

PRELIMINARY RESULTS OF USING TRANSPLANTS TO RESTOCK HISTORICALLY OCCUPIED MOUNTAIN GOAT RANGES

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Abstract: Between 1993 and 1995, 78 mountain goats were transplanted to four different release sites in southern Alberta in an effort to repopulate portions of range previously occupied by nearby goat populations. Goats were obtained from 4 separate locations in British Columbia and 2 areas of Alberta and transplanted in late summer. Radiocollars were placed on 35 goats to facilitate monitoring. Goats were captured by aerial netgunning with one mortality. Nine radiocollared goats died 3 days to 2.5 years post-release (1 capture myopathy, 1 grizzly bear predation, 1 wolf predation, 2 accidental falls, and 4 from unknown causes). Goats either established home ranges around the release site or dispersed to establish home ranges in areas distant from where they were released. Average distance from release site to center of home ranges was 27.6 kms (range 7.7-67.6 kms). No differences were detected between billies and nannies in the distance moved, however, the sample size for billies was small. Due to the great distances moved before home range establishment, these transplants were not particularly successful in reestablishing populations in some of the desired target areas.

INTRODUCTION

Several mountain goat (*Oreamnus americanus*) ranges in southern Alberta experienced major population declines in the early 1950s to 1960s (Gates 1972). The suspected cause of these declines was attributed to excess hunting pressure on goat populations as a result of increased access into previously inaccessible areas of the mountains. While hunting seasons were regulated by license and a limit of 1 goat per license applied, there were no limits on the number of licenses. Prior to the expansion of road building in the area, most populations were protected from overharvest merely by their inaccessibility. By 1960, it had become evident that several ranges (i.e. Highwood Range) no longer harbored viable goat populations.

Goat hunting was curtailed in southern Alberta by 1969 but continued in other areas of the province through the issuance of permits designed to limit harvests and better distribute the kill. Wildlife managers felt that goat populations in southern Alberta would increase on their own and naturally recolonize these previously occupied areas, however, that did not appear to be happening and other alternatives such as transplants were considered. The failure to recolonize was believed to be the result of poor recruitment experienced by nearby populations.

Our objective with these transplants was to rees-

tablish viable goat populations on outlying areas of suitable habitat. Early attempts to transplant goats started in 1986 and continued for 3 years, however, capture methods proved inefficient, time consuming, and manpower intensive (Smith 1986). Only a few goats were actually moved. In 1993, funding was made available to capture and move relatively large numbers of goats using methods more reliable but also more expensive. This report describes the preliminary results of our attempts to repopulate portions of historical goat ranges in southern Alberta from 1993 to 1996. Monitoring of the transplants is expected to continue for 2 more years.

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TRANSPLANT SITES AND METHODS

Preliminary selection of transplant locations was made from aerial photographs and topographical maps of the mountainous regions of southern Alberta. Historical records were examined and interviews conducted with individuals who had a long history of use (usually hunters, outfitters, or Department Forestry officials) in the areas. More detailed examinations were then done of topography, vegetation components, and other factors characteristic of other goat ranges in the area (Gates 1972, Ross 1993). A detailed vegetation analysis (species composition, biomass) was done for one of the areas (Barnaby Ridge) (Gates 1972). Additional factors such as isolation from other ranges, present and future land use, and presence/absence of resident goats were also considered.

Four areas were selected to receive the initial transplants: Highwood Range, Nihahi Ridge, the Livingstone Range, and Barnaby Ridge (Figure 1). All four of these sites harboured goat populations in the past and except for Barnaby Ridge some resident goats were known to exist on the ranges prior to any of these releases. Our objective was to release at least 20 goats consisting of primarily young animals (<5 years of age) into each area with a sex ratio of approximately 3 females to 1 male. To avoid disrupting nanny-kid bonds, no kids or nannies with kids were to be captured.

Goats were captured from several areas in British Columbia and Alberta (Figure 1) where populations were large and stable enough to contribute animals. A helicopter using a netgun was initially employed to capture goats. Each animal was then hobbled, blindfolded, fitted with horn guards, and transported back to a staging area in the backseat of the helicopter. A mild dose (50-100 mg) of xylazine hydrochloride (Rompun) was administered to excessively struggling goats. Once at the staging area, individuals were fitted with either coloured Allflex ear tags, a radiocollar with mortality sensor, or a coloured identification collar. Ivermectin was administered at a dose of 0.2 mg/kg and Vitamin E-selenium was given at a dose of 1ml/100 lbs. Some goats received an injection of Covexin 8 and Penicillin (Derapen 5-10 cc).

After processing, goats were placed in individual wooden crates and held in a 21-ft refrigerated "reefer" transport truck to ensure that hyperthermia would not result as daytime temperatures had the potential to reach 25°C to 30°C. Goats from White River were released on the same day as capture and did not require the reefer truck. These animals were kept cool with water and ice. Due to the great distance between capture site and release site, groups of goats captured in one day were then flown back to southern Alberta on a

Dash 8 aircraft. This greatly reduced the time the goats had to be held in the crates and allowed us to go farther afield to capture animals. Upon arrival, crates were loaded onto pickup trucks, driven to the release areas and either slung by helicopter into an alpine area on the target transplant site or driven to an area near treeline and released. Whenever possible, goats were released as a group.

Monitoring flights by helicopter were conducted following releases in order to document mortality, movements, and productivity. The timing between flights varied considerably. More frequent flights were made immediately following the release and during spring kidding season. Fewer relocations were available for analysis for the 1995 releases. Sequential relocations were used to determine post release movement patterns and to calculate sizes and locations of settled home ranges where possible. Distances from the centre of settled ranges to an individual's respective release site were calculated for each of the radiocollared goats where sufficient relocations were available. It was also noted whether the release site was within the settled range.

RESULTS

Captures

Twenty six, 6, and 46 goats were captured and released in 1993, 1994, and 1995 respectively (Table 1). Releases occurred during August and early September. All of the planned transplant sites except Barnaby Ridge received the desired number of goats. Only 6 goats were released on Barnaby Ridge. Due to the large area of the Highwood Range transplant site, it was decided to release 40 goats at 2 different locations (Pickeljar Lakes, and Trap Creek) but all within the same range.

Helicopter netgunning proved to be a very efficient and relatively animal safe method of capturing mountain goats. Only one goat died during the capture process of the operation. This was a yearling female which stopped breathing while it was being brought to the staging area. Efforts at revival failed.

An experienced crew was able to be selective in the sex and age of individuals captured. Avoidance of nanny-kid groups was possible and only one lactating nanny was captured. This nanny was in a group with 2 other goats neither of which were kids. She may have recently lost her kid or been briefly separated at the time of the capture operation. While it was possible to distinguish old billies from young billies, it was much more difficult to distinguish old nannies from young ones. Thus, several older than desirable (7-8 year old) nannies were captured.

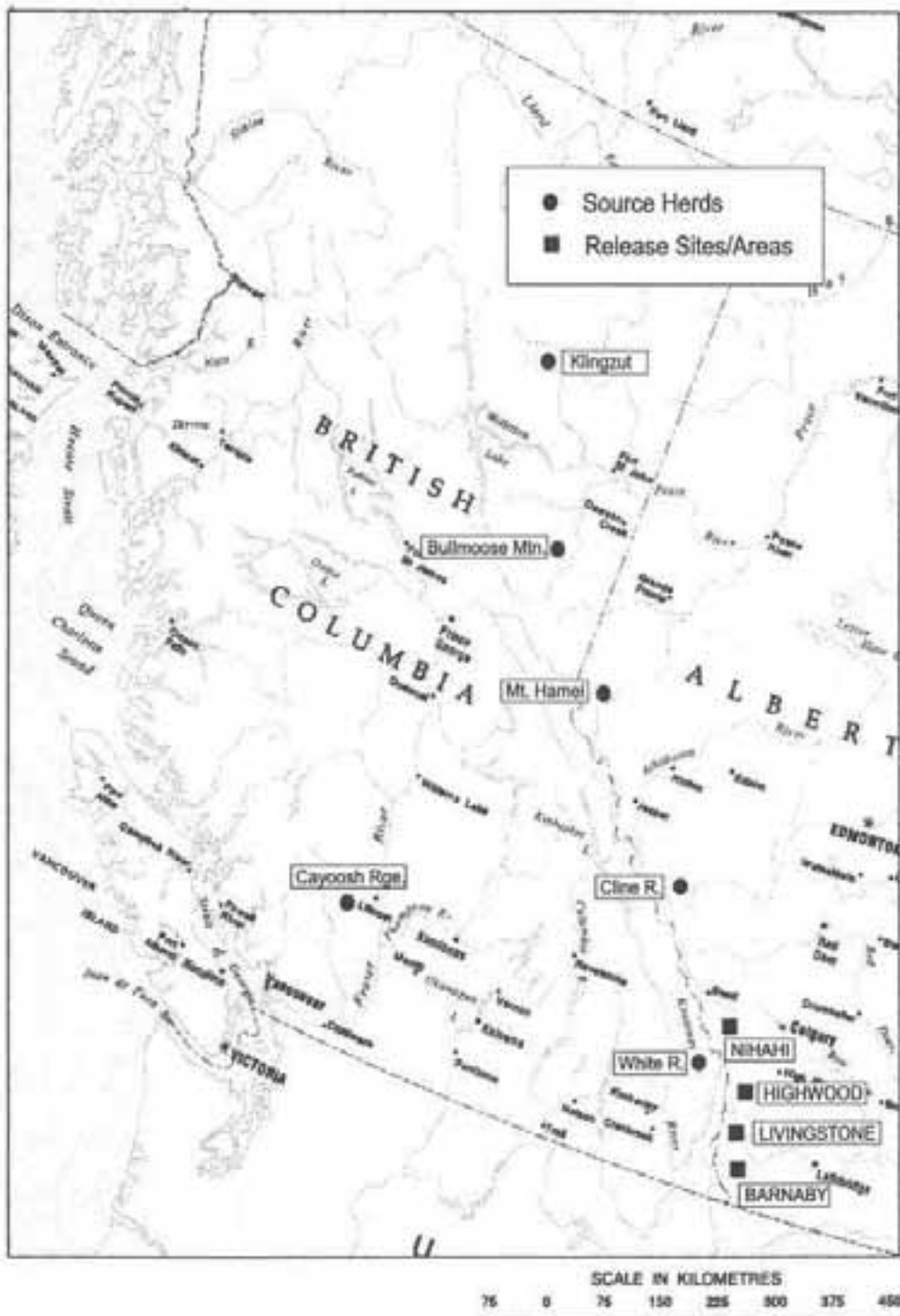


Figure 1. Locations of source herds and release sites for mountain goat transplants, 1993-1995.

Table 1. Summary of Goat transplants in Southern Alberta, 1993 to 1995

Release Site	Year	No. of goats	Sex	Age (yr)
Livingstone Range	1993	5	4 F 1 M	1-5 8
	1994	6	5 F 1 M	3-8 2
Highwood Range - Pickeljar Lakes	1993	21	15 F 6 M	1-9 1-6
	- Trap Creek	1995	20	12 F 8 M
Nihahi Ridge	1995	20	15 F 5 M	1-5 1-3
Barnaby Ridge	1995	6	5 F 1 M	3-4 2

Xylazine hydrochloride (Rompun) was administered to the first goats captured in 1993 and 1994 but discontinued after several animals went into respiratory distress and required manual resuscitation and an antidote, Idazoxan, to reverse the effects of the Rompun. Some individuals appeared to be quite sensitive to even small doses when captured via netgunning.

The use of the refrigerated truck proved most valuable in preventing hyperthermia. This method excluded the need for ice or water to cool individuals. The plane reduced the need to spend long hours in transport time (2 hrs vs. 14 hrs), however in most circumstances, logistics required the goats to be held overnight in order for the plane to load, return to an appropriate airstrip, and get the animals to their respective release sites before dark. Except for the goats released on the Livingstone Range and Trap Ck. (High-

wood Release site), goats were transported in their crates by helicopter to an alpine area and released in groups. While goats were released together, they invariably scattered in all directions and did not appear to remain together as any kind of cohesive group.

Mortality

Radiocollars were placed on 35 of the goats released between 1993 and 1995. One of these collars malfunctioned and the animal has not been found since release. As of the most recent relocation flights (October 1996), 9 of these goats had died (Table 2). Mortality causes ranged from grizzly bear and wolf predation to what appeared to be accidental falls. Several were found dead from unknown causes. Early in the first capture operation one very large billy was captured (estimated age 7 years). This billy died of capture myopathy within a week of release. One additional non-radiocollared billy was shot by a hunter in British Columbia during the legal hunting season. This goat had moved approximately 9.5 kms west of its release site on the Highwood Range.

Productivity

Based only on visual observations of radiocollared animals, nannies were documented to have produced kids on at least three of the release sites (Table 3). There was a potential to be 5 kids from Barnaby Ridge nannies. However, visual sightings were not made during any of the summer relocation flights leaving their productivity status unknown. Because of the infrequency of relocation flights during spring, some nannies may have had kids without our knowledge or lost their kids by the time they were observed. Not all nannies of breeding age (>2 years) appeared to

Table 2. Mortalities of radiocollared goats released between 1993 and 1995 (as of October, 1996).

Number of Goats Transplanted = 78	Number of Radiocollared Goats = 34*	Number of Radiocollared Mortalities = 9 (26%)		
Release Date/Location	Date Found Dead	Age	Sex	Cause
August 27, 1993/ Highwood	September 3, 1993	6	F	Grizzly bear
August 31, 1993/ Livingstone	September 2, 1993	7	M	Capture myopathy
August 25, 1993/ Highwood	May, 1994	9	F	Suspected fall
August 27, 1993/ Highwood	August, 1994	7	F	Unknown
August 25, 1994/ Livingstone	November, 1994	2	M	Unknown
August 27, 1993/ Highwood	January, 1996	4	F	Unknown
August 27, 1993/ Livingstone	March, 1996	8	F	Unknown (poor body condition)
August 30, 1995/ Barnaby	September 9, 1996	4	F	Wolf predation
August 30, 1995/ Barnaby	September 9, 1996	4	F	Suspected fall

* 1 additional radiocollar malfunctioned and not included in total.

Table 3. Productivity of transplanted nannies released between 1993 and 1995 (as of October, 1996).

Release Area	No. of potential kid-years	No. of kids with observed collared nannies
Livingstone Range	13	status of 3 unknown 4 (40%)
Highwood Range	17	status of 3 unknown 4 (28%)
Nihahi Ridge	6	status of 1 unknown 2 (40%)
Barnaby Ridge	5	status of all unknown

produce kids and some nannies were never known to have produced a kid despite having been monitored for 3 potential seasons. Other nannies have produce a kid in each potential year. One 1995 nanny from Nihahi Ridge moved away from its release site onto an isolated mountain peak (Moose Mountain) where there are no other goats.

Movements

After release, movements of radiocollared goats mostly followed two distinct patterns. One pattern consisted of a series of long range movements away from the release site followed by the establishment of a settled home range (Figure 2). In such instances, the release site was not part of the settled home range. Home range establishment usually occurred within 1 month of release. The other type of pattern involved the establishment of a settled range around the release site with the release site included in the settled range (Figure 2). These individuals essentially established settled ranges around their respective release site.

Some exceptions to these patterns did occur. These invariably involved goats which appeared to have settled down and established home ranges only to leave the settled range several months to a year later. For example, an adult nanny released on the Livingstone Range in 1993, established a settled range that included the release site and remained there for a full year. In 1995, she had a kid and then shortly thereafter left her settled range and migrated across approximately 16 kms of conifer covered foothills to an isolated mountain (Crownsnest Mountain) and has stayed there since.

Highwood and Nihahi Ridge

For three goats an insufficient number of relocation points were yet available to confidently delineate the location of a settled range. For animals where enough relocation points were available ($N = 18$), 89% of the radiocollared goats established settled ranges away from their release site. Only 2 individuals

established a settled range within which was included the release site. Distances from release sites to the centres of settled ranges were calculated for goats with sufficient relocation points (Figure 3). Goats with settled ranges away from the release point, moved an average of 29.4 kms (range = 7.7 to 67.6 km) away from their respective release sites. Two goats had settled ranges more than 60 kms from their release point. One other animal could not be found following its release but was found coincidentally 10 months later by Banff National Park staff west of Peter Lougheed Provincial Park in British Columbia approximately 42 kms from its release point. For the 2 goats with settled ranges that included the release site, the distances to the centre of the settled range was 7.3 and 5.1 kms.

There was no correlation between age of female goats and the distance moved prior to establishing settled ranges ($y = 9.9 + 4.1x$, $r = 0.44$, $df = 12$). Yearling animals were not radiocollared so they were not included in the above analysis. It was also not possible to adequately compare the movements of billies versus nannies as few billies were radiocollared. There was some indication that young billies may be less inclined to move long distances from a release site (Figure 3), however, an adequate sample of old billies was not available for good comparison.

From the analysis, it can be seen that most of the goats moved away from the immediate area of the release site and established home ranges in other locations. As a result of this dispersion, most of the home ranges for the Highwood and Nihahi Ridge transplants were established in areas outside of the desired target areas (Figures 4 and 5).

Livingstone Range

Goats released on the Livingstone Range appeared to exhibit only slightly more fidelity to their release site than those released at either the Highwood Range or Nihahi Ridge. Of 6 radiocollared goats released on the Livingstone Range, 3 (50%) have remained in the vicinity of the release site and in the target area while at Nihahi Ridge and the Highwood Range 0% ($N = 7$) and 18% ($N = 11$) respectively established settled ranges that were on the target area and included the release point. Those which moved away from the target area, moved an average of 19.7 km (Figure 6). These goats all moved from the Livingstone Range to Crownsnest Mountain (Figure 7).

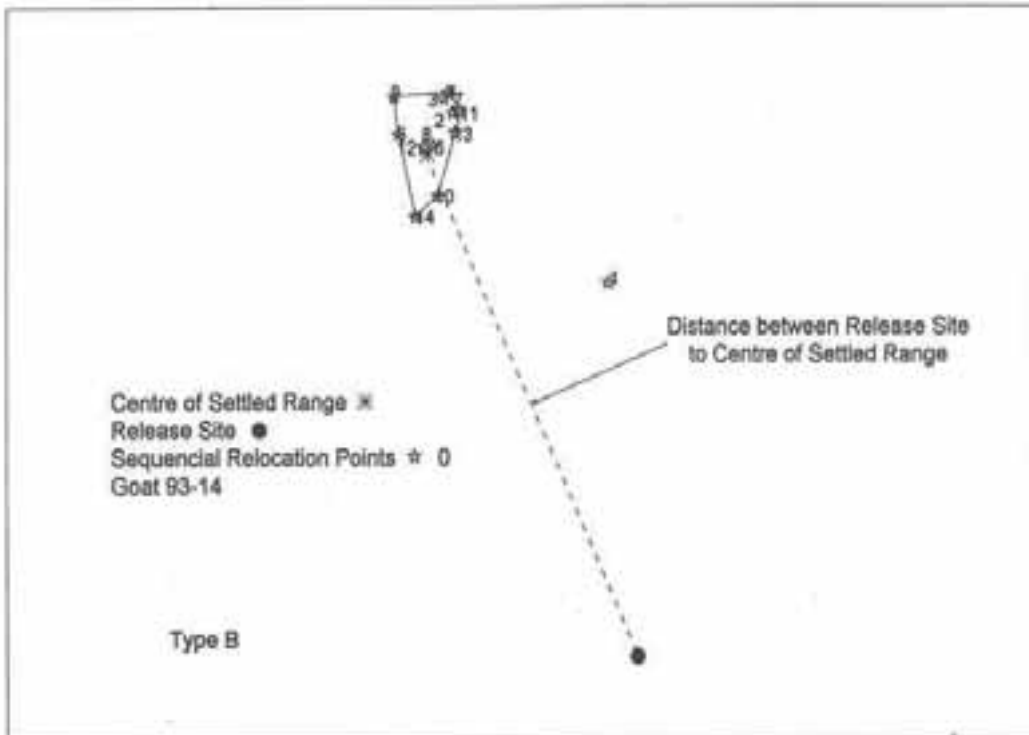
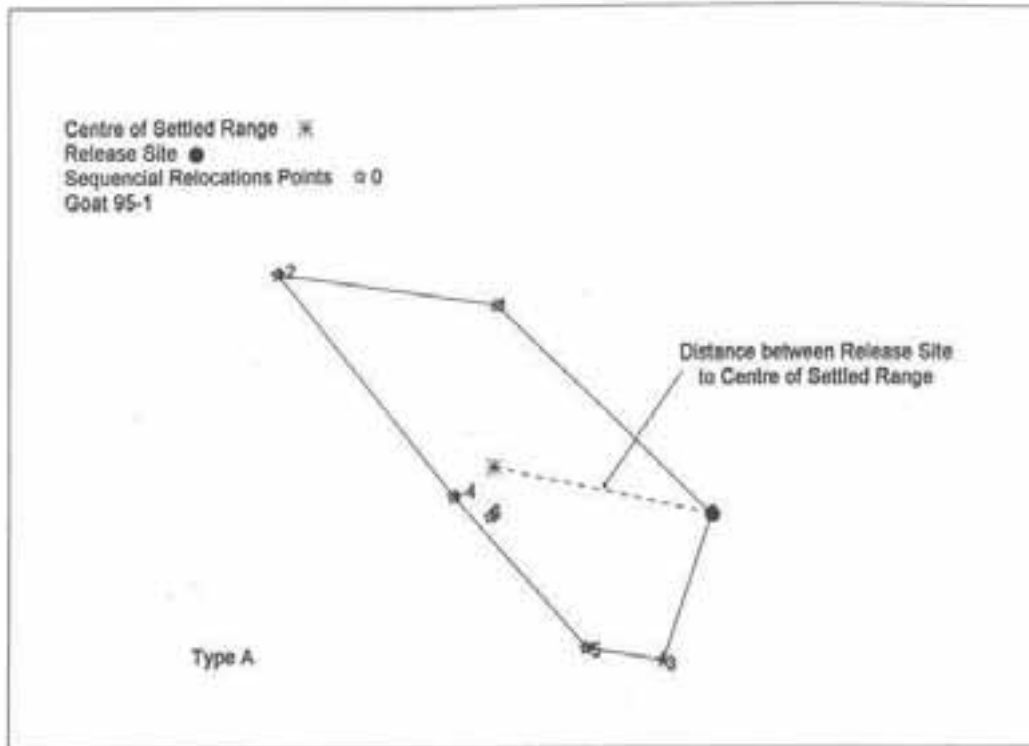


Figure 2. Patterns of movement displayed by mountain goats following their release in 1993-1995. Type A shows pattern where settled range includes the release point. Type B illustrates pattern where settled range does not include the release point.

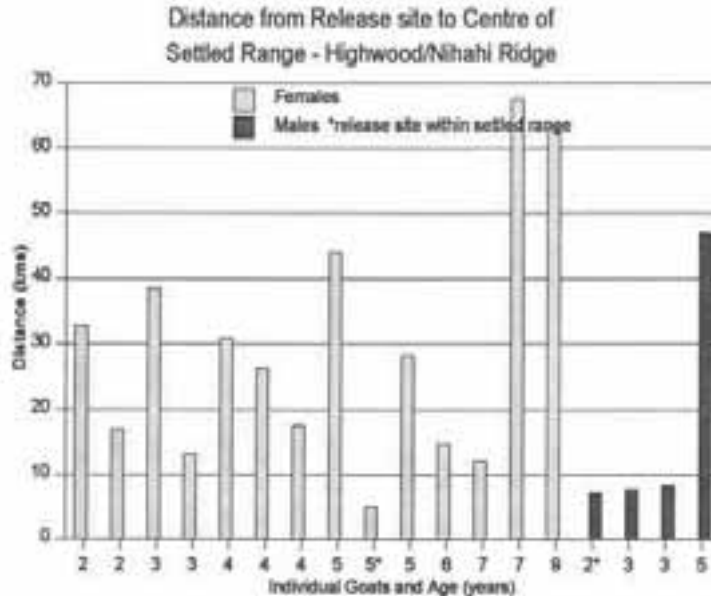


Figure 3. Locations of Settled Ranges in Relation to Release Site for Radiocollared Goats released at the Highwood and Nihahi Ridge sites, 1993 to 1996.

Barnaby Ridge

Barnaby Ridge goats also exhibited the same tendency to move away from the release area to establish settled ranges in other areas (Figures 7). Of the 6 goats released in 1995, one had a malfunctioning radiocollar and has never been found. Of the remaining 5 with working radiocollars, only one has remained on Barnaby Ridge. Another individual appeared to have settled down on Barnaby Ridge only to move approximately 7.5 kms off the ridge a year later and cross the valley to the west where it was found dead. The other 3 goats moved an average of 18.5 kms (range 10.5-26.2 kms) away from Barnaby Ridge before establishing a settled range. Two of these goats had moved into British Columbia where one was found dead (wolf predation). The other goat moved south into Waterton Lakes National Park.

DISCUSSION

Capturing goats by helicopter netgunning proved to be a very efficient and safe method. An experienced crew was able to quickly capture animals with minimal chasing and without the need for drugs. Also important was their ability to be selective in terms of age and sex. It was relatively easy to capture 10 goats in half a day and more could have been captured had larger source

herds been available. Capture related mortalities were minimal (<2%). The only capture related mortality involved a very large adult billy that died of capture myopathy within a week of release. Some scrapes and cuts did occur on some individuals. The refrigerated truck was extremely valuable in eliminating hyperthermia concerns as was the use of the aircraft to transport animals the long distance back to the release areas. This saved significant travel time, stress on the animals, and allowed us to capture goats from different source herds that were a great distance from the transplant sites.

Three years following the first releases in 1993, 26% of the radiocollared goats had died. Many of these goats, however, were only released in 1995 and have thus only been monitored for one year. For all years combined (1993 to 1996), the percent annual survival for adult radiocollared goats was 83% (N=52 adult goat-years). Assuming no differential mortality of nonradiocollared goats, of the original 78 goats released, 58 are estimated to remain alive. Post-release mortalities of some goats have occurred which was to be expected. These mortalities have taken place within 1 to 3 years of release from various causes ranging from predation to accidental falls. Both instances of predation (grizzly bear and wolf) appear to have taken place in valley bottoms while goats were attempting to

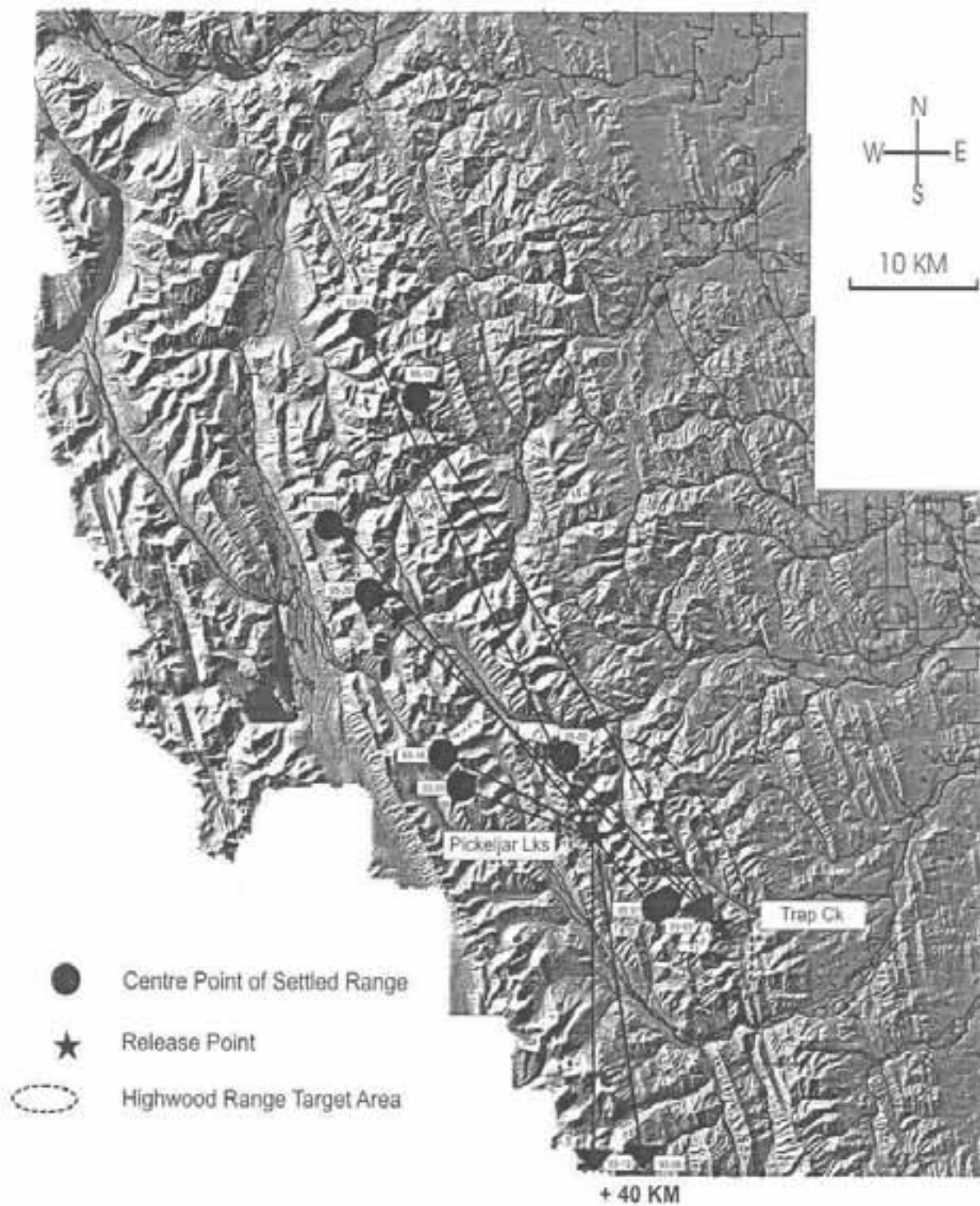


Figure 4. Movements from Highwood release sites to centre of settled ranges of transplanted goats, 1993-1998.

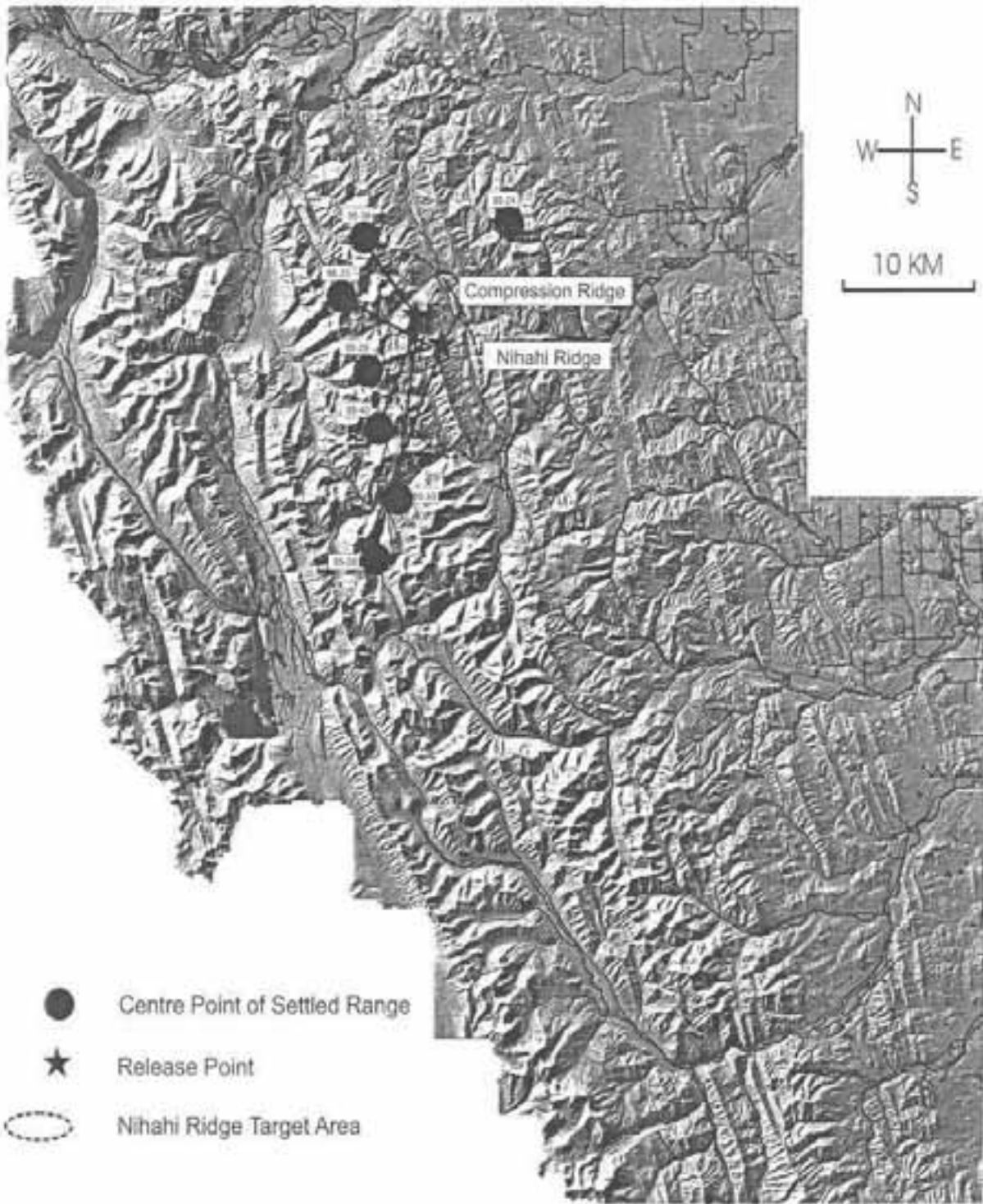


Figure 5. Movements from Nihahi release sites to centre of settled ranges of transplanted goats from 1995 to 1996.

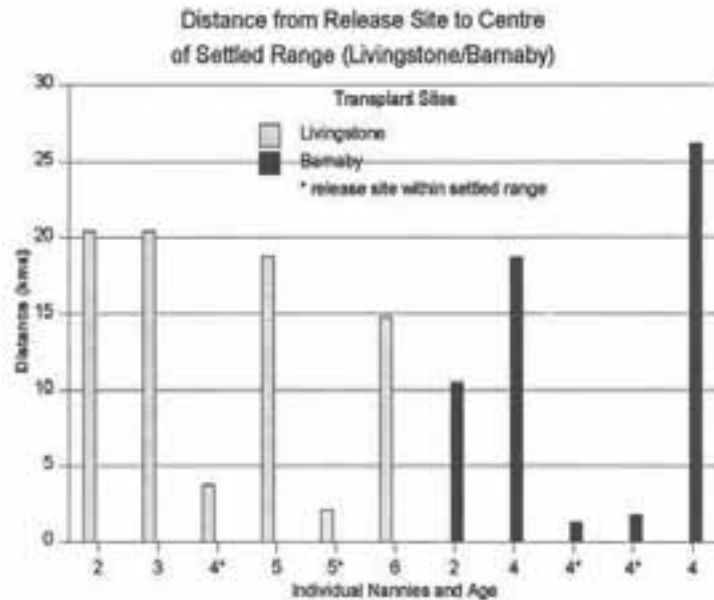


Figure 6. Distance from Release Sites to Centre of Settled Ranges for Radiocollared Goats at the Livingstone and Barnaby Ridge Transplant Areas.

cross to another mountain range. Unfortunately, several mortalities occurred from causes unknown. Little information exists on annual survival rates of mountain goats in other areas of Alberta but at Caw Ridge in northern Alberta where a study of marked individuals has been ongoing since 1987, combined male and female survival rates over a seven year period averaged 86% (Smith and Cote, 1995). This was very similar to the transplanted animals.

Goats released in 2 sites (Highwood and Nihahi Ridge) dispersed quickly and covered long distances before settling down. Less dispersal was observed by goats released on the Livingstone Range but even there, half of the radiocollared individuals moved off the intended range and migrated to another area. The Livingstone Range is more isolated from other mountains than either the Highwood or Nihahi areas which are contiguous with other mountain complexes. This may partly explain the difference in post release movement patterns. Barnaby Ridge also suffered the same fate as the other areas as only 1 of the initial 5 radiocollared goats remained on the ridge (a sixth transmittered goat was released, however, the collar failed hence the fate of this goat was unknown).

In terms of restocking the target areas initially identified in the proposal, these transplants were not as successful as desired. Most of the goats at the Highwood and Nihahi Ridge sites left their intended target areas in a matter of weeks to established home ranges in other nearby contiguous areas. Some of these areas already were occupied by other goat populations. While the newly established settled ranges for the most part did not include the release site, many goats had home ranges that overlapped to varying degrees the target areas. With time, it is possible that more goats will expand their home ranges such that at least part of the target areas will be included in seasonal movement patterns.

Success was somewhat better on the Livingstone Range in that a slightly higher percentage of goats remained on the release area. In addition to this transplant initiative, goats had been released on the Livingstone Range in 1987 (9), 1988 (2) and 1992 (2). Both of the 1992 goats remained on the Livingstone Range (1 subsequently was illegally shot in 1993) and successfully produced several kids. Surveys of the Livingstone Range in 1992 following the earlier releases observed a minimum of 11 goats (4 marked) in the area

indicating that several animals had remained after their release (Ross 1992, Gudmundson 1992). Post-release movements did not appear to differ with the age of individuals although no yearlings were radiocollared and thus monitored.

For transplants done this way, it may be necessary to saturate a target area with many more goats than were released during this attempt. One merely must take into consideration that a high proportion of the goats will move to other areas especially if there is suitable contiguous habitat nearby and plan accordingly. This, however, increases costs of establishing a minimum population. The goal of releasing a minimum population of 20 goats on each site has not been achieved yet on Barnaby Ridge.

LITERATURE CITED

- Gates, C. C. 1972. Selection of Goat Transplant Sites, Dept. of Environ. Protection, Nat. Res. Serv., Edmonton. 59pp.
- Gudmundson, L. 1992. Mountain goat census-South Livingstone Area. Alberta Fish and Wildlife Division, Lethbridge. 4pp.
- Ross, I. 1992. Mountain Goat reintroduction project:1992 final report. Alberta Fish and Wildlife Division, Calgary. 43pp.
- Ross, I. 1993. South Livingstone Range Mountain Goat Survey. Alberta Fish and Wildlife Division, Calgary. 5pp.
- Smith, K. 1986. Progress report of Mountain Goat Capture and Transplant Activities in Alberta during 1986. Department of Environmental Protection, Edmonton. 28pp.
- Smith, K., and S. Cote. 1995. Caw Ridge Mountain Goat Study. A progress report, November 1995 to the Department of Environmental Protection, Edson, Alberta. 13pp.



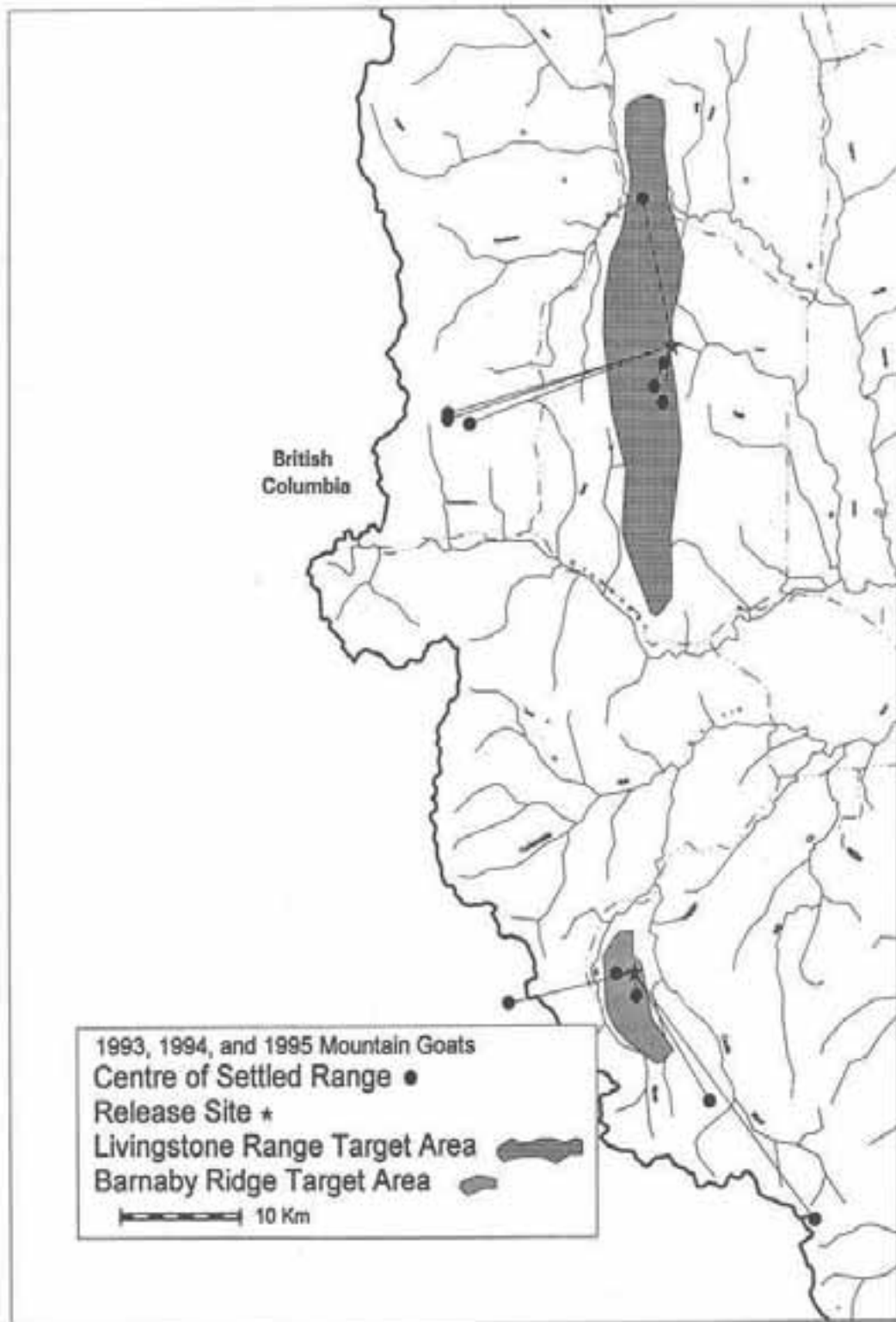


Figure 7.

