SEASONAL AND SPATIAL DISTRIBUTION OF BIGHORN SHEEP AT AN OPEN PIT COAL MINE IN THE ALBERTA FOOTHILLS1

by

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Abstract. Mining activity at Cardinal River Coals Ltd., an open pit mining site in the Alberta foothills, drastically changed the landscape from a closed canopy coniferous forest to open terrain consisting of reclaimed meadows in proximity to unreclaimed pit walls. A population of approximately 200 bighorn sheep which had been using the mine lease was studied during the year 1985-86. Ranges for the prerut, rut, winter and spring seasons were variously located on the lease area, as well as features such as lambing walls and mineral lick sites. High walls of exhausted pits were used for escape terrain and travel routes. Recommendations were made to the Alberta Land Conservation and Reclamation Council regarding maintenance of high walls in association with reclaimed meadows as integral components of bighorn sheep habitat. This site-specific wildlife study should be invaluable for mine planning and reclamation efforts.

In 1985, Cardinal River Coals Ltd. (CRC) initiated a population study of a herd of bighorn sheep that had been using their mine lease site for several years. CRC is an open pit coal mining operation that is situated in the foothills of west central Alberta 50 km south of the town of Hinton. CRC began mining activities in 1969 and reclamation work in 1971. Disturbed areas of the mine lease are being reclaimed for wildlife habitat and recreation as required by The Coal Development Policy for Alberta (Department of Energy and Natural Resources, 1976). Wildlife habitat was chosen as the end use because viable wildlife populations were present in the vicinity of the mining lease and reclamation costs were less than returning the disturbed land to timber production. Wallis and Wershler

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(1979) developed guidelines for reclaiming the CRC lease to bighorn sheep, mule deer, elk and moose habitat. Since that time, however, bighorn sheep have become the common species using the mine lease.

The purpose of this study was to obtain baseline data on the population of bighorn sheep at CRC in order to establish a long term monitoring program. The work was undertaken by the author as part of a Master's Degree Program at the Faculty of Environmental Design, University of Calgary during the year 1985-86. This paper discusses a portion of that work, concentrating on seasonal and spatial distribution of the bighorn sheep on the mining site and the implications this use has for reclamation efforts. Descriptive techniques will largely be used in the discussion of this work, because research is not quite finished.

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Study Area and Population

The study area is defined by CRC's Mineral Surface Lease # 5972 located in TWP 47 and 48, Rge 24, W of the 5th Meridian. As of December 31, 1986 a total of 43.9% or 1250 ha (3,088.6 acres) of the lease area had been disturbed, of which 504.3 ha (1246.1 acres) were in some stage of reclamation (Acott et al. 1987). The mineral surface lease is bounded on the west side by Gregg River, the north by Mary Gregg Creek, the east by tributaries of Luscar Creek and on the south by the front ranges that encompass Whitehorse Creek. The mine is bisected by Hwy 40 (Figure 1).

The study area is typified by rolling topography and steep slopes of uplifted Mesozoic shales and sandstones. Elevation of the mine ranges from 1680 to 1860 m a.s.l. (5512 to 6102 feet). Prior to mining, the study area was almost entirely forested with a closed canopy Subalpine spruce/fir forest. Forested areas are dominated by hybrid spruce (Picea glauca x engelmannii), lodgepole pine (Pinus contorta), fir (Abies lasiocarpa) and black spruce (Picea mariana). Aspen (Populus tremuloides) occurs on exposed, warm, south-facing slopes. Most timber within the lease is non-merchantable which is defined as <15.2 m (50 ft) high, <20.3 cm (8 in) dbh, <4 per ha (10 per acre). Soils of the study area are generally orthic gray luvisols on fine textured parent materials or eluviated brunisols on coarser textured materials.

The mining sequence involves site preparation by first salvaging or removing the timber resource. The topsoil and upper regolith layers are then salvaged and stockpiled. Finally, overburden is removed from the pit and used to backfill an existing pit or dumped externally onto an area where no previous mining activity has occurred.

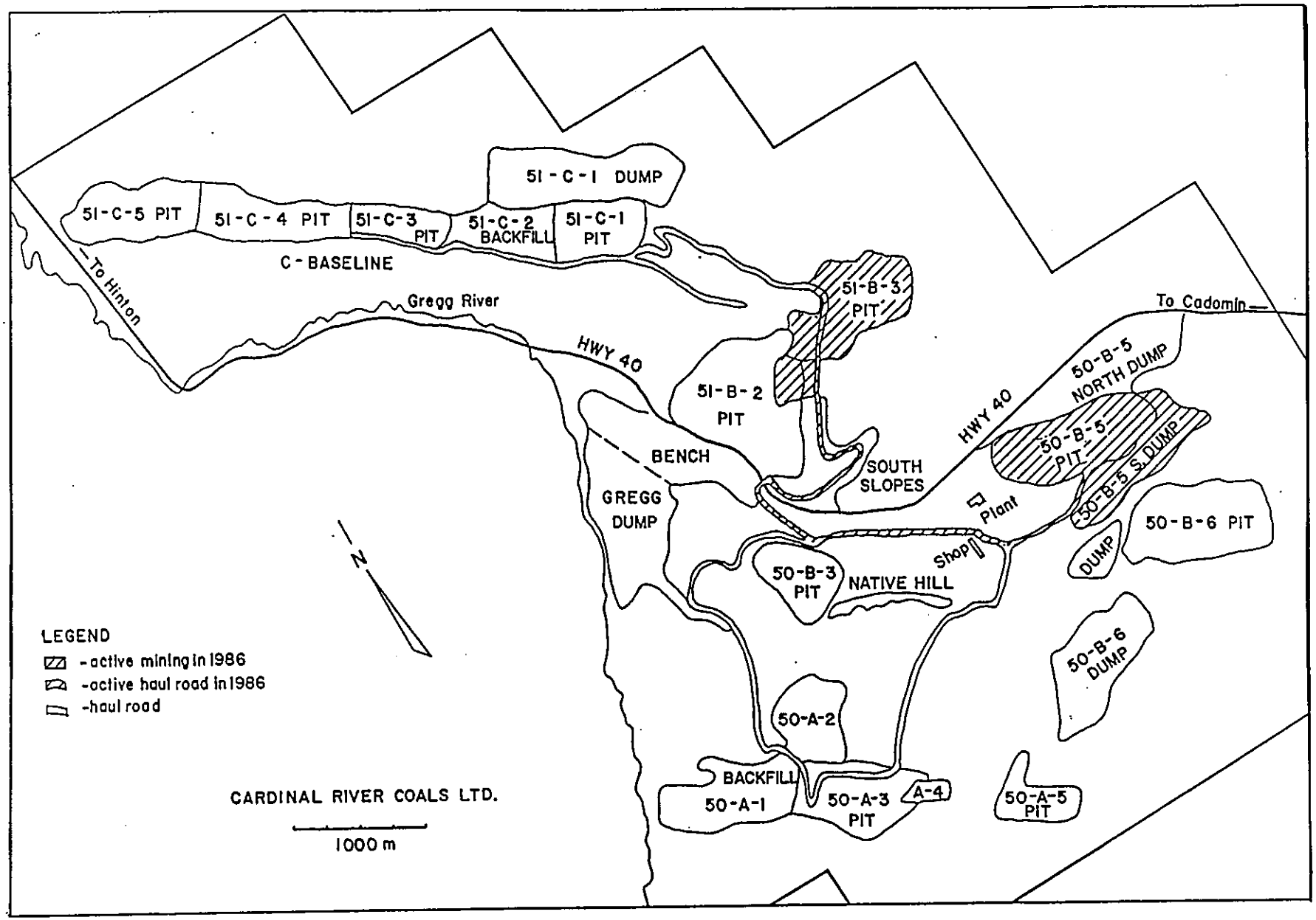

Figure 1. Location of pits, dumps and backfills at Cardinal River Coals Ltd., 1986

Following the mining activities, the dumped or backfilled overburden is graded and recontoured to a slope angle of 27o or less. Regolith is placed over the entire surface to a depth of 15 cm (5.9 in), and topsoil islands are placed in favourable locations. The whole area is then seeded and fertilized and the topsoil islands reforested.

Agronomic species are used for seeding in roughly a 50-50 grass/legume mixture. Grasses used are a combination of sod-forming and bunchgrasses - streambank wheatgrass (Agropyron riparium), smooth brome (Bromus inermis), red fescue (Festuca rubra), Canada bluegrass (Poa compressa), Kentucky bluegrass (Poa pratensis), crested wheatgrass (Agropyron pectiniforme), orchard grass (Dactylis glomerata), Russian wild ryegrass (Elymus junceus), tall fescue (Festuca arundinacea), hard fescue (Festuca ovina) and timothy (Phleum pratense). Legumes used are cicer milkvetch (Astragalus cicer), rambler alfalfa (Medicago media), sweet clover (Melilotus spp.), sainfoin (Onobrychis viciifolia) and alsike clover (Trifolium hybridum).

Approximately 250 bighorn sheep currently use the lease site from late summer to late spring. The sheep use reclaimed areas for foraging and the high walls of exhausted pits for escape terrain and travel routes. Sheep travel over non-reclaimed overburden and through active mining sites to gain access to forage areas. Some reclaimed areas located at distance from high walls are not used for forage, while some pits surrounded by coniferous forest or non-reclaimed overburden are not used for travel or escape.

A limited non-trophy sheep hunt was held in the fall of 1984, 1985 and 1987 on a reclaimed portion of the lease area. In addition, the Alberta Fish and Wildlife Division uses this site for capturing sheep for various purposes. A total of 84 sheep have been removed by hunting or other methods over the 4 year period ranging from 1984 - 1987. Eighty-two percent of these animals have been mature females.

Prior to the current mine development, rams were known to use old mine workings in the vicinity of the 50-A-3 pit for mineral licks. Surveys conducted by the Alberta Fish and Wildlife Division (Lynch 1972, Cook et al. 1978, Cook 1982) indicate that sheep were sighted on alpine ranges adjacent to the mine lease as well as on the 50-A-2 backfill. By 1979, large numbers of sheep of all age classes were frequenting reclaimed areas on the mine lease adjacent to timberline and were using the reclaimed south-facing slopes above HWY 40 (G. Acott, CRC, pers. commun.).

Methods

Animal observations in the field were made by direct ground counts from a fixed census route. Counts were begun September 17, 1985 and continued weekly until September 1, 1986. During each count, the location of each individual or group of sheep was marked on acetate overlays on a 1:4,800 base map. Notes were also made on the age

class and activity of each individual within the group. Eight age classes described by Geist (1971:54) were used. They were: lambs, yearling females, adult females, yearling rams, class I (2 yr) rams, class II (3-5 yr) rams, class III (6-7 yr) rams and class IV (8+ yr) rams. A total of 11,933 individual sightings from 138 census trips provided the data base for describing seasonal and spatial distribution of the sheep. Maximum counts of each age class were used to estimate population size for use in depicting seasonal fluctuations of the sheep herd on the lease.

Field data were computerized by coding and digitizing observation locations and by generating a corresponding database containing the numbers, age classes and activities of sheep associated with each location. Maps of data subsets and their locations that depict the cumulative frequency of observations per time period were then generated using the "nmap" program developed by the graphics laboratory at the Faculty of Environmental Design. A grid system with a cell size of 402 x 402 m (1320 x 1320 ft) or 16.2 ha (40 acres) was overlaid on the study area to assist in quantitative and visual analysis of the data. Cell size was arbitrarily selected. Data from the eight age classes were grouped into 2 categories - nursery herd (lambs, ewes, female and male yearlings and class I rams) and older rams (class II, III and IV rams).

Results

Seasonal Distribution

The rams that used the CRC lease during the year of 1985-86 made four seasonal movements which were described as: the fall congregation (prerut), the rut, winter segregation from the nursery herd and dispersal into adjacent alpine ranges during the summer.

The prerut, or fall congregation of rams onto the mine site had already taken place when the study began on September 17, 1985. Rams remained segregated from the nursery herd until early in November when they moved onto the rutting area, which was also the ewe prerut range. The rut was defined as the period when rams and estrous ewes were observed (November 15 to January 18, 1986). The peak of the rut occurred during the second week of December, 1985. In mid-January, the rams segregated from the ewes leaving them on the rutting range. The rams occupied a native south-facing slope that is centrally located on the lease. The rams alternately used this slope and the south-facing slopes above HWY 40 throughout the winter and spring until they began to leave the lease in late May. During the summer, groups of rams were sighted travelling between various alpine ranges. Only the occasional individual or small group was observed on the mine lease.

Four major movements were also observed for the nursery herd that occupied the CRC lease: fall congregation on the mine site (prerut), movement off the mine site by half the herd in late winter, movement to lambing grounds in May and dispersal into alpine ranges for the summer months.

The nursery herd had already congregated on the lease when the study began in September, 1985 where they remained for the rut and early winter season. In mid-February, half the herd left the mine site to winter elsewhere, while the remaining sheep continued to use essentially the same ranges as they had for the prerut, rut and early winter. In mid-May individual ewes began to leave the mine site in search of lambing areas. Most lambing occurred off the mine site with the exception of 6 ewes in 1986 and 5 in 1987 which lambed on the east wall of the 51-B-2 pit. The nursery herd regrouped in alpine meadows adjacent the mine site and used the 50-A-3 pit as a mineral lick throughout the month of June. During the summer, the nursery herd did not frequent the mine lease, but continued to move higher into the headwaters of alpine drainages as the season progressed.

When the above movements for both ewes and rams were combined, 6 seasonal activity periods were identified. These time periods were as follows:

Prerut - 09/17/85 to 11/14/85
Rut - 11/15/85 to 01/18/86
Winter - 01/19/86 to 02/14/86
Spring - 02/15/86 to 05/27/86
Lambing - 05/28/86 to 06/30/86
Summer - 07/01/86 to 08/10/86

Of the 11,933 individual sheep observations made between September 17, 1985 and August 10, 1986, 73% were lambs, ewes or yearlings of either sex, 5% were of class I rams and 22% were of older rams. Sheep were concentrated on the lease from the prerut through to the beginning of lambing season, a period of 256+ days for the 1985/86 season. The prerut period for the 1986/87 season began August 11 when the first large numbers of ewes, lambs, yearlings and class I rams began to appear on the lease. Older rams (class II, III and IV) did not congregate in large numbers for the 1986/87 prerut season until a few weeks later, in early September.

Spatial Distribution

Approximately 1/3 of the observations for the nursery herd (9,349) for the year 1985/86 were made within 32.4 ha (80 acres) of the 50-A-1 and 50-A-2 backfill (Figure 1). Another 1/3 of observations were made within an additional 32.4 ha of the 50-A-2 backfill and within 48.6 ha (120 acres) of the south slopes and valley bottom adjacent to HWY 40. The last 1/3 were scattered over 696 ha (1720 acres) of the lease. The total area used by the nursery herd for grazing, security, mineral licks or travelling within the lease boundaries was 809.4 ha (2000 acres).

Of the 2,584 observations made of the older rams, 1/3 occurred within 32.4 ha of the 50-A-1 and 50-A-2 backfill, plus a 16.2 ha block of the native hill and a 16.2 ha block of the south slopes above HWY 40. An additional 1/3 of observations were scattered over 113.3 ha (280 acres) located on the 50-A-2 backfill, on the slopes adjacent to HWY 40, and on a topsoil stockpile located on the C-baseline ridge. The last 1/3 of observations were located on 696 ha of the lease. The total area used by the older rams was 874 ha (2160 acres).

From the above description it is apparent that the most important area used by the sheep on the mine site is the 50-A-1 and 50-A-2 backfill. This area was reclaimed in 1977, 1978 and 1979 and is used for grazing by the nursery herd during the prerut, rut, winter and spring seasons. Rams congregated here for the rut, during which time the high walls of the adjacent 50-A-3 pit were used heavily by ewes escaping rams and by rams attending receptive females. The benched walls of this pit were used as escape sites, bedding areas, and in May and June the seeps from the walls were used as mineral licks by the nursery group that used the Luscar Creek valley immediately west of the lease. This daily movement was a response to the need for minerals as virtually no grazing took place on the mine at this season.

The sheep also made moderate to heavy use of the native grassed slopes of the large hill that is centrally located on the mine lease. This south-facing slope was used primarily by rams during the winter and spring period when they had segregated from the nursery herd. Heaviest use of this hill was on the NW corner which lies adjacent to the 50-B-3 benched pit wall. This slope and pit wall were used by the nursery herd chiefly as a travel route connecting the 50-A-2 backfill with the HWY 40 area.

The nursery herd used the south-facing slopes and valley bottoms adjacent to HWY 40 heavily during the prerut and spring seasons, while the rams used this area heavily in the winter and spring. This area was seeded in 1976. The east wall of the nearby 51-B-2 pit was used as escape terrain by the sheep when they frequented this area. In May of 1985 and 1986, 6 and 5 ewes respectively lambed on this wall. In 1986, these lambing sites were within a few hundred metres of an active dump site. Most lambing, however, took place off the lease.

Moderate use of the large bench and slopes of a portion of the Gregg dump was made by the nursery herd during the prerut This part of the Gregg dump was reclaimed in 1972 and 1979/80.

Rams also used a topsoil dump located on the C-baseline. This area received heavy use during the prerut. A powerline located on the C-baseline was reclaimed in 1978 while the topsoil island was reclaimed in 1983. Rams have been observed on the C-baseline by mine personnel since 1970.

Discussion and Conclusion

Mining activity at CRC has resulted in a drastically changed landscape. The closed canopy coniferous forest of the central portion of the lease has been replaced by open terrain composed of reclaimed areas, active and abandoned pits and non-vegetated regolith material. Patches of the original coniferous forest and native grasslands are interspersed throughout the mined area. The common feature of bighorn distribution, (the presence of rocky escape terrain in proximity to quality forage) has been reproduced through the process of mining development and reclamation. Every area on

the lease that was used heavily by the sheep for foraging was located adjacent to high walls of exhausted pits. These high walls served as escape terrain for the sheep, as bedding sites, as travel routes, and as sources for mineral licks. Some lambing occurred on benches of the high walls. Seventy-five percent of all sheep observations for the year 1985/86 occurred within 360 m (1181 feet) of escape terrain. No observations of sheep beyond 705 m (2315 feet) from escape terrain were made.

In addition to creating a usable habitat for bighorn sheep, other conditions that exist within the mine lease created a secure environment which was used by the sheep in an opportunistic fashion. Coyotes were observed often on the sheep ranges, however, no predation was observed. Grizzlies travelled through the mine seasonally, but did not linger on the reclaimed areas. Wolf tracks were observed on the peripheral edges of the lease but never in the central portion or on sheep ranges. Cougar sign was not observed. It is thought that while the sheep were on the lease, mortality from predators was minimal.

CRC has been an active coal mining operation since 1969. During the 1985/86 season, 2 pits were active (51-B-3 and 50-B-5). Dumping, grading, regolith and topsoil placement, reseeding and refertilizing activities all took place in areas utilized by the sheep. For the most part, however, these activities occurred in a predictable fashion, or in areas not yet used for forage, or in the summer when there was minimal use of the lease by the sheep. Once a reclaimed area was established on the lease, little activity actually took place on the site. There were no tourists, trail bikers, hikers or skiers. Hunters have been active only recently on the same ranges that are important to the sheep.

Bighorn sheep are modern ice-age mammals that have developed a high capacity for learning. Bighorns have historically used the areas adjacent to the CRC lease prior to its development. Once a usable habitat was developed by mining activity, the sheep were well equipped to take advantage of the predictable, secure environment offered by the mining site.

A significant population of bighorn sheep has developed seasonal and spatial use patterns on the CRC lease. Several factors must be considered and explored further to ensure that this use is sustained in the long term to be of benefit to other developments with similar potential. The significance of the high walls as part of bighorn habitat was not recognized by the Alberta Land Conservation and Reclamation Council (ALCRC) until this study was conducted. Recommendations regarding maintenance of high walls important to sheep have been made to the ALCRC (Acott, 1986) and have been accepted. Recommendations on high wall characteristics and placement in relation to foraging areas will be forthcoming. Future land management must recognize that sheep use of this site in part

depends on a secure and predictable environment. Reclamation efforts designed specifically for human recreation activities may not be compatible with sheep use of the area if they are poorly placed in relation to habitat developed for sheep. Each sheep population and mine operation have their own characteristics. This site-specific wildlife study has proven to be invaluable for mine planning and reclamation efforts.

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