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WINTER STUDIES OF FOREST-DWELLING MOUNTAIN GOATS OF PINTO CREEK, ALBERTA

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ABSTRACT

As a result of increased interest in petroleum development within the Pinto Creek Mountain Goat Reservation, a study was initiated to assess the potential impacts on this atypical population of forest-dwelling mountain goats (Oreamnos americanus). Baseline data were collected on the habits, distribution and basic ecology of the population during the winter of 1981. Suspected population limiting factors and the possible effects of future petroleum development are discussed.

INTRODUCTION

Management studies were initiated in 1980 to examine the potential impact of a proposed natural gas well on the forest-dwelling mountain goats of Pinto Creek, Alberta. Pinto Creek, despite being biogeographically isolated from typical mountain goat range by many kilometers of dense forest, provides suitable habitat for mountain goats. Although solitary mountain goats have been observed in other areas within the foothills of west-central Alberta, Pinto Creek provides the longest term example of a goat herd known to reside in a forested area in Alberta. The known range of the Pinto Creek herd consists of a 13 kilometer section of Pinto Creek and the area surrounding its junction with Hightower and Wroe Creeks. This area offers the only known occupied habitat suitable for mountain goats in the study area.

Mountain goats have inhabited Pinto Creek at least since 1945 and may have used the area as early as 1931 (Kerr 1965). A series of cliffs are connected by regularly used trails through forested areas. The proposed wellsite would be located within 400 m of one of these trails (Figure 1).

Little data is available on the subject of harassment (as defined by Geist 1975) of mountain goats. However, some applicable information is available. Singer (1978) examined the influence of a highway on mountain goat movements to mineral licks and demonstrated a negative correlation of highway crossings towards vehicular and human activity. McFetridge (1977) suggested that where resource development overlaps goat range, the impact on the resident herd may be severe, particularly if a core refuge is disturbed. He indicated "that the total area used by goats, or the frequency of excursions, might be reduced by the presence of heavy

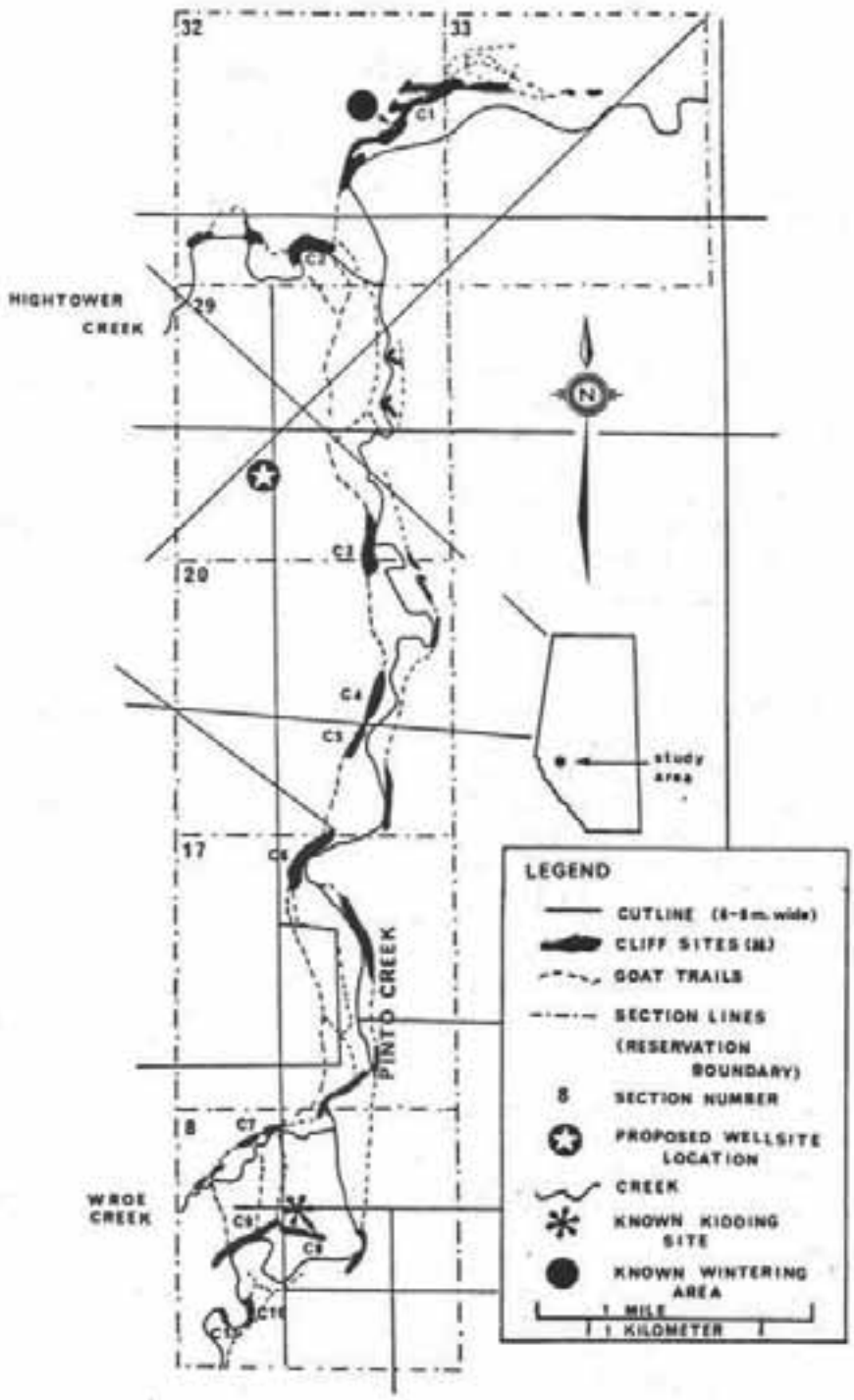

Figure 1. Pinto Creek mountain goat study area.

predation or regular interference by human activity" (p. 84). It was also suggested that the absolute amount of forage available to any herd of mountain goats is a function of the distance that they will travel from core areas of high security. Thus food is a key limiting factor for both the size and distribution of mountain goat herds. Furthermore, it appears that mountain goats are a species particularly vulnerable to disturbance and this high sensitivity should be reflected in management strategies. (Hunting has not been allowed in this area since 1964.)

Preliminary data from aerial surveys have indicated that mountain goats are more tolerant of activity located below them than from above (Bill Hall, Section Head - Wildlife management, Alberta Fish and Wildlife Division, Edmonton, Alberta, pers. comm.). This also has been documented for bighorn sheep (Ovis canadensis) (Geist 1971, Hicks and Elder 1979). Therefore wildlife managers have expressed particular concern that the location of a wellsite on the same contour or slightly above the goat trails will result in habitat alienation through direct disturbance. The ultimate impact would be disappearance of the herd.

Data was collected from 17 January - 13 April, 1981 to determine the habits, distribution and basic ecology of the population during winter and early spring. The purpose of the study was to ascertain whether or not development is compatible with management of these goats.

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STUDY AREA

The study area is located almost entirely within Township 55, Range 26, west of the 5th meridian approximately 38 km northeast of the nearest Rocky Mountain ranges. Total relief varies by less than 110 m throughout the study area (1112 - 1220 m elevation). Rowe (1972) has classified the area as Upper Foothills. The area largely consists of a gently rolling forested plateau dominated by lodgepole pine (Pinus contorta) and white spruce (Picea glauca). The steeply dissected valley breaks are dominated by poplar (Populus tremuloides) in the forest canopy and rose (Rosa sp.), dogwood (Cornus stolonifera), willow (Salix sp.), silverberry (Eleagnus commutata), buffalo berry (Shepherdia canadensis), raspberry (Rubus sp.) and various graminoids in the understory. Pinto Creek is bordered by rock walls, characterized by eroded sandstone and bedrock formations. These cliffs are dominated by bearberry (Arctostaphylos uva-ursi) and several graminoids including hairy wild rye (Elymus innovatus), bluegrass (Poa sp.), fescues (Festuca sp.), wheat grass (Agropyron sp.), and sedges (Carex sp.). Talus-like slopes often are found at the base of the cliffs. In some cases muskegs, dominated by black spruce (Picea mariana), separate the cliffs from Pinto Creek. Similar habitat types are found at the junctions of Wroe and Hightower Creeks.

METHODS

Observations were made with the aid of a 20-40X variable spotting scope and 8 X 40 binoculars. The mountain goats were located each day and observed from the other side of the valley at a distance of approximately 400 - 600 m.

Sex class was determined by horn curvature, urination posture, or both. Individuals were classified as kid, juvenile or adult based on body size (Debock 1970). As the observers became familiar with each individual by sex, horn size and configuration and body size a permanent identificaton number was assigned.

A system of track transects was established along known goat trails (identified by the presence of goat hair, pellets and tracks). These transects were checked periodically to determine daily movements between cliff complexes. Weather conditions and snow depths also were recorded at that time and old tracks erased.

Food habits and habitat selection were determined by direct observation and examination of bedding and feeding areas. In addition, pellet groups were collected and analyzed for lungworm levels using the Baerman technique as described by Samuel and Gray (1982). Fecal crude-protein levels were determined by the Kjeldahl method (Association of Official Analytical Chemists 1965). Wolf (Canus lupus) scats also were collected and analyzed for the presence of mountain goat hair.

Daily activity patterns were determined by recording the total time spent at each activity (bedding, standing, feeding and moving while not feeding) during daylight hours. (One observation hour is 1 mountain goat observed for 60 minutes or 6 goats observed for 10 minutes each). Total observation times varied from 1 to 9 hours per day.

Average hourly temperatures were calculated for each day mountain goat observations were made. The data were obtained from the nearest continually operating weather station at Edson, approximately 90 km southeast of Pinto Creek.

RESULTS AND DISCUSSION

During the study period, the herd was comprised of 3 adult females, a single 2 year old female, 2 adult males, 1 yearling male and 1 male kid for a total of 8 (Table 1). The size of the herd appears to have remained fairly constant in recent years and probably never consisted of more than 12 animals from 1942 - 1962 (Stelfox and Kerr 1962).

The nannies, kid and yearling male were first observed in the northern extent of the study area on 16 January 1981 (Figure 1, cliff #1). By 30 January the entire herd (including the 2 adult males) was observed on this cliff complex. They remained in that area until at least 17 March 1981.

Table 1. Historical mountain goat herd structures in Pinto Creek, Alberta.

Year	≥ Three years		Two years		Yearlings	Kids	Total
	males	females	males	females			
1962[1]	4[4]	5	1	2	3	2	17
1976[2]		7 adult goats			1	1	9
1977[3]		6 adult goats			1	2	9
1981	2	3		1	1 male	1	8

1 (from Kerr 1965)

2 (from Bibaud and Hall 1976)

3 (from Bibaud 1977)

4 (two adult males collected)

Examination of track transects on 25 March 1981 indicated that all of the goats with the exception of 1 adult male moved to the cliff complexes in the southern portion of the study area (cliffs 8 and 9, Figure 1). The goats remained in these same general areas until the termination of field work on 15 April 1981.

The cliff (#1) where the goats spent the majority of the winter is the largest of the south facing cliff complexes in the study area and provides the largest continuous snow free area. Bedding sites on all cliffs typically provided a clear view of the creek valley. However, some bedding sites were found up to 70 m from the cliff edge within the lodgepole pine forest (the majority was within 10 m).

Examination of the vegetation not covered by snow indicated that the majority of dominant shrubs, forbs and graminoids mentioned in the study area description was used as forage. In addition, the goats appeared to be pawing at bearberry in order to expose the roots. Most feeding took place within 50 m of escape terrain. However, on one occasion goats were observed feeding in a lodgepole pine forest as far as 400 m from the nearest cliffs. (Cranberry was the major plant species exposed in craters in the snow).

Daily activity patterns were characterized by bedding early in the day while feeding activity increased towards evening (Figures 2, 3). The lack of early morning activity corresponds with that reported by Geist (1971) and probably is a behavioral adaptation which minimizes energy expenditures during the colder periods of a winter day. A comparison of percentage of standing activity (includes standing, moving and feeding) with the average temperature on an hourly basis may partly explain this phenomenon (Figure 4). (Two linear regression formulas were calculated from the data presented in Figure 4: one formula incorporates all data points, the other formula does not include the outlying data point for the last hour of observation during the day. It is hypothesized that feeding might be overrepresented in the activity pattern at the end of the daylight period (regardless of ambient temperature) if the daily forage requirement had not been met by that time. When the data point for the last hour of observation during the day is ignored, the relationship becomes highly significant ($p < 0.01$). Reducing early morning activity would minimize heat loss by exposing the least amount of body surface area during the coldest period of the day. The resulting reduction of feeding periods would be consistent with the voluntary decrease in food consumption demonstrated by deer (Moen 1973) and moose (Heptner and Nasimovitsch 1968, cited by Geist 1971) in winter months. However, these data may be biased by the fact that direct animal observations were made only when goats were visible on the cliffs. If the majority of bedding activity was limited to cliffs, feeding would be underrepresented in the activity budget (goats were often observed feeding as they disappeared from view). This was particularly relevant to the observations of the adult males and for this reason the data comparing standing activity and average hourly temperature for adult males is not included. On numerous occasions they were not observed for the entire day

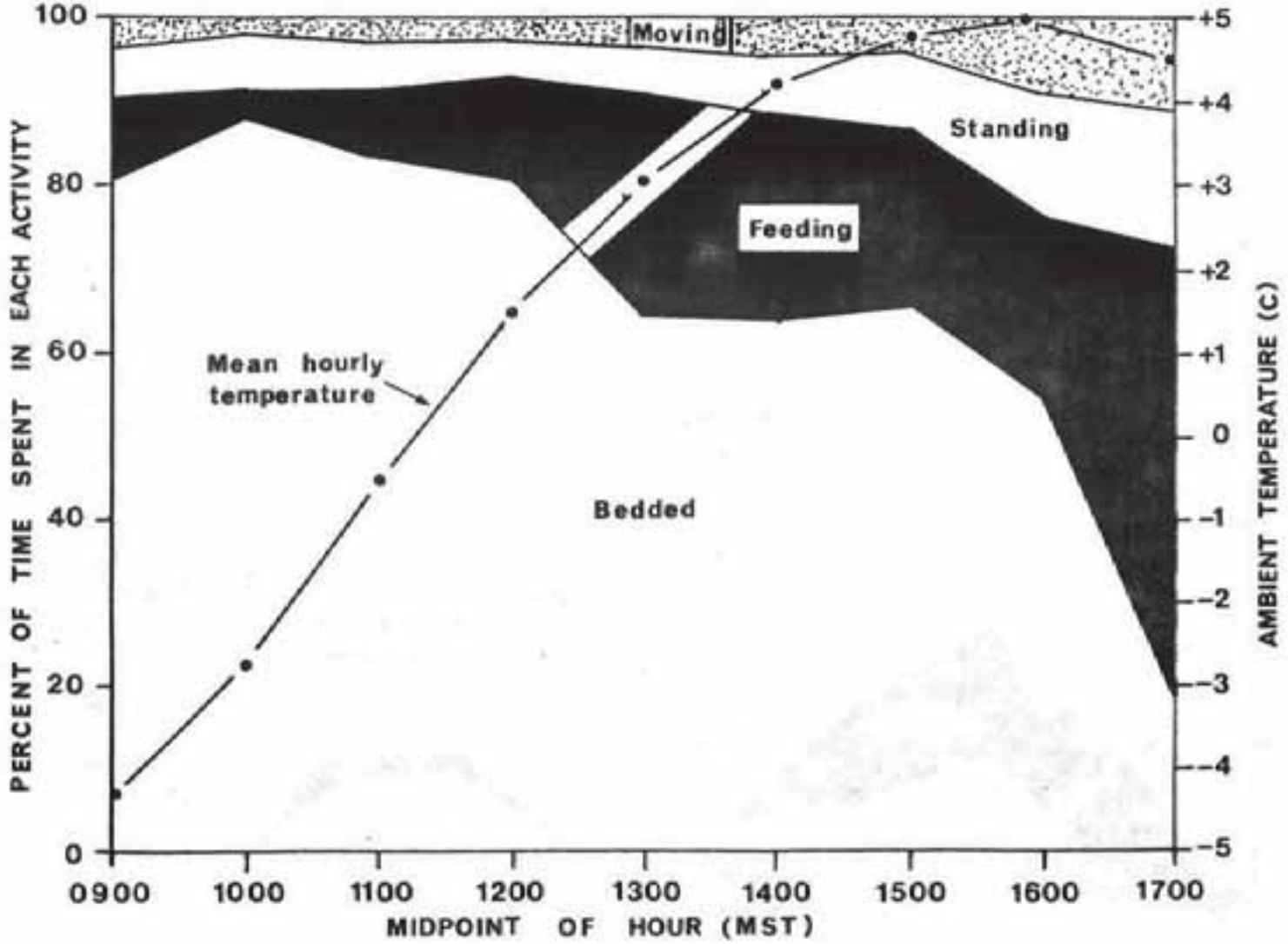

Figure 2. Percentage of time spent by nannies, kid and juvenile male in Pinto Creek, Alberta based on 498 observation hours during January 17 - April 13, 1981. Mean hourly temperature calculated from Edson, Alberta for those days mountain goat observations were made.
[a]Moving while not feeding.

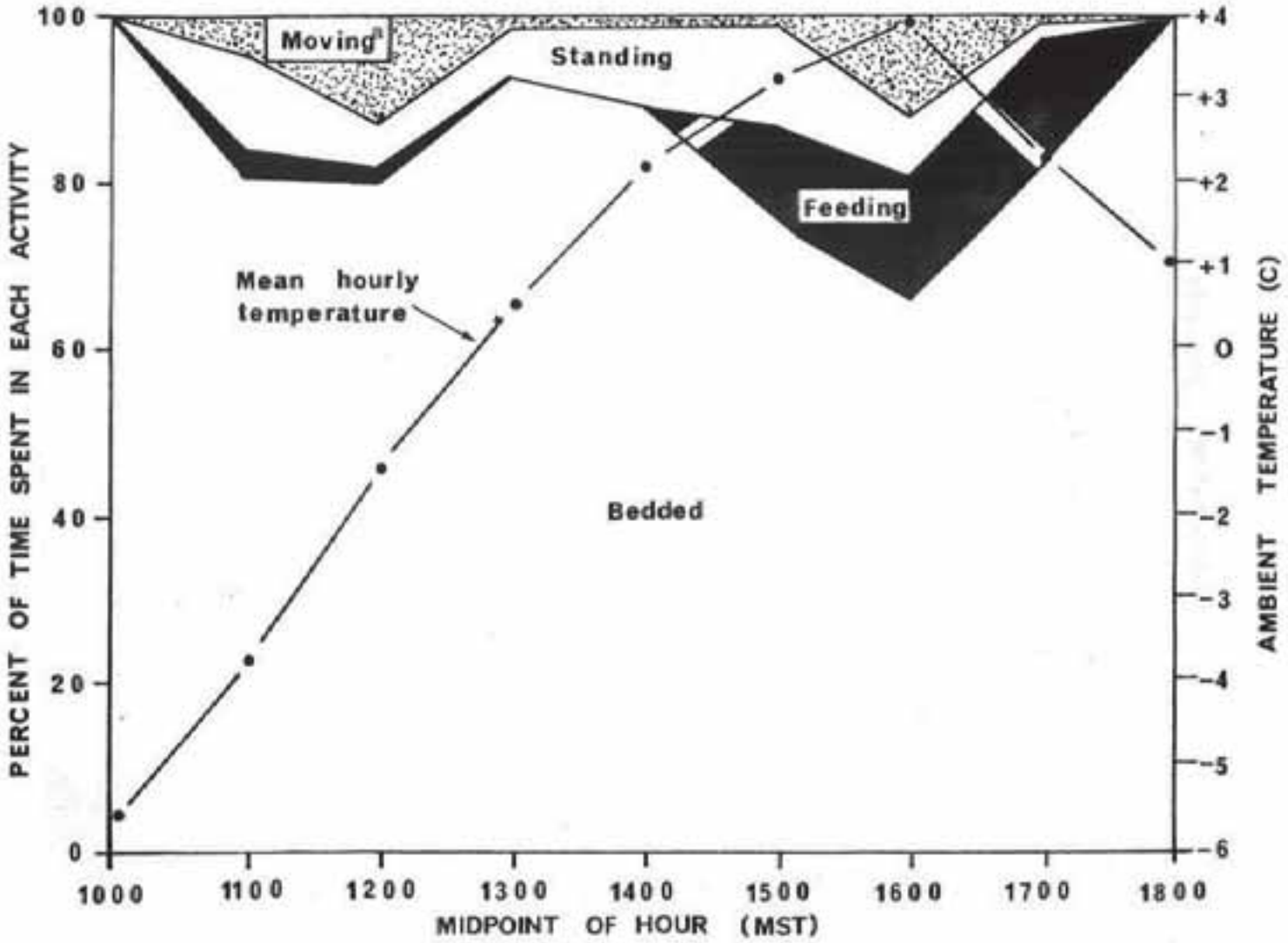

Figure 3. Percentage of time spent by adult billies in Pinto Creek, Alberta based on 52.3 observation hours during January 17 - April 13, 1981. Mean hourly temperature calculated from Edson, Alberta for those days mountain goat observations were made.
[a]Moving while not feeding.

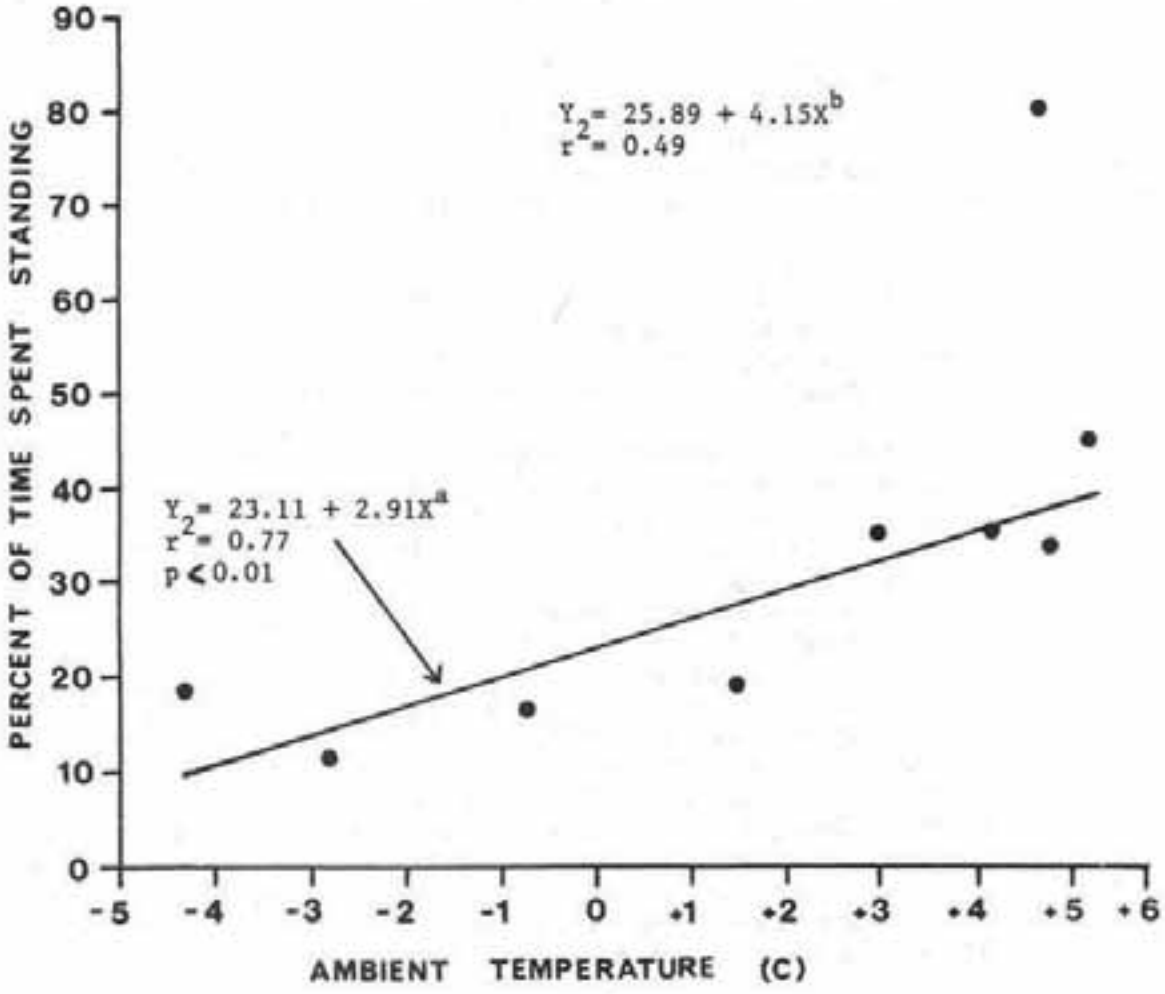

Figure 4. Relationship of percent of time nannies, juvenile male and kid spent standing (includes moving, feeding and standing) to varying ambient temperatures. Ambient temperature calculated as hourly means from Edson, Alberta for those days mountain goat observations were made.

[a]This linear regression formula does not include the outlying data point representing the last hour of observation during the day.
[b]This linear regression formula includes all data points.

even though track transects did not indicate that these animals had moved to adjoining cliff complexes. In these cases, all their activities occurred in, or near the forest. Geist and Petocz (1977), observed mature bighorn rams utilizing slopes significantly further from escape terrain than ewe-lamb groups and the same could hold true for mountain goats. In addition, the ability of male ruminants to limit food intake much more than female-young groups (Moen 1973) helps to explain the data presented in Figure 3. Continuous observations of the nanny-juvenile male-kid group indicates that the data more accurately reflects their actual activity patterns.

LIMITING FACTORS

Potential factors which might be individually or collectively limiting the Pinto Creek mountain goat herd include: illegal hunting, predation, emigration, interspecific competition, parasites, inbreeding and limited range.

Direct evidence does not exist which suggests that illegal hunting is limiting the herd, although access is readily available during winter months by snowmobile. However, this possibility can not be eliminated because poaching is very difficult to document.

Predation is another possible limiting factor. Wolf tracks were observed on the study area in late January and late March. Although evidence of mountain goat was not found in wolf scats collected during the summer of 1980 (N=7) it is possible that wolf predation could have a significant impact on the mountain goat population, particularly if wolves were to encounter goats between cliff complexes. (Mountain goats would be more vulnerable to wolf predation in these areas due to the lack of escape terrain). In addition, lynx (Lynx lynx) and black bear (Ursus americanus) tracks and golden eagles (Aquila chrysaetos) were observed on the study area. Furthermore, a significant grizzly bear (Ursus arctos) population (estimated at one bear per 70 sq. km) inhabits the general area (Nagy 1982). All of these species could prey upon mountain goats. If emigration is maintaining the band at a constant level, those animals have not been observed as established herds in similar areas. Predation may be limiting the opportunity for this to occur. Mountain goats have been observed on the Berland River (downstream destination of Pinto Creek via the Wildhay River) for short durations.

Elk (Cervus canadensis), moose (Alces alces) and mule deer (Odocoileus hemionus) are found in the study area. Although all 3 ungulates utilize forage species common in the diet of mountain goats, their preferred habitats differ; goats prefer areas close to the cliff faces, a zone the other species usually do not occupy.

Results of fecal analyses suggest high levels of "lungworm" infections (Figure 5). Levels of larvae of the nematode family Protostrongylidae in goat feces are higher than reported for other mountain goat populations (Cooley 1976, McFetridge 1977), however, these authors did not sample goats during the late winter-spring when the highest counts are usually recorded (Bill Samuel, Department of Zoology, University of Alberta, Edmonton, Alberta, pers. comm.). Although most larvae were straight-tailed and presumably are Protostrongylus stilesi or P. rushi, the usual lungworms of goats (Samuel et al. 1977), 85 percent of 15 samples examined under a compound microscope contained some spined larvae (not Protostrongylus sp.). Spined larvae were also found in 58 and 70 percent of the goats from the Skeena and Stikine Rivers, respectively, in British Columbia (Samuel and Foster, unpubl. data). The identity of this larvae has not been confirmed, however, several possibilities exist. Parelaphostrongylus odocoilei adults were recovered recently from a mountain goat from Washington State and one from Jasper National Park, Alberta (Margo Pybus, Bill Samuel, Department of Zoology, University of Alberta, Edmonton, Alberta and Bill Foreyt, Department of Veterinary Microbiology and Pathology, Washington State University, Pullman, Washington, unpubl. data). In addition, adult lungworms of the genus Muellerius were recovered from bighorn sheep lungs from the "Black Hills" of South Dakota and also could occur in mountain goats (Pybus and Samuel, unpubl. data). Their larvae are spined.

It was also found that 2 percent of the dorsal spined larvae also had a ventral spine on the tail. Double spined larvae have not been reported in feces of North American wild ruminants, but are known from Chamois (Rupicapra) in Europe and may be similar to those found in feces from mountain goats (also rupicaprids) in Pinto Creek (B. Samuel, pers. comm.). There also is a possibility that the nematode has not been described previously. In summary, more than the usually-recorded Protostrongylus spp. occur in the Pinto Creek goats. Whatever their identity, continuous use of restricted range throughout the year increases the possibility of reinfection by them.

Inbreeding could be a factor limiting population growth. "A review of the literature shows that even a small amount of inbreeding typically undermines fecundity and viability" (Soule 1980, p.168). Ralls et al. (1979) presented data "which suggests that increased juvenile mortality in inbred young is a general phenomenon in ungulates" (p.1102). Furthermore, based on a rule of thumb employed by animal breeders, the basic rule of conservation genetics is that the maximum allowable rate of inbreeding is 1 percent, which corresponds to a genetically effective population size of 50 (Soule 1980, p.168). (The Pinto Creek herd totalled 8 during the winter of 1981). However, limited observations suggest that immigration occassionally occurs and could contribute genetically to the population. (Two males collected by Kerr were physically comparable to mountain goats from populatins with much larger gene pools (Kerr 1965, Rideout 1978).

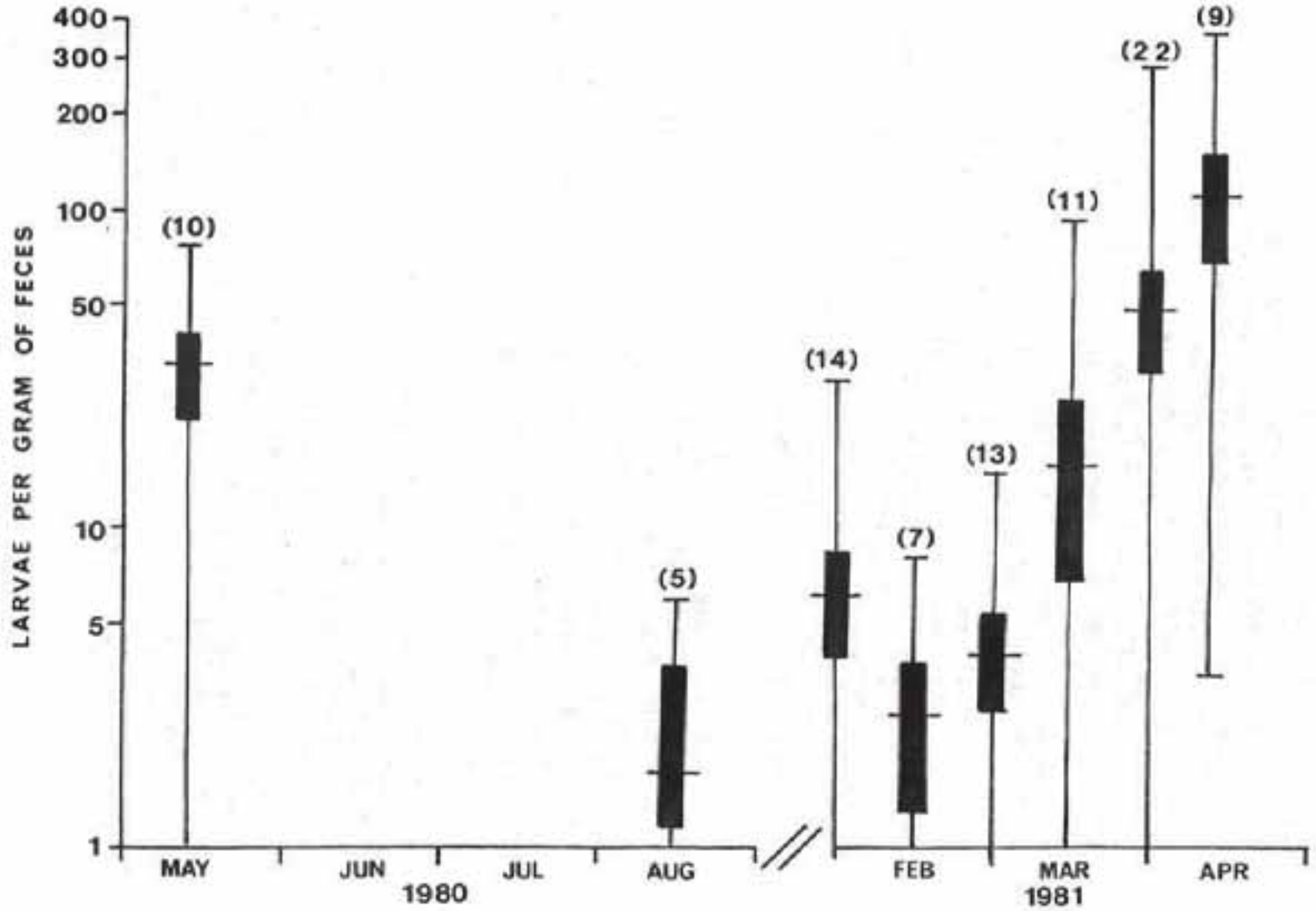

Figure 5. Seasonal changes of larvae of the nematode family Protostrongylidae in mountain goat feces from Pinto Creek, Alberta, 1980-1981. Means, ranges, ± one standard error and sample sizes (in parentheses) are presented.

Fecal crude-protein values (Figure 6) were comparable to those observed in other mountain goat populations (McFetridge 1977). The available forage appears to be of sufficient quality to provide a suitable plane of nutrition. However, the reliance of the herd on a single cliff complex for the majority of the winter suggests that a combination of range and availability of secure habitat might be a significant limiting factor on herd size.

All of the aforementioned factors, with the exception of interspecific competition, may be playing an active role in limiting the Pinto Creek goat herd.

POSSIBLE EFFECTS OF PETROLEUM DEVELOPMENT

The Pinto Creek goat herd has successfully colonized a very restricted range. Limited observations during the year indicate that continuous movement between cliff complexes is typical for all seasons, with the exception of winter, suggesting a rotational-like grazing system. Any disturbance of this routine could severely limit alternatives for the herd. Therein lies the most detrimental possible effect of drilling an exploratory natural gas well within the Pinto Creek study area. The herd could be forced to abandon all, or part of its core range of high security because of activities associated with petroleum development. This could result in the demise of the herd due to the lack of alternative and suitable habitat with escape terrain. Abandonment could be the result of visual, auditory and olfactory stimuli related to drilling activity or direct human harassment.

More subtle impacts might include disruption of daily activity patterns, habitat selection, and seasonal distribution. This would disrupt the herd's ability to use an already limited range and thus could affect the viability of the population by reducing productivity. Increased access would also increase opportunities for illegal hunting.

Habituation, similar to that documented for highway crossings by mountain goats (Singer 1978) might be the only possible behavioral alternative if the Pinto Creek goats are to survive with development. Evidence to date suggests that the disturbance must occur predictably and persistently to allow for habituation (Geist 1978); criteria somewhat foreign to petroleum development. Even if this can be accomplished, factors such as illegal hunting, and human harassment will be very hard to control after the initial access is provided and could severely affect the Pinto Creek herd.

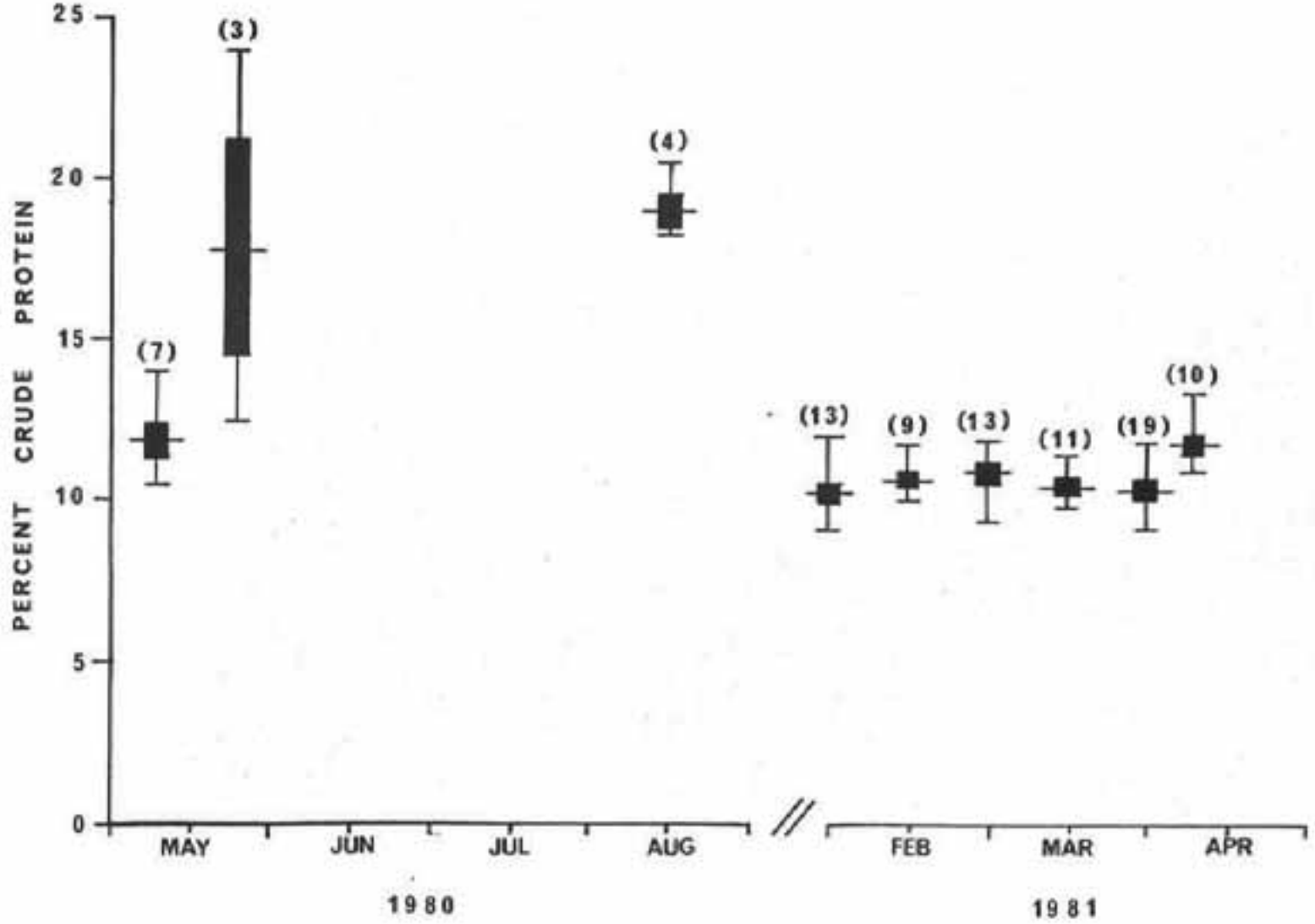

Figure 6. Seasonal changes in fecal crude protein content of mountain goats from Pinto Creek, Alberta 1980-1981. Means, ranges ± one standard error and sample sizes (in parentheses) are presented.

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CONFERENCE DISCUSSION

Q. Was there any attempt by the oil company to move their wellsite further away from Pinto Creek by direction drilling?

Ans. The proposed location would require directional drilling. We were given the impressiong that the "gas pocket" is underneath Pinto Creek itself and the proposed location was the maximum distance the wellsite could be removed from the target area.

Q. Do you have any information regarding the impact of petroleum activity on other species in your region that you could apply in this situation?

Ans. Yes, we have limited data for elk, moose and deer, however, we felt that the forest-dwelling goat population was somewhat unique and therefore warranted special attention. We weren't prepared to extrapolate the information from the other species since we were concerned that goats would be more sensitive to distrubance, particularly in this situation.

Q. Do you realistically feel that you can control petroleum development because of 8 mountain goats?

Ans. I'm confident that if the research indicates that there is a very high probability of petroleum activity resulting in the demise of the goat herd, that we would be successful in avoiding it. Although we know of two other small herds in similar habitats which are equivalent distances from mountain ranges, they do not appear to be as successful. One could take the opposite approach and ask the question "Do you feel that this atypical mountain goat herd should be sacrificed at the expense of a natural gas well of which hundreds are currently capped in Alberta but not producing because of lack of market or low prices"? I admit an oil well would be a different situation. Perhaps an analogy in the U.S. would be the concern over 250 snail darters and the proposed dam which could adversely affect them, although I admit I'm not well informed on that situation.

Q. Have you looked at alternatives to cancelling the petroleum lease?

Ans. Perhaps one option would be to transplant the goats, however, as I mentioned previously, the herds in similar habitats have not been doing well. We have transplanted goats from one mountain complex to another in Alberta, but that herd is only maintaining itself at very low numbers and doesn't appear to be expanding.

Another option might be to exchange the drilling rights for adjoining lands or lands in other promising gas fields, however, the companies' argument would probably be that they are reasonably confident they would be successful at Pinto Creek based on considerable exploration (seismograph) effort and this could not be guaranteed in other areas. The Alberta government does not have a record of returning monies collected for mineral rights.