F	NW	34	29N	34W		Mount Vernon-Spar Peak	ABLA/XETE	1676	2	2	4	2	4
10-29	1U	SE	4	28N	34W		N. Fork Ross Creek	ABLA/XETE	1676	5	3	2	1	5
3-11	1A	NE	5	28N	33W		Spires	TSHE/CLUN	1219	3	3	2	2	5
5-22	1F	SE	9	29N	34W		Stanley Peak Road	TSHE/CLUN	1402	2	3	2	1	1
5-23	1F	NE	6	28N	33W		Mount Vernon	PSME/XETE	1250	4	3	4	1	1
6-19	1M	NW	NW	34	28N	34W	E. Fork Blue Creek	ABLA/CLUN	1585	5	2	4	5	5
7-13	2F	NW	35	29N	34W		Stanley Creek	ABLA/MEFE	1554	1	2	2	1	1
7-13	1F	NW	29	29N	34W		Whoopee Creek	ABLA/XETE	1707	3	2	2	1	5
7-13	1F2M	NW	11	29N	35W		Thunder Creek	ABLA/XETE	1889	6	2	2	1	5
7-13	1M	NW	33	28N	34W		E. Fork Blue Creek	ABLA/MEFE	1859	4	2	2	5	5
7-13	3M	NE	28	28N	34W		Sawtooth Peak	ABLA/MEFE	1646	7	3	4	1	5

1 Observations are abbreviated as follows: U = unclassified, M = male, F = female and FN = fawn.

2 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.

3 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.

4 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.

5 Distance to cover and distance from road coded as follows: 1 = 0-10m, 2 = 10-50m, 3 = 50-100m, 4 = 100-200m and 5 = 200m.

6 Fawns of 1976. Reported by personnel of Olson-Elliott & Associates, Helena, Montana.

Appendix 10. White-tailed deer observations recorded during 1977 and 1978.

DATE	COMPO- SITION ¹	LOCATION				AREA	HABITAT TYPE	ELEVATION ²	ASPECT ³	TOPOG ⁴	CONFIG- URATION ⁵	D-COVER ⁶	D-ROAD ⁶	
		¼	¼	S	T									R
4-8	1U	SE	SE	26	31N	34W	Iron Creek	TSHE/CLUN	790	9	5	2	1	1
4-8	2F	SE	SE	36	31N	34W	Iron Creek	TSHE/CLUN	790	9	5	2	1	1
4-9	1F	NW	SE	19	31N	33W	Highway 2	PSME type 6	610	9	5	2	1	1
4-9	2F	NW	NW	29	31N	33W	Lake Creek Road	PSME/LIBO	730	6	5	2	2	3
4-9	2F	NW	NE	24	30N	34W	Keeler-Lake Creek Road	TSHE/CLUN	730	3	4	2	1	1
4-12	1F	SE	NE	24	30N	34W	N. Fork Keeler Creek	THPL/CLUN	790	4	5	2	1	1
4-21	1F	NW	SW	5	29N	33W	Camp Creek	TSHE/CLUN	670	9	5	2	3	1
4-21	1U		NW	9	28N	33W	Bull Lake-S. end	THPL/CLUN	730	9	5	4	2	1
4-21	3F	NE	NW	28	31N	33W	Bull Lake-Highway 202	PSME/CARU	700	9	5	4	2	1
4-24	2F	SE	SW	13	29N	34W	Stanley Creek Road	TSHE/CLUN	730	9	5	4	2	1
4-24	2F	SE	NW	6	29N	33W	Stanley-Lake Creek Road	TSHE/CLUN	790	9	5	4	1	1
4-25	1F		SW	24	30N	34W	Keeler Creek Road	TSHE/CLUN	760	4	4	2	2	5
5-2	2F	SW	NE	18	30N	33W	Lake-Keeler Creek Road	TSHE/CLUN	730	3	4	2	1	1
5-2	1F		NE	18	30N	33W	Lake-Keeler Creek Road	TSHE/CLUN	730	3	4	2	1	1
5-2	3U	SW	NE	32	30N	33W	Highway 202	TSHE/CLUN	700	9	5	2	4	4
5-3	1F	SW	NE	8	30N	33W	Highway 202	TSHE/CLUN	700	9	5	2	1	1

Appendix 10. (continued)

5-5	1F	NE	NW	13	29N	34W	Stanley Creek	TSHE/CLUN	790	3	4	4	1	1
5-6	2F	SW	SW	19	30N	33W	Stanley Creek	TSHE/CLUN	730	3	3	2	2	2
5-6	2F	NE	SE	13	30N	34W	Keeler Creek Road	TSHE/CLUN	730	3	4	4	1	1
5-6	1U	NE	SW	24	30N	34W	N. Fork Keeler Creek	TSHE/CLUN	730	4	4	2	1	1
5-6	2F	SE	SW	12	29N	34W	Stanley Creek Road	TSHE/CLUN	820	4	4	4	1	1
5-6	2F	NW	NW	28	31N	33W	Schoolhouse Lake	TSHE/CLUN	680	7	5	2	1	1
5-7	4U	NW	NW	19	30N	33W	Lake Creek Road	TSHE/CLUN	700	2	5	2	2	2
5-7	3U	NE	NE	24	30N	34W	Lake-Keeler Creek Road	TSHE/CLUN	730	2	5	4	1	1
5-7	1F	SE	SW	19	30N	33W	Keeler Creek	TSHE/CLUN	720	9	5	2	5	3
5-7	3F	NW	SW	19	30N	33W	Lake Creek Road	TSHE/CLUN	700	2	5	2	2	2
5-13	2F	SE	NW	18	30N	33W	Lake Creek Road	TSHE/CLUN	730	3	5	2	2	2
5-18	1F	NE	NE	8	28N	33W	Ross Creek	TSHE/CLUN	730	3	4	4	1	1
5-25	2U	NW	NW	19	30N	33W	Keeler Creek	TSHE/CLUN	730	3	4	2	1	1
5-29	2U	NW	NW	13	19N	34W	Stanley Creek	TSHE/CLUN	790	4	4	4	1	1
5-29	1U	NE	NW	24	29N	34W	Stanley Creek	TSHE/CLUN	790	4	4	4	1	1
6-6	4M	SW	NE	5	29N	33W	Camp Creek-Highway 202	TSHE/CLUN	700	9	5	4	1	1
6-10	1F	SW	NE	29	30N	33W	Highway 202	TSHE/CLUN	700	9	5	4	1	1
6-18	1F	NW	SE	29	28N	34W	S. Fork Ross Creek	ABLA/MEFE	1390	8	4	4	1	5
7-11	1F	NE	NE	24	30N	34W	Keeler Creek	TSHE/CLUN	760	3	5	4	1	1
7-14	1M	SW	SE	4	28N	33W	Bull Lake-S. end	THPL/OPHO	730	9	5	4	1	1

Appendix 10. (continued)

7-14	1M	NW	NE	25	28N	34W	N. Branch Dry Creek	TSHE/CLUN	1220	1	3	2	1	1
7-25	1M	SE	NE	7	30N	33W	Lake Creek Road	TSHE/CLUN	730	9	5	2	1	1
8-9	1F1FN	SW	SE	30	30N	34W	Keefer Creek	TSHE/CLUN	940	3	6	4	1	1
8-9	1M	SE	SW	7	29N	33W	Stanley-Lake Creek	TSHE/CLUN	700	9	5	2	1	1
9-9	1F	NW	SE	12	29N	34W	Stanley Creek	TSHE/CLUN	760	4	4	4	1	1
9-13	1F1FN	SE	SW	18	30N	34W	Stanley-Keefer Road	TSHE/CLUN	720	9	5	2	1	1
9-13	2M	NE	NW	31	30N	34W	Stanley Creek Road	TSHE/CLUN	730	3	3	4	4	1
10-15	1F2FN	SW	NE	5	29N	33W	Camp Creek	TSHE/CLUN	762	9	5	4	1	1
10-27	2M1F	NE	NE	13	29N	34W	Stanley Mountain	TSHE/CLUN	1158	8	2	2	1	5
11-18	1F	NW	NE	31	30N	31W	Lake Creek	TSHE/CLUN	686	1	6	3	1	5
11-19	1F	NE	NW	8	28N	33W	Ross Creek	TSHE/CLUN	792	5	3	4	1	1
11-19	1F	SE	NW	5	28N	33W	Ross Creek	TSHE/CLUN	914	3	3	2	1	5
11-19	1F	NE	NE	8	29N	33W	Ross Creek	TSHE/CLUN	792	4	3	4	1	4
11-20	2F	NE	SW	7	29N	33W	Stanley Creek	TSHE/CLUN	792	1	4	4	1	5
11-20	1U	NE	SW	7	29N	33W	Stanley Creek	TSHE/CLUN	792	1	4	4	1	5
11-20	1F1U	SE	NW	18	29N	33W	Stanley Mountain	PSME/PHMA	914	5	3	2	1	5
1-5	1M	SE	SE	29	30N	33W	Porcupine Creek	TSHE/CLUN	747	7	4	4	2	1
1-7	1F1FN	SE	NE	30	31N	33W	Lake Creek	PSME/PHMA	640	7	3	2	2	1
1-22	2A	NW	NW	21	30N	33W	Twin Creek	TSHE/CLUN	731	7	4	4	2	1

Appendix 10. (continued)

1-24	1M	NW	31	30N	33W	Keeler Mountain	TSHE/CLUN	731	3	4	4	1	1
3-11	1U	NE	31	31N	33W	Freeman Ridge	TSHE/CLUN	792	6	5	4	1	5
4-25	1F1FN	NW	32	31N	33W	Lake Creek	PSME/ARUV	671	6	5	4	1	1
4-25	1M	SW	19	30N	33W	Keeler Creek	TSHE/CLUN	732	3	4	4	1	1
4-25	1F		19	30N	33W	Keeler Creek	TSHE/CLUN	732	3	5	2	1	1
4-27	2A2U	SW	29	31N	33W	Lake Creek	PSME/ARUV	671	9	2	2	1	2
4-27	1F	NW	32	31N	33W	Lake Creek	PSME/ARUV	671	6	4	3	1	1
4-27	1U	NW	30	30N	33W	Keeler Creek	PSME/ARUV	701	9	5	2	3	2
4-30	4M	NW	9	28N	33W	Ross Creek	THPL/CLUN	686	9	5	2	1	1
5-1	1U	NW	32	31N	33W	Lake Creek	PSME/ARUV	640	9	5	2	2	2
5-11	2U	SW	24	29N	34W	Stanley Creek	THPL/CLUN	823	1	5	2	1	1
5-18	3F	NE	29	30N	34W	Keeler Creek	TSHE/CLUN	914	5	4	4	1	1
5-22	2A	SE	9	28N	33W	Bull River	THPL/CLUN	701	5	5	2	3	4
7-13	2F	NW	12	30N	34W	Copper Creek	TSHE/CLUN	762	4	6	3	2	5

1 Observations are abbreviated as follows: U = unclassified, M = male, F = female and FN = fawn.

2 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.

3 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.

4 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.

5 Distance to cover and distance from road coded as follows: 1 = 0-10m, 2 = 10-50m, 3 = 50-100m, 4 = 100-200m and 5 = >200m.

6 Exact habitat type not determined.

Appendix 11. Mountain goat observations and sign recorded during 1977 and 1978.

DATE	COMPOSITION ¹	LOCATION				AREA	SITE DESCRIPTION	SLOPE ²	ELEVATION	ASPECT ³	TOPOG ⁴	CONFIGURATION ⁵	D-COVER ⁶	D-COVER ⁶
4-12	1A	SE	SW	11	28N	34W	Ross Point	> 50	1220	8	3	2	3	5
4-28	5U,1J	SW	SW	21	28N	34W	Sawtooth Mountain	> 50	1520	7	3	4	1	5
4-28	10U	NW	NE	35	29N	35W	Savage Mountain	> 50	1580	6	3	4	1	5
5-16	1A	NE	NE	28	28N	34W	Sawtooth Mountain	> 50	1920	6	2	4	1	5
5-25	2M,1F	SW	SE	36	29N	34W	Mount Vernon	25-50	1460	4	3	4	1	5
5-25	1A	NE	SE	36	29N	34W	Mount Vernon	> 50	1400	4	3	4	1	5
5-26	Hair	SW	NE	34	29N	34W	Mount Vernon-Spar Peak	10-25	1770	9	1	1	1	5
5-26	Pellets	34&35		29N	34W	Mount Vernon-Spar Peak	ABLA/MEFE, timber	10-25	1770	9	1	1	1	5
5-26	Tracks	NW	SW	35	29N	34W	Mount Vernon-Spar Peak	10-25	1770	9	1	1	1	5
6-3	Tracks	SE	SE	33	29N	34W	Mount Vernon-Spar Peak	10-25	1770	9	1	1	1	5
6-3	2F,2J	NW	SW	33	29N	34W	Mount Vernon-Spar Peak	25-50	1520	2	2	4	1	5
6-3	Tracks	SE	SW	34	29N	34W	Mount Vernon-Spar Peak	25-50	1740	1	1	1	1	5
6-3	Pellets	NE	SE	34	29N	34W	Mount Vernon-Spar Peak	25-50	1770	2	1	1	1	5
6-3	Tracks	NE	SE	34	29N	34W	Mount Vernon-Spar Peak	25-50	1770	2	1	1	1	5
6-3	1A	NW	NE	5	28N	33W	Mount Vernon-Spires	> 50	1440	4	3	4	1	5
6-3	1A	SE	SW	31	29N	33W	Mount Vernon-Spires	> 50	1400	4	3	4	1	5

Appendix 11. (continued)

6-4	1A	SW SW	31	29N	33W	Mount Vernon-Spires	Cliffs, scree	> 50	1400	3	3	4	1	5
6-4	1F,1K	NE SW	31	29N	33W	Mount Vernon-Spires	Base of cliffs, talus	> 50	1220	2	3	4	1	5
6-5	Tracks	NE SW	36	29N	34W	Mount Vernon	ABLA/MEFE, clearcut	10-25	1490	1	3	4	4	1
6-6	1A	SW SW	33	29N	34W	Mount Vernon-Spires	ABLA/MEFE, shrubs, rocks	25-50	1580	1	3	4	2	5
6-6	1A,1U	NE SW	31	29N	34W	Mount Vernon-Spires	Cliffs, scree	> 50	1220	3	3	4	1	5
6-10	2A ⁷	NW NE	5	28N	33W	Mount Vernon	PSME/SYAL, shrubs	> 50	1040	3	3	4	2	1
6-18	Tracks ⁷	27&28	28N	34W		Sawtooth Mountain	Rocky, ABLA hab. type	25-50	1770	3	1	4	-	5
6-19	1A,2F,2K	NW SE	36	29N	34W	Mount Vernon-Spires	TSHE/CLUN timber, cliffs	10-25	1220	2	3	4	1	5
6-20	2F,2K	SW SE	36	29N	34W	Mount Vernon-Spires	PSME/VAGL, open grassy	25-50	1490	3	2	2	2	5
6-20	1A,1F,1K,3U	NE SE	21	28N	34W	Sawtooth Mountain	Sidehill park	25-50	1700	8	3	2	2	5
6-20	1A,1F,1K	NW SE	11	28N	34W	Ross Point	Opening near cliffs, timber	10-25	1280	1	3	2	1	5
7-19	1M	NW NW	4	28N	34W	Spar Peak	ABLA/LUHI rocky, timber	> 50	1830	1	3	4	1	5
7-19	3U,5F,5K	SE SE	25	29N	35W	Savage Mountain	ABLA/LUHI rocky, burn	10-25	1860	4	5	4	1	5
8-1	Hair	NE SE	6	28N	34W	Little Spar Lake	ABLA/XETE timber, rocky	10-25	1700	3	3	4	1	5
8-2	1M,2A	SW	4	28N	34W	Spar Peak	ABLA/LUHI shrubs, timber	> 50	1860	8	2	4	1	5
8-2	1A ⁷	NE NE	15	56N	3E	Scotchman No. 2	ABLA hab. type, basin	> 50	1830	3	3	3	1	5
8-9	1A	SW NE	18	29N	34W	Drift Creek	ABLA hab. type, cliffs	> 50	2020	7	4	4	-	5
8-10	1A	SW NE	18	29N	34W	Drift Creek	ABLA hab. type, cliffs	> 50	2160	7	3	4	-	5
8-17	2A,2F,2K	SW SW	20	28N	34W	Mid Fork Ross Creek	ABLA hab. type, sidehill	> 50	2120	8	3	4	5	5
8-17	3A,2J	NW NE	28	28N	34W	Sawtooth Mountain	Cliffs and ledges	> 50	1890	8	3	4	5	5

Appendix 11. (continued)

8-18	Hair	SW	SW	27	28N	34W	Middle Mountain	Cliffs, shrubs	> 50	1830	2	3	2	3	5
8-18	3A, 1M 2F, 2K	SW	NE	32	28N	34W	W. Fork Blue Creek	Grassy bluffs	> 50	2010	1	3	2	5	5
8-19	1F	SE	NW	5	28N	33W	Mount Vernon-Spires	Scree, on road	25-50	1310	4	3	6	2	1
9-2	1F, 1J	SW	SW	31	29N	34W	Mount Vernon-Spires	PSME hab. type, timber	25-50	1460	4	3	4	1	5
9-2	1M, 1A	NE	NW	4	28N	34W	Spar Peak	ABLA hab. type, rocky	> 50	1830	8	2	4	1	5
9-2	1A	SE	NE	8	28N	34W	Mid Fork Ross Creek	Bare shelf rock	25-50	1890	1	3	4	1	5
9-2	10A, 2J, 2K	SW	SW	28	28N	34W	Mid Fork Ross Creek	ABLA hab. type, ledges	> 50	2100	8	1	1	1	5
9-9	2A, 1F, 1K	SE	NW	29	28N	34W	Mid Fork Ross Creek	Scree, shelf rock	25-50	1770	2	2	2	4	5
9-9	1A, 1J	NW	SE	28	28N	34W	Middle Mountain	Scree, cliffs, timber	> 50	1830	8	3	4	1	5
9-9	1A	SE	NE	28	28N	34W	Sawtooth Mountain	Scree, rocky cliffs, timber	> 50	1830	8	3	4	1	5
9-9	2A	SE	SW	28	28N	34W	Mid Fork Ross Creek	Scree, shelf rock	25-50	1830	1	3	4	5	5
9-9	1F, 1K	NW	SW	28	28N	34W	Mid Fork Ross Creek	Scree, shrubs, timber	> 50	1830	1	3	4	1	5
9-9	3A, 3K, 1J	NW	SW	31	29N	33W	Mount Vernon-Spires	PSME hab. type, timber	10-25	1400	3	5	2	1	5
9-15	1A	SW	NE	35	29N	35W	Savage Mountain	Ledges, grassy, shrubs	25-50	1400	6	3	4	1	5
9-15	1M	NW	SW	4	28N	34W	Spar Peak	Rocky, shrubs, timber	25-50	1650	7	3	2	2	5
9-15	5A, 1K	NW	SE	29	28N	34W	Mid Fork Ross Creek	Bare shelf rock	10-25	1770	7	5	2	5	5
9-27	1M	NW	SE	5	28N	34W	Spar Peak	Benches, shrubs, rocky	25-50	1580	7	3	4	1	5
9-27	1A	SW	NW	20	28N	34W	Mid Fork Ross Creek	Rocks, talus	25-50	1770	3	3	2	5	5
9-27	1A	SW	SE	21	28N	34W	Sawtooth Mountain	Crags, shrubs, timber	> 50	1580	7	3	4	1	5
9-27	1A	NE	NW	29	28N	34W	Mid Fork Ross Creek	Base of cliffs	25-50	1710	2	3	2	1	5

Appendix 11. (continued)

9-27	4A, 2K	NE SW	14 28N 34W	S. Fork Ross Creek	Benches, grassy	10-25	1340	7	3	2	1	5
9-27	1F, 1K	NE SW	14 28N 34W	S. Fork Ross Creek	Benches, grassy	10-25	1340	7	3	4	1	5
9-27	1A	SE NW	14 28N 34W	Ross Point	Opening in timber	25-50	1280	7	3	4	1	5
9-27	1A	SE SW	11 28N 34W	Ross Point	Scree, cliffs, benches	25-50	1280	1	3	4	1	5
9-27	4A, 1K	NE NE	5 28N 34W	Mount Vernon-Spires	PSME/PHMA, cliffs	25-50	1160	4	3	3	1	5
9-27	1A	SE SW	31 29N 33W	Mount Vernon-Spires	Cliffs, rocky	25-50	1160	5	3	4	1	5
9-27	1A	SE NE	31 29N 33W	Mount Vernon-Spires	Timber, cliffs	25-50	1160	2	3	4	1	5
10-11	1A	NW SW	24 29N 35W	E. Fork Lightening Creek	ABLA/MEFE, rock	10-25	1524	7	2	2	2	5
10-11	1F, 1K	NW SW	24 29N 35W	E. Fork Lightening Creek	Scree	>50	1402	7	3	2	1	5
10-11	1A	NW SW	24 29N 35W	E. Fork Lightening Creek	Scree	>50	1402	7	3	2	1	5
10-11	1A	SW SW	13 29N 35W	Thunder Creek	Scree	25-50	1463	7	3	2	3	5
10-11	1A	SE SE	31 29N 34W	Spar Peak	ABLA/MEFE	25-50	1372	7	3	3	1	5
10-11	2F, 2U, 2K	NW SW	32 29N 34W	Spar Peak	ABLA/MEFE	25-50	1402	8	3	3	1	5
10-11	3A	NE NE	21 28N 34W	Sawtooth	Scree, shrubs	>50	1524	7	3	3	1	5
10-11	2A	NE NW	23 28N 34W	Ross Point	Bluffs	25-50	1341	7	3	1	1	5
10-28	4U	NE	21 28N 34W	Sawtooth	ABLA/MEFE	25-50	1524	8	3	4	1	5
11-3	Tracks	SW	28 28N 34W	Mid Fork Ross Creek	Scree	25-50	1646	1	3	2	2	5
11-3	Tracks	SE	21 28N 34W	Sawtooth	ABLA/MEFE, shrubs	25-50	1463	8	3	4	1	5
11-18	2A	SW SE	11 28N 34W	Ross Point	Scree	10-25	1158	6	3	4	1	5
11-29	1A	NW NE	5 28N 33W	Spires	PSME Series, cliffs	10-25	1158	4	3	4	1	5
11-30	1M, 2F, 2K, 1J, 1U	NW SW	30 29N 33W	Spires	PSME/PHMA, cliffs	>50	1219	2	3	4	1	5

Appendix 11. (continued)

11-30 1F,2A	NW NE	5 28N 33W	Spires	PSME/PHMA, cliffs	25-50	1158	5	3	4	1	5
11-30 1F,1A, 1U,1K	NW SW	34 57N 3E	Savage Creek	PSME Series	25-50	1219	6	3	4	1	5
11-30 1M	NW SW	34 57N 3E	Savage Creek	PSME Series	>50	1250	6	3	4	1	5
11-30 Tracks	24 29N 35W	E.Fk. Lightening Cr.		PSME Series, cliffs	25-50	1219	5	3	4	1	5
11-30 1M,1F, 1A,2J	NW SW	14 28N 34W	Ross Point	TSHE/CLUN, cliffs	25-50	1219	6	3	4	1	5
11-30 1F,1K,1J	NE NW	14 28N 34W	Ross Point	TSHE/CLUN, cliffs	25-50	1219	8	3	4	1	5
1-23 Tracks	SW	31 29N 33W	Spires	TSHE/CLUN, scree	25-50	1158	4	3	4	1	5
1-23 Tracks	SW	31 29N 33W	Spires	TSHE/CLUN, scree	25-50	1158	3	3	4	1	5
2-10 3F,1U,3K	SE SW	31 29N 33W	Spires	PSME Series, cliffs	10-25	1189	2	3	4	1	5
2-13 Tracks	SE	31 29N 33W	Spires	PSME Series, scree	10-25	914	4	4	3	5	5
2-13 Tracks	SW	31 29N 33W	Spires	PSME Series, scree	25-50	1158	4	3	4	1	5
2-13 Tracks	NE	5 28N 33W	Spires	PSME Series, cliffs	25-50	1097	4	3	4	1	5
2-13 Tracks	NW	31 29N 33W	Spires	PSME Series, timber	<10	1341	2	2	2	1	5
2-13 Tracks	SE	36 29N 34W	Mount Vernon	ABLA/CLUN, timber	<10	1646	5	2	2	1	5
2-13 Tracks	SE	34 29N 34W	Vernon-Spar Ridge	ABLA/XETE, timber	<10	1737	9	1	3	1	5
2-13 Tracks	SW	33 29N 34W	Vernon-Spar Ridge	ABLA/XETE, timber	<10	1707	9	1	3	1	5
2-13 Tracks	NW	34 29N 34W	Vernon-Spar Ridge	ABLA/LUHI, timber	10-25	1707	1	2	1	1	5
2-13 Tracks	SE	32 29N 34W	Vernon-Spar Ridge	ABLA/LUHI, timber	10-25	1707	1	2	1	1	5
2-13 Tracks	SE	5 28N 34W	Spar Creek	ABLA/LUHI	25-50	1829	8	3	2	1	5
2-13 1A	NW	4 28N 34W	Spar Peak	ABLA/LUHI	10-25	1829	8	3	2	1	5

Appendix 11. (continued)

2-13	1A	SE	32	29N	34W	Vernon-Spar Ridge	ABLA/LUHI	10-25	1707	1	1	1	1	5
2-13	Tracks	NW	24	27N	34W	Squaw Lookout	ABLA Series	10-25	1829	4	2	2	5	5
2-13	1A	NW	11	28N	34W	Ross Point	TSHE/CLUN, cliffs	10-25	1158	8	3	4	1	5
2-13	1A	NW	11	28N	34W	Ross Point	TSHE/CLUN, bluffs	10-25	1158	7	3	4	1	5
2-13	Tracks	11	28N	34W		Ross Point	TSHE/CLUN, cliffs	25-50	1128	8	3	4	1	5
2-13	Tracks	14	28N	34W		Ross Point	TSHE/CLUN, cliffs	25-50	1128	7	3	4	1	5
2-13	Tracks	NW	26	28N	34W	S. Fork Ross Creek	ABLA/MEFE	25-50	1676	7	2	2	4	5
3-1	Tracks	NW	31	29N	33W	Spires	TSHE/CLUN, scree	25-50	1219	2	3	2	1	5
3-1	Tracks	SE	30	29N	33W	Weasel Creek	TSHE/CLUN, timber	25-50	1006	3	3	2	1	5
3-1	Tracks	NE	5	28N	33W	Spires	TSHE/CLUN, scree	25-50	975	3	3	4	1	5
3-1	Tracks	SE	31	29N	33W	Spires	TSHE/CLUN, scree	25-50	1158	4	3	2	2	5
3-1	Tracks	SW	33	29N	34W	Vernon-Spar Ridge	ABLA/LUHI, timber	10-25	1707	8	1	1	1	5
3-10	Tracks	SW	31	29N	33W	Spires	TSHE/CLUN, timber	<10	1341	2	1	2	1	5
3-10	Tracks	SE	36	29N	34W	Mount Vernon	ABLA/XETE, timber	10-25	1585	4	1	4	1	5
3-10	Tracks	SW	33	29N	34W	Vernon-Spar Ridge	ABLA/MEFE, timber	10-25	1798	1	1	1	1	5
3-11	1A	SW	30	29N	33W	Weasel Creek	TSHE/CLUN, timber	>50	1158	4	3	4	1	5
3-11	1M,2A	NE	5	28N	33W	Spires	TSHE/CLUN, scree	>50	1219	3	3	4	1	5
3-11	1A,1J	SW	33	29N	34W	Vernon-Spar Ridge	ABLA/XETE, timber	<10	1736	5	1	1	1	5
3-11	1A	SW	14	28N	34W	Ross Point	ABLA/MEFE, timber	>50	1311	7	3	4	1	5

Appendix 11. (continued)

4-24	2F, 3K, 2A	NE NW	5	28N	33W	Mount Vernon-Spires	Talus	<10	1402	3	3	2	1	5
5-22	1A	SW NE	31	29N	33W	Mount Vernon-Spires	TSHE/CLUN, rimrocks, timber	25-50	1280	2	2	4	1	5
5-22	1A	SW NE	31	29N	33W	Mount Vernon-Spires	Cliffs	25-50	1280	2	2	4	1	5
5-22	2A	NE	5	28N	33W	Mount Vernon-Spires	PSME type, cliffs	25-50	1097	3	3	4	1	5
5-22	2A	SW NE	31	29N	33W	Mount Vernon-Spires	PSME type, cliffs	25-50	1280	3	3	4	1	5
5-22	4A	NE NW	5	28N	33W	Mount Vernon-Spires	PSME type, park	25-50	1280	3	3	3	3	5
5-22	1A	SW NE	31	29N	33W	Mount Vernon-Spires	PSME type, talus	25-50	1280	3	3	3	1	5
5-22	3A	NE	28	28N	34W	Sawtooth Mountain	ABLA type, bluffs	25-50	1524	7	3	4	1	5
5-22	1A	NE	28	28N	34W	Sawtooth Mountain	ABLA type, bluffs	25-50	1524	7	3	4	1	5
5-22	1F, 1K	NE	28	28N	34W	Sawtooth Mountain	ABLA type, bluffs	25-50	1494	7	3	4	1	5
5-22	2F, 2K, 3U	NE	28	28N	34W	Sawtooth Mountain	ABLA type, park	25-50	1463	7	3	4	1	5
5-22	1F, 1K, 1A	SW	11	28N	34W	Ross Point	ABLA type, cliffs	25-50	1189	7	3	4	1	5
5-22	Hair	NE	6	28N	33W	Mount Vernon	PSME type, road	10-25	1494	5	3	4	1	1
5-23	Hair	SW	31	29N	33W	Mount Vernon-Spires	PSME type, shrubs	10-25	1524	4	2	4	1	5
5-23	Pellets	SW	31	29N	33W	Mount Vernon-Spires	Open, shrubs	10-25	1524	4	2	4	1	5
5-23	Pellets	SE	36	29N	34W	Mount Vernon-Spires	PSME type, timber	10-25	1585	4	3	4	1	5
5-23	Pellets	SE	31	29N	33W	Mount Vernon-Spires	PSME type, timber	<10	1585	3	5	4	1	5
5-23	Beds-2	SE	31	29N	33W	Mount Vernon-Spires	PSME type, bluff	<10	1585	3	5	4	1	5
6-3	Tracks-2	SW	35	29N	34W	Mount Vernon-Spar Peak	ABLA/MEFE	<10	1585	5	2	2	1	5
6-5	2A	NE	5	28N	33W	Mount Vernon-Spires	PSME type, timber	25-50	1097	4	3	4	1	5

Appendix 11. (continued)

6-19	1A	NW	31	29N	33W	Mount Vernon-Spires	Talus	> 50	1158	4	3	4	1	5
6-19	1A	SW	NW	14	28N	34W	Ross Point	TSHE/CLUN, bluffs	10-25	1280	7	3	4	1
6-19	1A	NW	31	29N	33W	Mount Vernon-Spires	Talus	25-50	1158	4	3	4	1	5
6-19	4A,2K,1J	SW	NE	31	29N	33W	Mount Vernon-Spires	ABLA type, timber	10-25	1341	3	5	2	1
7-12	1F,1K	NE	5	28N	34W	Spar Creek	Sheer rock	25-50	1402	8	3	4	1	5
7-13	1M	NW	4	28N	34W	Spar Peak	Cliffs, scrub timber	> 50	1981	8	1	4	1	5
7-13	1F	NE	5	28N	34W	Spar Creek	ABLA/MEFE, crevice	> 50	1707	8	3	4	1	5
7-13	1A	NW	36	29N	35W	Savage Mountain	Scree, cliffs	25-50	1951	5	3	4	1	5
7-13	2A	SE	NE	15	57N	3E	Cliff Creek	Scree, cliffs	> 50	1829	7	1	4	1
7-13	1A	SW	18	29N	34W	Drift Creek	Scree	> 50	1829	8	2	3	1	5
7-13	1A	SE	21	28N	34W	Sawtooth Mountain	Timbered bench	25-50	1829	8	3	4	1	5

1 All observation reports are abbreviated: U = unclassified goat, A = adult, M = male, F = female, K = kid and J = juvenile.

2 Slope in degrees.

3 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.

4 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.

5 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.

6 Distance to cover and distance from road coded as follows: 1 = 0-10m, 2 = 10-50m, 3 = 50-100m, 4 = 100-200m and 5 = >200m.

7 Reported by personnel of Olson-Elliott & Associates, Helena, Montana.

Appendix 13. Black bear sign observed during 1977 and 1978.

DATE	TYPE OF REPORT	LOCATION			AREA	HABITAT TYPE	SITE DESCRIPTION	SLOPE	ELEVATION	ASPECT ¹	TOPOG ²	CONFIG ³	D-COVER ⁴	D-COVER ⁴
		REPORT NO.	1/4	S T R										
4-21	Scat	1	NW	9	28N 33W	S. end Bull Lake	THPL/CLUN	<10	730	9	5	4	2	5
5-16	Scat	3	SE	35	29N 34W	Mount Vernon	ABLA/MEFE	10-25	1460	5	3	2	1	1
5-16	Scat	3	NE	6	28N 33W	Mount Vernon	ABLA/MEFE	10-25	1400	5	3	2	1	1
5-25	Scat	1	NW	15	30N 34W	N. Fk. Keeler Cr.	TSHE/CLUN	<10	940	4	3	4	1	1
5-25	Scat	1	NW	24	30N 34W	Keeler-Iron Cr. Rd.	TSHE/CLUN	<10	760	3	4	2	1	1
5-25	Scat	1	SW	36	29N 34W	Mount Vernon	ABLA/MEFE	10-25	1450	8	2	4	1	1
5-25	Scat	1	SW	36	29N 34W	Mount Vernon	ABLA/MEFE	<10	1460	5	1	1	1	1
5-25	Scat	1	SW	36	29N 34W	Mount Vernon	ABLA/MEFE	10-25	1460	8	3	2	1	5
5-25	Track	1	SW	36	29N 34W	Mount Vernon	ABLA/MEFE	25-50	1490	8	1	4	1	5
5-25	Track	1	SW	36	29N 34W	Mount Vernon	ABLA/MEFE	25-50	1490	8	1	4	1	5
6-6	Scat	1	SE	34	29N 34W	Mt. Vernon-Spar Rdg.	ABLA/MEFE	<10	1800	1	1	1	1	5
6-11	Scat	1	NE	24	29N 34W	Stanley Creek	TSHE/CLUN	<10	820	1	6	3	1	3
6-11	Scat	1	SE	13	29N 34W	Stanley Creek	TSHE/CLUN	<10	850	7	3	4	1	5
6-11	Scat	1	SE	12	29N 34W	Stanley Creek	TSHE/CLUN	<10	760	7	4	1	1	2
6-11	Scat	1	SW	7	29N 33W	Stanley Creek	TSHE/CLUN	<10	760	7	4	1	1	2
6-12	Scat	1	NW	8	29N 33W	Lake Cr.-Dry Cr.	TSHE/CLUN	<10	760	7	4	1	1	2
6-12	Scat	1	NW	8	29N 33W	Lake Cr.-Dry Cr.	TSHE/CLUN	<10	760	7	4	1	1	2

Appendix 13. (continued)

6-12	Scat	1	SE	20	29N	33W	Bull Lake	TSHE/CLUN	riparian	<10	1370	6	4	4	1	3
6-12	Scat	1	NE	9	29N	34W	Spruce Lakes	TSHE/CLUN		<10	1340	1	3	2	1	1
6-12	Scat	1	SW	4	29N	34W	Spruce Lakes	TSHE/CLUN		<10	1370	1	3	2	1	1
6-12	Scat	1	NW	21	29N	33W	Crowell Cr. Rd.	TSHE/CLUN		<10	760	7	4	4	1	1
7-14	Scat	1	NW	24	28N	34W	N. Fk. Dry Cr.	TSHE/CLUN	road	10-25	1280	1	3	3	1	1
7-14	Scat	2	NE	23	28N	34W	N. Fk. Dry Cr.	TSHE/CLUN	road	10-25	1220	1	3	3	1	1
7-14	Scat	2	SE	23	28N	34W	N. Fk. Dry Cr.	TSHE/CLUN	road	10-25	1160	1	3	3	1	1
7-20	Scat	1	SW	36	29N	34W	Mount Vernon	TSHE/CLUN	road	10-25	1310	5	3	2	1	1
7-20	Scat	2	SW	36	29N	34W	Mount Vernon	TSHE/CLUN	cut unit	10-25	1160	2	3	2	1	1
7-20	Scat	3	SW	36	29N	34W	Mount Vernon	ABLA/CLUN	cut unit	10-25	1220	2	2	2	1	1
7-20	Scat	2	SW	36	29N	34W	Mt. Vernon-Weasel L.	ABLA/CLUN	road	10-25	1550	3	4	3	1	1
7-20	Scat	4	SE	36	29N	34W	Mt. Vernon-Spires	ABLA/CLUN		10-25	1550	4	2	4	1	5
7-24	Scat	3	NW	26	28N	34W	S. Fk. Ross-Dry Rdg.	TSME/XETE		<10	1780	2	1	2	1	5
7-25	Scat	3	SE	26	28N	34W	N. Branch Dry Cr.	TSHE/CLUN		<10	1370	5	3	4	1	1
8-8	Scat	2	NE	10	30N	34W	Grouse Mountain	PSME/AGSP		<10	1400	2	1	1	1	5
8-9	Scat	1	SE	13	29N	35W	Drift Cr.	ABLA/CACA		<10	1770	2	5	4	1	5
8-11	Scat	1	NE	35	30N	34W	Keeleer Mountain	ABLA/CACA		<10	1400	3	3	2	1	5
8-11	Scat	1	SE	25	30N	34W	Keeleer Mountain	PSME/PHMA		25-50	1070	1	3	2	1	5
8-12	Scat	1	NE	25	29N	34W	Stanley-Emma Pass	ABGR/CLUN		>50	1190	5	3	2	1	5
8-12	Scat	1	NE	25	29N	34W	Stanley Mountain	ABGR/CLUN		<10	1250	1	1	2	1	5

Appendix 14. (continued)

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
1/13/76	Taylor Mountain	Marked	Adult	Female	Tagged, #A99
1/23/76	Emma Gulch	Treed	Adult	Female	#A99
1/76	Stanley Creek	Treed	Adult	Male	Large
1/76	Keeler Creek	Track	Adult		
2/76	S.Fk. Bull River	Marked	Adult	Female	Tagged, #2
2/76	S.Fk. Bull River	Treed	Adult	Female	#2
3/76	Keeler Mountain	Treed	Adult	Female	
3/76	Stanley Creek	Marked	Adult	Male	Tagged, #3
3/76	Lake Creek	Treed	Adult and two kittens		Female with two kittens, all were treed
3/76	Lake Creek	Treed	Adult	Female	#A99
3/76	Keeler Creek	Kill	Adult	Male	
5/76	Callahan Creek	Track	Adult		
5/76	Berray Mountain	Track	Adult		
12/76	Keeler Mountain	Track	Adult and two kittens		Female with two kittens
1/13/77	Keeler Mountain	Treed	Adult	Female	#A99
4/77 ³	Lake Creek	Scat			
5/13/77 ²	Ross Creek	Scat			
5/13/77 ²	Stanley Creek	Scat			

Appendix 14. (continued)

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
6/03/77 ³	Mount Vernon-Spar Peak Ridge	Track			
8/12/77 ³	Stanley Mountain	Scat			
11/19/77 ³	Bull Lake-Spires	Track	Adult		Three piles of duff
11/19/77 ³	Bull Lake-Spires	Scrapes			
11/19/77 ³	Bull Lake-Spires	Scat	Adult		
12/77	Keeler Mountain	Track	Adult and two kittens		Female with two kittens
12/05/77	N. Fk. Bull River	Treed	Adult	Female	
12/05/77	N. Fk. Bull River	Track	Adult		
12/16/77 ³	Keeler Creek	Tracks	Adult and two kittens		Female with two kittens
12/17/77	Keeler Creek	Kill	Adult	Female	Kitten tracks in vicinity
12/17/77	Keeler Creek	Tracks	Two kittens		
12/26/77	Ross Cr.-Bull Lake	Kill	Adult	Male	
12/29/77 ⁴	Keeler Creek	Treed	Two kittens		
1/06/78 ³	Keeler Creek and Keeler Mountain	Tracks	Two kittens		
1/10/78	Stanley Creek	Track	Kitten		
1/22/78 ³	Taylor Mountain Rd.	Track	Adult		
1/23/78 ³	Camp Creek	Marked	Kitten	Female	
1/24/78 ³	Lake Creek	Track	Adult		Had killed whitetail buck

Appendix 15. Small mammal trapline site information collected during spring and fall 1977.

NAME AND LOCATION	ELEVATION	ASPECT	HABITAT TYPE	SITE DESCRIPTION
Tailing Pond Site NE $\frac{1}{4}$ NE $\frac{1}{4}$ S31 T30N R33W	700	None	TSHE/CLUN	0.35 Km south of Little Joe, Mt. turn west, go 2.25 Km into large clearcut. 70m east of road. Line set at S50°E. Clearcut, broadcast burn.
Well and Substation Site SE $\frac{1}{4}$ NE $\frac{1}{4}$ S13 T29N R34W	780	North	TSHE/CLUN	0.3 Km south of Stanley Creek bridge. 45m east of road. Line set at N45°E. Clearcut 13 years old, broadcast burn.
Clarification Pond Site ¹ SE $\frac{1}{4}$ NW $\frac{1}{4}$ S13 T29N R34W	780	North	TSHE/CLUN	0.4 Km south of Stanley Creek bridge. 15m west of road. Line set at W10°N. Timbered, undisturbed area.
Lower Mill Site NE $\frac{1}{4}$ NE $\frac{1}{4}$ S26 T29N R34W	1060	North	TSHE/CLUN	6.75 Km south of Stanley Creek bridge. 27m south of road. Line set at S40°E. Last year's selection cut, thick slash and debris. Slash had been piled by fall trap period.
Upper Mill Site NE $\frac{1}{4}$ NE $\frac{1}{4}$ S26 T29N R34W	1160	Northeast	TSHE/CLUN and THPL/OPHO	7.7 Km south of Stanley Creek bridge. 50m south of road up cut bank. Line set due south. Edge of selection cut. Timbered site. Moist areas dispersed throughout.
<i>Thuja plicata</i> / <i>Oplopanax horridum</i> habitat type SE $\frac{1}{4}$ NE $\frac{1}{4}$ S26 T29N R33W	1190	East	THPL/OPHO	8.2 Km south Stanley Creek bridge or, 6 Km N of Mount Vernon Pass in dry creek bed. Line set at N80°W. Western hemlock, western red cedar and Douglas fir overstory with devil's club, thimbleberry and ferns understorey.
<i>Tsuga heterophylla</i> / <i>Clintonia uniflora</i> habitat type SW $\frac{1}{4}$ NW $\frac{1}{4}$ S32 T30N R33W	715	None	TSHE/CLUN	About 0.35 Km south of Little Joe, Mt., on Highway 202 turn west, go 1.6 Km to abandoned cabin, then 45m beyond cabin toward pond. Line set due south. Western hemlock, grand fir, Douglas-fir, lodgepole pine, ponderosa pine overstory with twinflower, pinegrass, buffalo-berry and oceanspray understorey.

Appendix 15. (continued)

NAME AND LOCATION	ELEVA- TION	ASPECT	HABITAT TYPE	SITE DESCRIPTION
<i>Abies lasiocarpa/Menziesia fermiginea</i> habitat type NE¼ SW¼ S36 T29N R33W	1675	Northwest	ABLA/MEFE	From Ross Creek-Stanley Creek pass on Mount Vernon, east 0.5 Km, then north 0.2 Km, then 30m north of bend in road. Line set due east. Subalpine fir, Douglas-fir, spruce forest having microsites of ABLA/CACA.

¹ Plans for the clarification pond have been deleted by ASARCO. This site represents an undisturbed
TSHE/CLUN habitat type.

Appendix 16. Blue grouse observations 1977 - 1978.

DATE	COMPOSITION	LOCATION					AREA	HABITAT TYPE	ELEVATION	ASPECT	TOPOGRAPHY	CONFIGURATION	D-COVER	D-ROAD
		1/4	1/4	S	T	R				2	3	4	5	5
5-1	Roosting Site	NE	SW	35	29N	34W	Mount Vernon Ridge	ABLA/XETE	1710	5	2	2	1	5
5-18	1M	NE	NE	6	28N	33W	Mount Vernon Ridge	ABLA/MEFE	1430	4	3	2	1	1
5-26	1A	SW	SW	34	29N	34W	Mount Vernon	ABLA/MEFE	1550	3	1	1	1	5
6-3	Roosting Site	NE	SW	34	29N	34W	Mount Vernon Ridge	ABLA/LUHI	1710	5	1	1	1	5
6-4	2F	NW	NE	5	28N	33W	Ross Creek-Vernon	ABLA/XETE	1460	5	3	2	1	1
6-5	1F	SW	NE	5	28N	33W	Ross Creek-Vernon	PSME/SYAL	1070	4	3	2	2	1
6-5	1F	SW	NE	5	28N	33W	Ross Creek-Vernon	PSME/SYAL	1070	4	3	2	2	1
6-5	1F	SW	NE	5	28N	33W	Foss Creek-Vernon	PSME/SYAL	1040	4	3	2	2	1
6-6	1M	SW	NE	5	28N	33W	Ross Creek-Vernon	PSME/SYAL	1100	5	3	2	2	1
7-20	1F1Y	NW	NW	5	28N	33W	Ross Creek-Vernon	TSHE/CLUN	1400	5	3	4	1	1
7-24	1A	NW	SW	26	28N	34W	S. Fork Ross Creek	TSME/XETE	1740	2	1	1	1	5
7-25	1A		NW	23	28N	34W	S. Fork Ross Creek	TSHE/CLUN	1580	3	3	2	1	5
8-2	1F4Y	SW	SE	36	29N	35W	Spar Peak	ABLA/LUHI	1830	1	1	4	1	5
8-8	1A	SE	NE	10	30N	34W	Grouse Mountain	PSME/AGSP	1400	2	1	1	1	5
8-9	1A	SE	SE	13	29N	35W	Drift Lake	ABLA/CACA	1710	2	6	2	1	5

Appendix 16. (continued)

8-11	1A	NE NW 36 30N 34N	Keeler Mountain	ABGR/CLUN	1460	3	3	4	1	5
8-11	7Y	NW NE 36 30N 34W	Keeler Mountain	ABLA/CACA	1400	3	3	4	1	5
8-11	1M2A	NE SE 25 30N 34W	Keeler Mountain	PSME/PHMA	1280	2	1	4	1	5
8-11	1F2Y	NW SW 30 30N 34W	Keeler Mountain	PSME/PHMA	1280	2	1	4	1	5
8-11	1A	SW NW 30 30N 33W	Keeler Mountain	PSME/PHMA	1100	2	3	2	1	1
8-11	1F7Y	SE SW 36 30N 34W	Keeler Mountain	ABLA/MEFE	1400	4	1	1	1	1
8-12	1A	SW NW 19 29N 33W	Stanley Mountain	ABGR/CLUN	1250	9	1	2	1	5
8-12	1A	NW NE 25 29N 33W	Stanley-Emma Creek	TSHE/CLUN	970	7	5	2	1	5
8-12	1A	NW NE 25 29N 33W	Stanley-Emma Creek	TSHE/CLUN	970	7	6	2	1	5
8-16	1A	SW NE 23 28N 34W	Dry Creek	ABLA/MEFE	1580	1	1	4	1	5
8-16	1A	SW NE 23 28N 34W	N. Fork Dry Creek	ABLA/MEFE	1520	3	3	2	1	1
8-16	Dusting Site	NW NW 26 28N 34W	N. Fork Dry Creek	TSME/XETE	1710	3	1	2	1	5
8-16	3Y	NW NE 34 28N 34W	N. Fork Dry Creek	ABLA/LUHI	1650	9	1	4	1	5
8-17	1F1Y	SW SW 27 28N 34W	S. Fork Ross Creek	ABLA/CACA	1150	1	4	4	1	5
10-15	1M	NW 5 28N 33W	Mount Vernon	PSME/PHMA	1402	5	3	2	1	1
10-27	1A	SW 7 29N 33W	Stanley Mountain	TSHE/CLUN	914	8	2	2	1	5
10-27	1A	SW 7 29N 33W	Stanley Mountain	TSHE/CLUN	1158	8	3	2	1	5
10-27	1A	NW 2 28N 34W	Vernon-Spar ridge	ABLA/XETE	1524	9	1	1	1	5
3-11	1A	SW 33 29N 34W	Vernon-Spar ridge	ABLA/MEFE	1768	8	1	1	1	5
5-23	Roosting Site	SE 36 29N 34W	Mount Vernon	ABLA/MEFE	1524	3	5	2	1	5

Appendix 16. (continued)

- 1 Observations are abbreviated as follows: F = female, M = male, Y = young and A = adult.
 - 2 Aspect coded as follows: 1 = north, 2 = northeast, 3 = east, 4 = southeast, 5 = south, 6 = southwest, 7 = west, 8 = northwest and 9 = no aspect.
 - 3 Topography coded as follows: 1 = ridge, 2 = upper slope, 3 = mid slope, 4 = lower slope, 5 = bench or flat and 6 = creek bottom.
 - 4 Configuration coded as follows: 1 = convex, 2 = straight, 3 = concave and 4 = undulating.
 - 5 Distance to cover and distance from road coded as follows: 1 = 0-10m, 2 = 10-50m, 3 = 50-100m, 4 = 100-200m and 5 = over 200m.
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Appendix 17. Ruffed grouse observations 1977 - 1978.

DATE	COMPOSITION	LOCATION			AREA	HABITAT TYPE	ELEVATION	ASPECT	TOPOGRAPHY	CONFIGURATION	D-COVER	D-COVER
		$\frac{1}{4}$	$\frac{1}{4}$	S	T	R		2	3	4	5	5
4-12	1F	SE	SE	13	30N	34W	Keeler-Iron Creek Road	730	3	5	4	1
4-12	1F	NW	NW	6	29N	33W	Spar Lake Road	730	4	4	4	1
4-12	1M	SE	NW	13	29N	34W	Stanley Creek Road	780	3	6	3	2
4-12	1M	SE	NW	13	29N	34W	Stanley Creek Road	790	1	3	4	2
4-13	1M	SW	SW	6	29N	33W	Stanley Creek Road	790	2	4	4	1
4-19	1M	SE	NW	20	30N	33W	Lake Creek	700	9	5	4	1
4-20	1M		NW	13	29N	34W	Stanley Creek	760	1	4	2	1
4-21	1M	SE	NW	24	30N	34W	Keeler Creek	850	4	4	4	1
4-21	1M	NW	NW	9	28N	33W	Ross Creek	730	9	5	4	1
4-24	1M	SE	NE	18	29N	33W	N. end Bull Lake	700	9	5	4	1
4-25	1F	SE	NW	12	30N	34W	Copper Creek	790	5	3	2	1
4-25	1F	SE	NW	12	29N	34W	Copper Creek	790	5	6	4	1
4-25	1M	SE	NW	5	29N	33W	Camp Creek	730	9	5	2	1
4-30	1A	NE	SW	6	29N	33W	Stanley Creek Road	790	3	3	4	1
5-1	1M	NE	NW	24	30N	34W	N. Fork Keeler Creek	790	4	4	2	1
5-1	1M	SE	NW	13	29N	34W	Stanley Creek	850	2	9	2	1

Appendix 17. (continued)

5-1	1F	NE	NE	24	30N	34W	Keeler Creek Road	TSHE/CLUN	730	3	4	4	1	1
5-2	1F	NE	NE	12	29N	34W	Stanley Creek Road	TSHE/CLUN	760	4	3	2	1	1
5-3	1M	SE	NE	13	29N	34W	Stanley Creek	THPL/OPHO	850	2	6	4	1	2
5-6	1M	NE	NW	6	29N	33W	Stanley Creek Road	TSHE/CLUN	790	3	3	4	1	1
5-7	1M	NE	SW	30	30N	33W	Keeler Creek	PSME/CARU	715	3	5	2	1	5
5-8	1A	NE	SE	12	29N	34W	Stanley Creek	TSHE/CLUN	790	3	3	4	1	1
5-14	1M	NW	NW	30	30N	33W	Keeler Creek	TSHE/CLUN	750	3	3	2	1	1
5-14	1M	NE	SW	17	29N	33W	Highway 202	TSHE/CLUN	670	6	4	4	1	5
5-18	1M	NW	NW	8	28N	33W	Ross Creek	TSHE/CLUN	850	4	4	2	1	2
5-18	1M	NW	NW	4	29N	33W	Camp Creek	PSME type ⁶	730	6	4	2	1	2
5-26	1A	NE	NE	30	31N	33W	Mud Lake	TSHE/CLUN	670	9	4	2	1	1
6-2	1F	SE	SE	29	31N	33W	Millnor Lake	PSME/LIBO	700	9	5	4	1	5
6-12	1M	NW	NW	17	29N	33W	Lake Creek	TSHE/CLUN	720	9	5	4	1	5
6-12	1F3Y	SE	SE	6	29N	33W	Lake Creek	THSE/CLUN	720	9	5	4	1	5
7-15	1F5Y	SE	NE	24	30N	34W	Keeler Road	TSHE/CLUN	780	2	4	4	1	1
7-15	1F	SW	NW	24	30N	34W	Keeler Road	TSHE/CLUN	780	2	4	4	1	1
7-20	1Y	SE	SE	29	30N	33W	Highway 202	TSHE/CLUN	700	9	5	2	2	1
7-20	2Y	SE	SE	20	30N	33W	Highway 202	TSHE/CLUN	700	9	5	2	2	1
7-25	1A	SW	SE	23	28N	34W	N. Fork Branch Creek	TSHE/CLUN	1430	4	3	2	1	1
8-1	1F5Y	SW	SW	19	30N	33W	Keeler Creek	TSHE/CLUN	760	3	6	3	1	1

Appendix 17. (continued)

8-8	10Y	SW SE	12	30N	34W	Copper Creek	TSHE/CLUN	790	5	4	2	1	1
8-11	1A	SE NW	36	30N	34W	Keeler Mountain	ABLA/XETE	1460	1	2	2	1	5
8-11	1F3Y	SE NW	6	29N	33W	Stanley Creek Road	TSHE/CLUN	820	5	4	2	1	1
8-11	1M	SW NE	26	30N	34W	Keeler Creek	THPL/CLUN	760	2	6	2	1	5
8-12	1F7Y	SW SW	19	30N	33W	Keeler Creek	TSHE/CLUN	790	4	4	2	1	1
8-12	1M	SW NE	25	29N	33W	Emma Gulch	TSHE/CLUN	1030	3	3	3	1	5
8-12	1M	SW NE	25	29N	33W	Emma Gulch	TSHE/CLUN	730	3	6	2	1	5
8-16	5Y	SW NW	25	31N	34W	Iron Mountain Road	PSME/PHMA	760	4	4	2	1	1
8-16	6Y	NE NW	1	30N	34W	Copper Creek Road	PSME/PHMA	820	1	4	2	1	1
9-8	1A	NW NE	19	31N	33W	Junction Highway 202 and 2	TSHE/CLUN	670	9	5	2	2	1
9-10	1U	SE NW	31	30N	33W	Stanley-Keeler Road	TSHE/CLUN	760	3	3	4	1	2
9-11	3Y		7	30N	33W	Stanley-Keeler Road	TSHE/CLUN	760	3	-	-	-	-
9-12	1M	NE NW	7	29N	33W	Stanley Creek Road	TSHE/CLUN	760	4	4	4	1	1
9-12	1M	NE NW	7	29N	33W	Stanley Creek Road	TSHE/CLUN	760	4	4	4	1	1
9-14	1M	SW SW	5	30N	33W	Stanley Creek Road	TSHE/CLUN	760	4	4	4	1	1
9-15	1M	NW NW	18	30N	33W	Iron Creek Road	TSHE/CLUN	700	3	4	4	1	1
9-15	1U	NE SE	13	30N	34W	Iron-Lake Road Junction	TSHE/CLUN	700	3	4	4	1	1
9-15	1U	NW NE	30	30N	33W	Stanley-Keeler Road	TSHE/CLUN	730	3	4	4	1	1
9-15	1U	NE SW	6	29N	33W	Stanley Creek Road	TSHE/CLUN	1015	4	4	4	1	1
10-1	2U	SW SW	6	30N	33W	Iron Creek Road	TSHE/CLUN	731	3	4	4	1	1
10-1	2U	SW SW	6	30N	33W	Iron Creek Road	TSHE/CLUN	731	3	4	4	1	1

Appendix 18. (continued)

DATE	TIME START (a.m.)	TIME FINISH (a.m.)	UPPER STANLEY CREEK ROUTE ^{5/}															TOTAL	AVG. NO. DRUMS/STOP
			STOP NUMBER																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
4/27/78	5:10	6:35	2	2	2	0	2	2	0	1	0	0	0	1	0	0	0	10	0.66

DATE	TIME START (a.m.)	TIME FINISH (a.m.)	ROSS CREEK ROUTE ^{6/}															TOTAL	AVG. NO. DRUMS/STOP
			STOP NUMBER																
4/30/78	6:00	7:15	3	5	0	0	4	5	4	0	2	0	0	1	2	3	0	29	1.9

- 1/ Route started 3.25 miles (5.5km) up N. Fk. Keeler Creek from junction of roads 404 and 473 and was run down the drainage and onto the road which skirts Lime Butte for 3.75 miles (6km).
- 2/ Stops were made at one quarter mile intervals.
- 3/ Number of drums heard during the 4 minute stop.
- 4/ Route started 1.1 miles (1.77km) south of Stanley Creek bridge (S13, T29N, R34W) and was run down the drainage then up to the Spar Lake road then down that road for a total of 3.75 miles (6.0km).
- 5/ Route started 0.5 miles (0.8km) below junction of Spar Lake road and Stanley Creek road, NW $\frac{1}{4}$ S14 T29N R34W. Route turned down the Stanley Creek road and continued to the washed-out bridge site on Lake Creek, NE $\frac{1}{4}$ S7 T29N R33W.
- 6/ Route started 3.75 miles (5.5km) up the Ross Creek campground road, NW $\frac{1}{4}$ S7 T28N R33W and was conducted downstream to Highway 202.