MOUNTAIN GOAT TRANSPLANTS IN ALASKA: RESTOCKING DEPLETED HERDS AND MITIGATING MINING IMPACTS

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ABSTRACT

During June and July 1983, 14 mountain goats (Oreamnos americanus) were captured and transplanted on the Kenai Peninsula to restock a depleted population and 18 mountain goats were captured on the southern mainland near Ketchikan, Alaska and transplanted to Revillagigedo Island to establish a new population. Two male and 10 female goats survived the Kenai transplant, but two females died immediately afterwards and two additional females dispersed from the release site. Dispersing goats showed distinct "homing" directionality. Five male and 12 female goats survived the Ketchikan transplant and no mortalities were documented through March 1984. Lactating females appeared to search for their lost kids and 4 of these females dispersed from the release site in the Ketchikan transplant. Probable breeding of the remaining females was documented. Capture and handling procedures are described and recommendations for future transplants are offered.

INTRODUCTION

A history of successful mountain goat (Oreamnos americanus) transplants in many parts of western North American (Harmon 1944, Lentfer 1955, Burris and McKnight 1973, Denney 1977, Kuck 1977) combined with improved techniques for the capture and handling of goats (Hebert et al. 1980, Nichols 1982) have combined to make the relocation of goats an increasngly attractive tool for re-establishing depleted herds (McCallum 1983) as well as initiating new populations. As basic knowledge of mountain goat biology and habitat

requirements has accumulated, improved methods for predetermining the potential for success of a transplant have been proposed (Gates 1972, Hebert et al. 1980, Guenzel 1980).

The purpose of this paper is to document two recent transplants in Alaska, one designed to replenish a population previously decimated by hunting and the other to establish a new population on vacant range as mitigation for anticipated losses in a nearby herd exposed to mineral development. Because results of the pre-transplant habitat suitability studies are available elsewhere (Culbertson and Walker 1981, Smith 1984a) they will be touched on only briefly here. This paper deals primarily with the mechanics and results of the transplants themselves.

KENAI PENINSULA - REINTRODUCTION

Mountain goats have historically occupied most of the Kenai Mountains (Klein 1953). Development of access to the Kenai Peninsula in the mid 1900's exposed goats to increased hunting pressure. As in many areas in British Columbia (Phelps et al 1975) timely inventory data were unavailable to managers and local, easily accessible sub-populations were occasionally depleted before season closures were invoked. One such area was the ridge complex southwest of Kenai Lake (see Fig. 1) now officially known as Cecil Rhode Mountain (CRM).

During the 1950's CRM was in the Cooper Landing Closed Area and supported a population of at least 22 mountain goats (A.D.F. & G. unpubl. data). Hunting was permitted in the early 1960's and within a few years all but two goats, apparently both males, were killed before the area was again closed. From then until 1982 occasional sightings of 1 to 4 goats were made on the mountain. A survey in spring 1983 found 4 goats, all males, on CRM.

Culbertson and Walker (1981) conducted forage biomass analyses on some areas identified by the junior author as sites used during winter by transient males on CRM, and/or similar in biophysical character to sites used by radiocollared goats on adjacent ridges in the Kenai Mountains. Results of these analyses indicated that CRM winter range could support additional use by mountain goats, so plans were made in cooperation with the USDA-Forest Service to capture from surrounding areas and transplant to CRM 2 male and 10 female goats in the summer of 1983. These animals plus the existing males would provide an initial base populations of 16 goats with a sex ratio of .6 male/female to restock CRM.

KETCHIKAN AREA - NEW POPULATION

Goat populations on the south coastal mainland of Alaska are lightly hunted and major population trends appear to be a function of long-term weather patterns (Smith 1984b). However, in view of expanding timber harvests and mineral development, declines in some populations resulting from habitat loss, disturbance and hunting (legal and illegal) are anticipated (Pendergast and Bindernagel 1977, Smith and Raedeke 1982). Of major concern in the Ketchikan area are the probable effects of activities associated with development of a large open-pit molybdenum mine by U.S. Borax, Inc., at Quartz Hill.

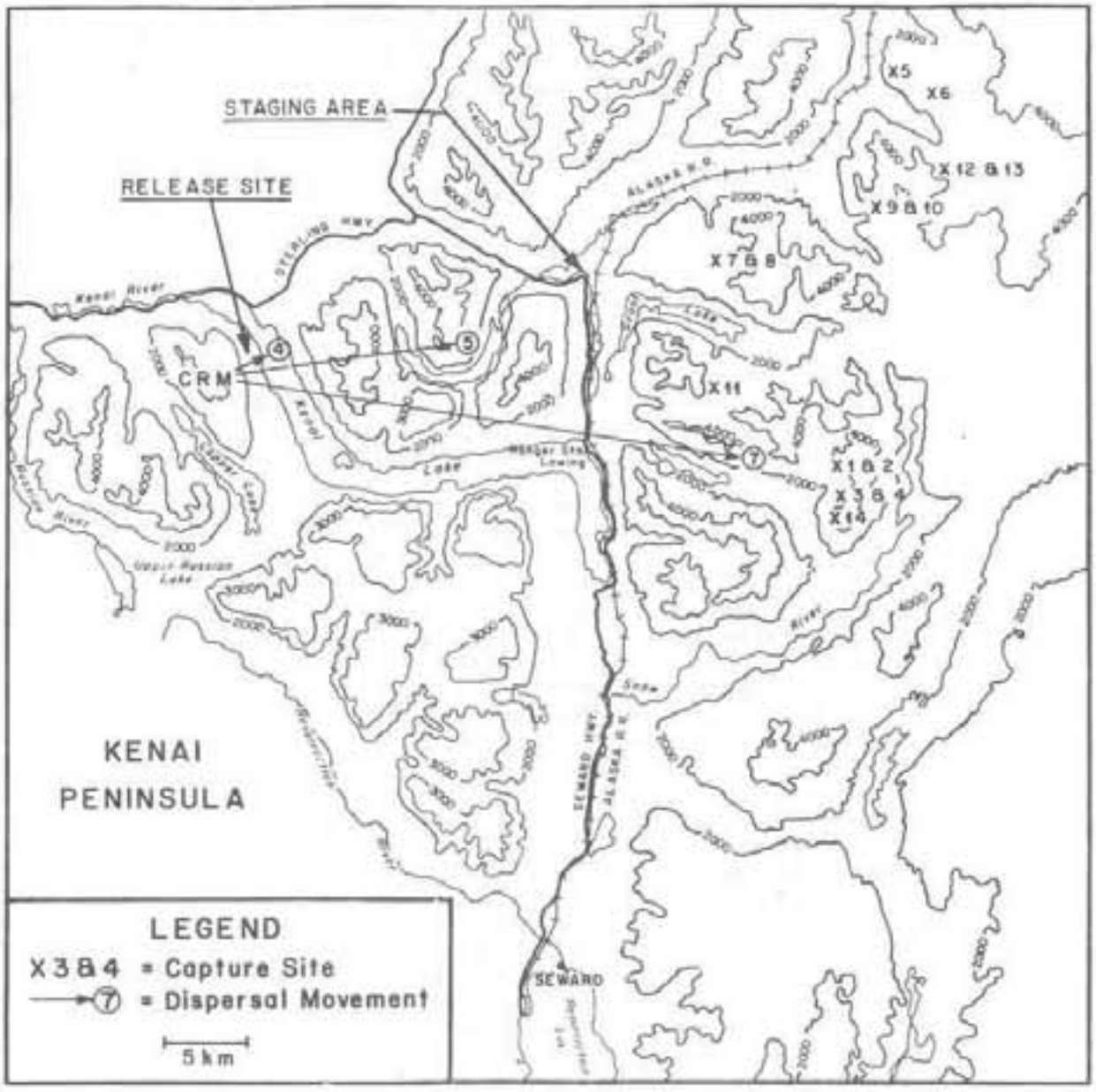

Figure 1. Capture locations, release site and dispersal movements of transplanted goats, Cecil Rhode Mountain (CRM), Alaska, July, 1983.

In evaluating the potential means for mitigating the anticipated losses at Quartz Hill, the possibility of transplanting goats to vacant habitat to create a new population was considered. Because all mainland ridges currently support goat populations, vacant habitat had to be found on one of the larger islands of the Alexander Archipellago.

A preliminary reconnaissance of potential transplant sites in the Ketchikan vicinity indicated that approximately 1000 km^2 on Revillagigedo Island (locally called "Revilla") was similar in biophysical characteristics to mainland ridges across the 2 km wide Behm Canal (Fig. 2). Revilla is part of the Coastal Foothills physiographic division of Southeast Alaska dominated by quartz diorite and granodiorite formations with elevations up to 1500 m and features deepened and accentuated by glacial action (Jacques 1963).

Division of Game policy on introducing species to new areas requires that prior to a transplant, studies must document that adequate habitat exists at the proposed release site to support a viable population of the new species and that the introduction will not adversely affect any resident species.

Smith (1984a) summarized the habitat suitability studies completed on Revilla Island. Major plant communities were sampled for over-and-understory composition and forage biomass, snow depth patterns were compared to those of mainland goat ranges, and topographic and timber types were sampled to provide data for winter range identification. A model of goat winter range based on discriminant function analysis of habitat selection with respect to elevation, slope, aspect, distance to cliff and timber volume derived from data gathered on radio-collared goats on adjacent ranges (Smith 1983) was used to identify potential winter habitat on Revilla Island. Results of these analyses indicated that the northeast third of Revilla Island could support 600-1000 mountain goats at densities comparable to those on adjacent mainland ridges.

Adverse effects of goats on resident species were judged to be minimal inasmuch as all species on the island coexist with goats on the mainland. In fact, goats could potentially benefit one resident species, wolves (Canis lupus), by providing an alernative source of prey.

Plans were made in cooperation with the Forest Service and Ketchikan Sports and Wildlife Club to transplant at least 5 male and 10 female goats between the ages of 2 and 8 years to northeast Revilla Island from the adjacent mainland in summer 1983. This was estimated to be the minimum number of animals capable of becoming established based on simple population models using our best estimates of local productivity and mortality (A.D.F. & G. unpubl. data). These numbers correspond with those found by Guenzel (1980) to be typical for successful transplants.

The release site chosen was a remote ridge complex in the center of the potential habitat area. This choice reflects the desire to keep the newly introduced goats together, avoid human access to the young herd, and allow dispersal of the growing population in all directions.

METHODS

KENAI PENINSULA

Potential transplant stock were located by spotters in a Piper PA-18-150 Super-cub in the mountains north and east of Kenai Lake (Fig. 1). When goats were found, a capture crew in a Bell Jet Ranger was called by radio. Goats were captured using standard helicopter darting techniques (Nichols 1982) with a dose of 4 mg. M99 (etorphine). Use of the fixed wing spotter plane to track a darted goat allowed the helicopter crew to pursue and dart a second goat while waiting for the first animal to go down.

Once the goats were down, the helicopter dropped the 2-man capture crew at the nearest landing site. They would climb to the goat, load it in a sling net and then attach the sling line to the hovering helicopter. The sedated goats were ferried to a staging site at the end of the road near the capture area.

At the staging site, the goats were blindfolded and hobbled, sections of rubber hose were placed over the horns and rectal temperatures were monitored. After being weighed, measured, aged by counting horn annuli and ear tagged, 6 goats were fitted with radiocollars, and 1 with a colored material collar. The remaining 5 goats were uncollared. The goats were loaded into a covered pick-up truck, the bed of which was filled with crushed ice under burlap. After several goats were captured and loaded into the truck they were driven to the base of CRM, a distance of about 70 km.

At the release site the goats were placed in a holding pen constructed of woven wire fence covered with burlap, released from their hobbles, the blindfolds and hoses were removed, and each was then given 8 mg. of M50-50, diprenorphine, intravenously. When all the goats in the pen appeared to have recovered from the drug (usually 1-2 minutes) the gate on the uphill side was opened. Wing fences served to guide the animals upslope toward the nearest cliffy terrain.

Total personnel involved included 6 A.D.F. & G. biologists, 1 USFS biologist and 4 USFS volunteers, a helicopter pilot, and 3 agency PR people.

Following release of the goats, periodic survey flights were made in a PA-18-150 Super Cub equipped with a scanning receiver and twin 3-element yagi antennae to monitor the radio-collared individuals and other goats on CRM.

KETCHIKAN AREA

Potential transplant animals for Revilla were sought on the adjacent mainland north, east and south of the island (Fig 2). No spotter plane was used. A capture crew flying in a Hughes 500 "D" helicopter would locate and dart a goat with 4 mg. of M99. Terrain and vegetation conditions in this area required that the helicopter stay with, and occasionally herd, the goat until it was decumbent. Once down, the goat was approached by the capture crew, sex and age were verified, a blindfold was put on the goat and its ears were plugged with cotton. It was then loaded into a sling net and ferried under the capture helicopter to a nearby staging area, usually a level snowfield. Processing at the staging area consisted of weighing, measuring, ear tagging, blood sampling, placing hose on the horns, radio collaring and securing the

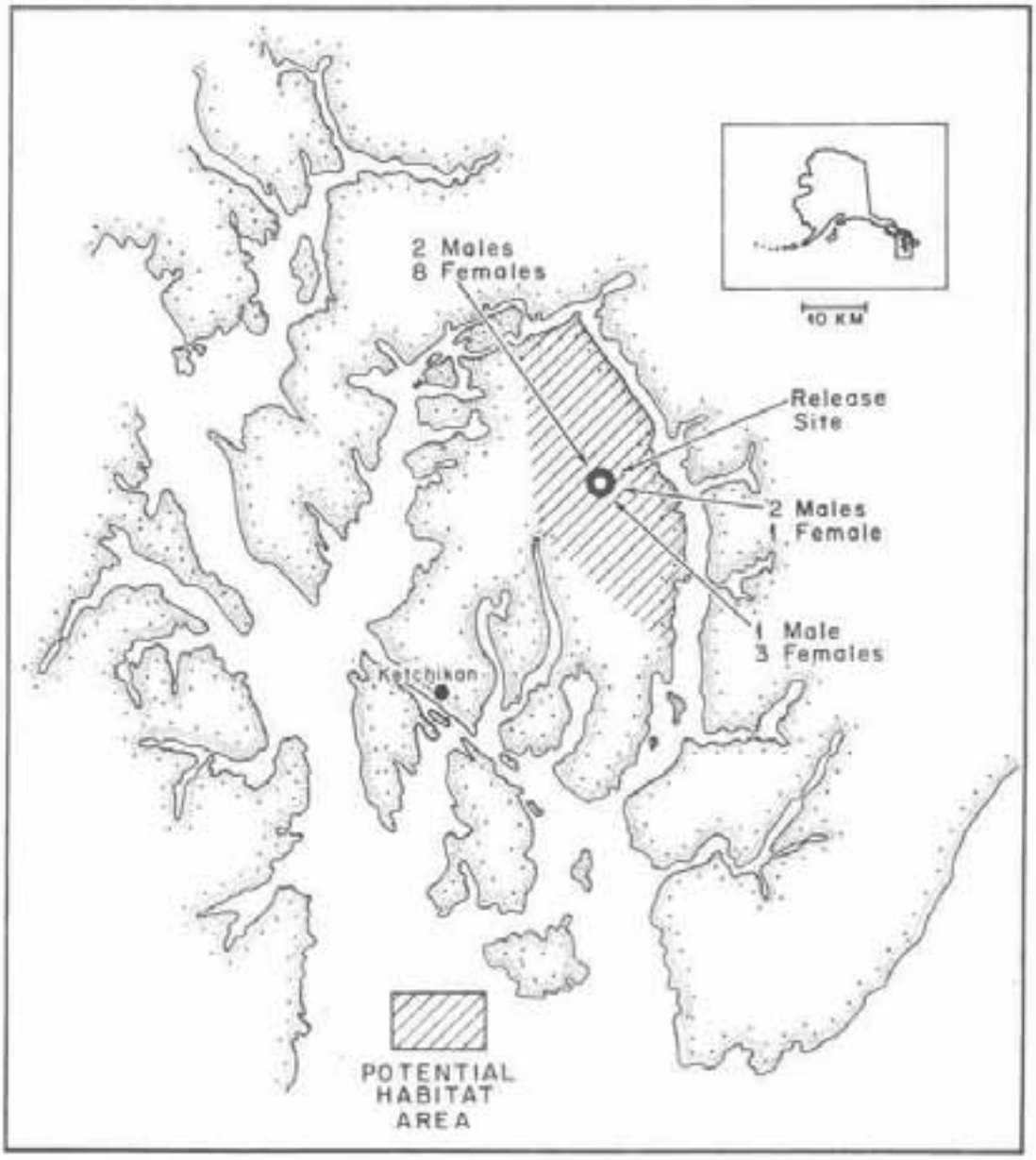

Figure 2. Capture areas, release site and potential habitat for transplanted mountain goats near Ketchikan, Alaska, June-July 1983.

goat in a small "bag" of seine net to restrict movement and facilitate handling. Body temperature, pulse, and respiration were monitored. If the rectal temperature exceeded 105° F, snowmelt water was poured over the goat until body temperature declined.

When 2-4 goats were at the staging site, a second helicopter was called to transport the goats to the release site. The sedated goats were loaded inside the helicopter to allow higher air speeds enroute to the island, 20 to 90 km from the staging areas.

At the release site, an open ridge on the island, hoses, earplugs and blindfolds were removed from the goats and 8 mg's of M50-50 was administered intravenously. No pen was used to confine the goats, but doses were administered quickly to allow all goats released from a single flight to regain consciousness simultaneously.

Total personnel involved included 2 or 3 biologists and 1 technician from A.D.F. & G., 1 biologist from U.S.F.S. and 2 helicopter pilots.

Periodic telemetry surveys were flown following release in a PA-18-150 Super Cub equipped with a scanning receiver and twin 2-element yagi antennae to monitor dispersal and behavior of transplanted goats. Initial mobility of the goats was calculated by dividing the sum of the straight-line distances moved between relocations during the first month by the number of days between release and radio locations. This statistic was also calculated for goats captured in the same areas but not transplanted by Smith (1983) using the capture site as the point of origin. Dispersal distance was calculated as the mean distance between the release site and all subsequent radio locations. Differences between sex-classes and transplanted vs resident goats were calculated using paired t-tests.

RESULTS

KENAI PENINSULA

A total of 14 goats were captured on 25 and 26 July 1983 on the Kenai Peninsula (Table 1). Immediate capture-related mortality resulted in the deaths of two goats. A 5 year old female given two doses of M99 died from complications associated with a bloated rumen during transport in the truck, and a yearling female died of unknown causes, in the sling beneath the helicopter. The day after the transplant was completed, two additional mortalities were detected. A 10+ year old female that responded poorly to both the M99 and M50-50 and was slow to leave the release site was found dead 50m upslope from the pen, and an 8 year old female that went downhill and tried to swim across Kenai Lake drowned. All other goats were found to have moved up onto CRM.

In addition to the 4 goat mortalities, this operation was marred by the serious injury of one A.D.F. & G. biologist who fell from a snowbank/cliff while attempting to reach a sedated goat. The presence of the press, the need to process goats quickly and large number of staff resulted in some confusion. Nevertheless, the operation was generally successful and total operating (i.e. non-salary) costs averaged $714.00 per live goat released on CRM.

Table 1. Results of mountain goat capture and transplant activities, Kenai Peninsula, Alaska 25-26 July 1983.

Goat Number	Date of Capture	Age	Sex	Lactating	Weight (kg)	Status Following Release
1	7/25	7	F	No	-	Alive on CRM[1] thru February 1984.
2	7/25	7	F	No	63.5	Alive on CRM thru February 1984.
3	7/25	1	F	No	36.3	Alive on CRM thru August 1983.
4	7/25	8	F	Yes	61.2	Drowned crossing Kenai Lake 27 July 1983.
5	7/26	3	F	No	65.8	Dispersed from CRM on 9 September, 1983 toward capture site.
6	7/26	1	F	No	38.6	Alive on CRM thru August 1983.
7	7/26	1	F	No	-	Dispersed from CRM in September 1983; seen near capture site in October 1983.
8	7/26	1	F	No	40.8	Alive on CRM thru August 1983.
9	7/26	2	M	N/A	61.2	Alive on CRM thru February 1984.
10	7/26	5	F	Yes	71.7	Died in truck during transport.
11	7/26	1	M	N/A	40.8	Alive on CRM thru August 1983.
12	7/26	10	F	No	73.9	Died near pen after release.
13	7/26	1	F	No	36.3	Alive on CRM thru August 1983.
14	7/26	1	F	No	-	Died in sling under helicopter.

1. CRM = Cecil Rhode Mountain

Unfortunately, the Bureau of Land Management chose the day after the transplant to do some surveying on CRM. Their helicopter activity scattered the goats widely over the mountain and they were still in singles and pairs as of 23 August, the last date prior to snowfall when all 14 goats were seen on CRM.

On 5 September one of the goats, a 3 year old female, swam across Kenai Lake (Fig. 1) and moved into the Crescent Mountain area. Over the next month she moved farther northeast until snowfall apparently halted her movement from the release site toward her former home range. During the same time a non-radioed yearling female disappeared from CRM. Subsequently, a hunter reported seeing a collared goat matching this animal's description on a ridge above Ptarmigan Lake (Fig. 1). As of this writing the other 8 transplanted goats are believed to remain on CRM with the original 4, giving a total population of 6 males and 6 females.

KETCHIKAN AREA

A total of 18 goats, including one pregnant female, was captured on 23 and 24 June and 15-17 July, 1983 in the Ketchikan area for transplant to Revilla Island (Table 2). The only mortality in this group resulted when the senior author attempted to lasso and under-dosed 3 year old female; in the struggle she slipped from a ledge and broke her neck when the rope was snubbed tight. One other goat, also an adult female, was darted but not captured; it fell 1500' from a cliff when the drug took effect. Composition of the surviving goats was 5 males and 12 females, aged 1 to 6 years. All except one yearling of each sex were radio collared.

No human injuries were experienced and the reduced number of people involved helped make this operation less confused. One other significant aid in the Ketchikan operation was the use of 10 x 15 cm mylar data sheets pinned to each goat's blindfold. This kept the record in a convenient, conspicuous form with the goat as it transferred from capture crew to staging crew, to release crew to ensure that data were thoroughly recorded. Careful monitoring of body temperatures and treatment for hypothermia prevented heat stress mortality. Total operating cost for the operation averaged $1100.00 per goat released alive including the price of the radio collars.

Immediately following release each group of goats was observed to move quickly to nearby cliffy terrain. Several sought water from snowmelt streamlets on cliffs and most began feeding within 5 minutes. Within 5 days the goats had dispersed over several kilometers of the ridge.

Radio tracking of the goats following their release revealed that lactating females were significantly ($p < 0.05$) more mobile than males or non-lactating females during their first month on the island (Table 3). No significant difference was found between the latter two classes. Conversely, lactating females which were not transplanted were significantly ($p < 0.10$) less mobile than non-transplanted males or non-lactating females (Table 4). Again, no difference was detected between the latter two classes. Comparisons within classes between transplanted and non-transplanted goats indicated that transplanted lactating females and males were significantly more mobile than their non-transplanted counterparts ($p < 0.05$ and $p < 0.10$ respectively). Although the transplanted non-lactating females also appear to be more mobile

Table 2. Results of capture and transplant of mountain goats near Ketchikan, Alaska, 23-24 June and 15-17 July, 1983.

Goat Number[1]	Date of Capture	Age	Sex	Lactating	Weight (kg)	Time under Sedation (hr:min)	Status on 8 March 1984
1	23 June	1	M	N/A	43.1	3:22	Unknown, not radioed; last seen alive on 20 July.
2	23 June	3	F	Yes	55.3	2:05	Alive on release site ridge.
3	23 June	3	F	Yes	-	N/A	Died of broken neck during capture.
4	24 June	5	M	N/A	79.4	5:10	Alive on release site ridge.
5	24 June	3	M	N/A	56.7	3:46	Alive, across valley south of release site with #7.
6	24 June	5	F	Yes	79.4	3:04	Alive, dispersed to ridge 18 km south of site.
7	24 June	3	F	No[2]	77.1	1:39	Alive, across valley south of release site with #5.
8	15 July	3	M	N/A	61.2	2:22	Alive on release site ridge.
9	15 July	2	M	N/A	72.6	1:54	Alive on release site ridge.
10	15 July	6	F	Yes	65.8	1:14	Alive on release site ridge.
11	16 July	3	F	No	56.7	2:15	Alive on release site ridge.
12	16 July	4	F	Yes	72.6	1:18	Alive, dispersed to ridge 10 km northeast with #17.
13	17 July	3	F	No	70.3	2:55	Alive on release site ridge.
14	17 July	6	F	Yes	72.6	2:24	Alive, across valley west of release site ridge.
15	17 July	1	F	No	31.8	2:51	Unknown, not radioed
16	17 July	3	F	Yes	65.8	2:01	Alive, dispersed to ridge 8 km west.
17	17 July	5	F	Yes	80.7	2:31	Alive, dispersed to ridge 10 km northeast with #12.
18	17 July	2	F	No	57.6	1:24	Alive on release site ridge.

1. One additional goat was darted but fell from a cliff and could not be recovered
2. This female was determined to be pregnant by external palpation.

than non-transplanted ones, the limited sample of such goats (n=2) reduces confidence in this conclusion ($p < 0.15$).

The lactating females' greater mobility on the island resulted in their being more widely dispersed than males or non-lactating females (Table 5). Several of these nannies eventually settled into fall/winter range areas isolated from the rest of the population by one or more low elevation valleys and beyond the movements of any of the collared males.

Radio tracking during the breeding season documented associations of 3 billies with 4 nannies in the vicinity of the release site, and the movement of the billies between relocations indicated that encounters with other females were likely.

Table 3. Mean, standard deviation and range of rate of movement (km/day) of transplanted goats during the first month after release on Revilla Island, summer 1983.

Category	Mean	S.D.	Minimum	Maximum	N
Males	0.22	0.12	0.20	0.39	4
Females					
non-lactating	0.19	0.05	0.14	0.24	4
lactating	0.34[1]	0.09	0.19	0.41	7

1. Significantly greater than non-lactating females and males at $p < 0.05$.

Table 4. Mean, standard deviation and range of rate of movement (km/day) of resident goats during the first month after capture on the mainland adjacent to Revilla Island, summer 1981.

Category	Mean	S.D.	Minimum	Maximum	N
Males	0.11	0.00	0.11	0.11	4
Females					
non-lactating	0.11	0.10	0.04	0.17	2
lactating	0.03[1]	0.03	0.01	0.09	5

1. Significantly less than males at $p < 0.05$; less than non-lactating females at $p < 0.10$.

Table 5. Mean, standard deviation and range of distances (km) between transplant release site and all radio relocations of mountain goats on Revilla Island July 1983 - March 1984.

Category	Mean	S.D.	Minimum	Maximum	N
Males	2.2	0.9	0.0	4.1	28
Females					
non-lactating	2.4[1]	1.0	0.8	5.5	25
lactating	5.0[2]	3.0	0.7	13.9	42

1. Not significantly different from males ($p > 0.20$).

2. Significantly greater than males and non-lactating females at $p < 0.05$.

By mid-December all goats had moved into predicted winter range areas. Weather conditions were mild through March and no mortalities were documented.

DISCUSSION

Helicopter darting was an efficient and effective means of capturing goats for both transplants in areas where other types of capture (e.g. trapping, drop nets, etc.) were impractical. In most cases, with careful monitoring of body temperature and posture, goats survived sedation for up to 5 hours without ill-effect. The number of goat mortalities and the human injury experienced were unusual compared to previous capture operations in Alaska (Nichols 1982, Smith 1983), but were kept to acceptable levels given the conditions and terrain where the work was carried out and the amount of handling to which the goats were subjected.

The major limitation with helicopter darting is that it is virtually impossible to capture nanny-kid pairs, as the goats usually scatter when pursued for a shot. If taking intact family groups is deemed important, some other approach is recommended. Although the "CODA" netgun was not effective for capturing goats in southeast Alaska (Smith 1983), it has been used successfully for this purpose in the Yukon (Barichello, pers. comm.) and may facilitate capture of nannies with kids.

The differential mobility and dispersal of lactating females on Revilla may have been due to "searching" efforts, trying to locate the kid that was left behind. Such movement might be eliminated if intact family units were transplanted. Nevertheless, our evidence indicates that any transplanted goat is likely to be more mobile than its resident counterpart, and the dispersal of several females from the release sites in both areas indicates that it may be necessary to introduce more than the desired minimum number of goats to establish a population.

It will be a number of years before final determination as to the viability of these populations can be made. Nevertheless, in view of our success in the physical translocation of goats and the apparent settlement of most of the goats into their new habitat, we would encourage the reasoned use of transplants after adequate habitat suitability studies are completed to restock depleted herds or establish new populations to mitigate impacts of development on native goat populations.

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