

Results of a Mountain Goat Transplant along Lake Chelan, Washington

Abstract

In an attempt to increase the population, marked mountain goats (*Oreamnos americanus*) ($n = 44$) were transplanted from Olympic National Park to Lake Chelan in the Cascade Mountains of Washington in 1983 and 1984. To evaluate the success and integration of these individuals into the population, we compiled sightings of the marked mountain goats. Twenty-seven individuals were resighted a total of 95 times following release. Distances moved by released males and females were not significantly different ($P > 0.05$). Males traveled an average of 19.8 linear km (SE = 10.2) from release sites, compared to 13.9 km (SE = 15.4) for females. Released kids were never seen beyond 5 days after release. Released goats occupied vacant goat range, joined native goat bands within the drainage, or left the drainage. Transplanted goats intermixed with native goats to potentially introduce genetic variability. A minimum of ten kids were born to transplanted nannies during the three summers after initial release. This study showed that collars and ear tags are both inexpensive and effective methods to mark mountain goats for study over an extended period. Further, because many transplanted mountain goats intermixed and bred with members of the local population, the transplant should be considered successful.

Introduction

Mountain goats (*Oreamnos americanus*) were numerous along Lake Chelan in central Washington until the late 1970's (Johnson 1983). During the 1960's and 1970's, as many as 100 goat hunting permits were issued in the three units bordering the lake. By the late 1970's goat populations had declined sharply. The only historical goat population data available for this area are from Washington Department of Wildlife (WDW) once-per-winter, randomly scheduled (November-April) surveys conducted from a boat during 25 of the 30 winters from 1953-54 through 1982-83. Examination of these data showed a negative rate of increase (Caughley 1977) of $\bar{r} = -0.07$ during that period. Because of this decline, and low kid:adult ratios reported on goat hunter harvest questionnaires, goat hunting was closed in the Stehekin Valley and south shore units after the 1978 season and in the north shore unit after the 1980 season in an effort to increase goat numbers. Data are not available to assess effects of the hunting closure because WDW discontinued their surveys after the 1982-83 winter and our later surveys were more intensive (12/winter) and results are not comparable. Also, goat hunter report cards were no longer obtained from these goat units to gather comparable data on kid to adult ratios.

Mountain goats were introduced into the Olympic Mountains in western Washington (prior

to the creation of Olympic National Park) from Alaska and Alberta in the 1920's (Stevens and Driver 1978). Much of the Olympic Mountains was later included within the boundaries of Olympic National Park. By the early 1980's, the goat population within the park reached levels which prompted park officials to reduce goat numbers to preserve habitat quality (Houston *et al.* 1986). As a part of the park's reduction program, goats were captured and transplanted by WDW to other areas.

During the summers of 1983 and 1984, goats were transplanted from Olympic National Park to the shores of Lake Chelan in an attempt to increase that goat population. Expected benefits of the transplant identified in the U.S. Forest Service environmental assessment were to:

- 1) increase goat numbers in suitable goat habitat which was unoccupied or underpopulated (compared to past WDW surveys), and
- 2) possibly increase the reproductivity of the Lake Chelan goat population by introducing genetic variability from the Olympic Mountains goat herd.

Although mountain goats have been transplanted into many areas (Guenzel 1980), little information is available concerning the movements and interactions of the released individuals. We evaluated the Lake Chelan transplant to determine:

- 1) transplanted goats' affinity to release sites,

2) transplanted goats' association with native goats, and

3) the number of offspring produced by transplanted goats.

Study Area

Lake Chelan lies on the east slope of the Cascade Mountains in northern Chelan County in central Washington (Fig. 1). The lake is approximately 1.6 km wide and 82 km long, extending from the Columbia River breaks to the high Cascades. The lake's maximum elevation is 335 meters m.s.l. and mountain peaks exceeding 2,400 meters m.s.l. overlook the lake.

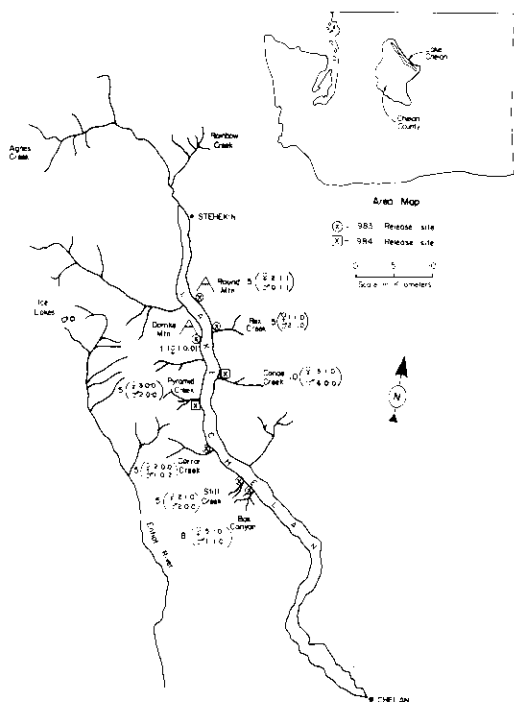


Figure 1. Mountain goat transplant area along Lake Chelan, Washington, 1983-84 (numbers of released goats indicated in parentheses by age, i.e., adults: yearlings:kids).

All of the release sites were along the shores of the northwest half of Lake Chelan within the Wenatchee National Forest. Vegetation zones within this area include: *Pinus ponderosa*, *Pseudotsuga menziesii*, *Abies grandis*, *Pinus*

contorta, and *Abies lasiocarpa* (Franklin and Dyrness 1973).

Methods

Mountain goats were captured with drop nets and prepared for transport on Klahhane Ridge in the Olympic Mountains (Johnson and Moorhead 1982, Houston *et al.* 1984). They were transported in individual crates by truck to Lake Chelan and by boat to release sites along the lake.

A total of 44 goats was released. Eighteen females and 11 males were released in 1983 at two sites along the north shore and four along the south shore. Seven females and eight males were released in 1984 at one north shore and one south shore release site (Fig. 1). Group sizes of released goats ranged from 1-10 ($\bar{x} = 5.5$, $n = 8$, $SE = 2.62$).

Guidelines suggested by Hebert *et al.* (1980) were used to select release sites. All release sites had been occupied by goats within the previous 20 years and currently were unoccupied or had goat numbers less than the 1960-70 levels.

At the release sites the goats were collared and/or ear tagged before release. Release sites along each shore were designated by different colored canvas neck collars. Collars were riveted around the necks of adults (goats two years or older). Yearlings and kids were not collared. Males and females were tagged in opposite ears to differentiate sexes. Adults, yearlings, and kids were identified by different colored, numbered, large plastic ear tags. Different ear tag colors were used in 1984 and 1983. This system allowed (if the ear tag number was unreadable) identification of the goat's age class (at release), sex, release site, and year of release. Veterinarians inspected the goats for injury of handling stress prior to release. In 1983, three kids were released simultaneously with the nannies with which they were captured.

Posters distributed in the lake vicinity and local newspaper articles provided project information and requested reports of sightings. In addition to these sightings, Chelan PUD wildlife personnel recorded sightings during winter big game surveys along the lake.

Differences between males and females in distance moved from release sites were analyzed by a standard t-test. Relationships between age and movement distances from release site and

between release group size and goat fidelity to release site were analyzed by linear correlation analysis (Zar 1984).

Results and Discussion

Between their release date and 1 July 1987, 95 sightings (29% from PUD surveys and 71% from

the WDW, USFS, and general public) of at least 27 individual transplanted goats were compiled (Table 1). Individual goats identified included 36 sightings of 11 of the 19 released males and 59 sightings of 16 of the 25 released females. Forty-two additional sightings contained insufficient information to establish the identity of individual goats.

Table 1. Sightings of mountain goats released along Lake Chelan, Washington.

Goat ¹	Age at release ²	Months between release and last observation ³	No. times observed	Greatest distance from release site (km)	Within 9 km of release site	Remained within Lake Chelan basin ⁴	With native goats
Males							
G- 1	1	4	1	35			
G- 6	1	1	2	10		yes	
O- 1	3	24	13	22	yes	yes	yes
B-15	3	13	1	11			
B-20	3	1	1	13		yes	
O- 9	4	1	4	42			
B-16	4	1	2	13		yes	
B- 2	4	13	1	21			
O-14	6	16	3	16		yes	yes
O-11	6	40	5	21			
O-13	6	3	3	14		yes	yes
Totals			36		1	6	3
Means			$\bar{x} = 3.3$	$\bar{x} = 19.8$ (SE = 10.2)			
Females							
K- 3	0	<1	1	3	yes	yes	
G- 2	1	37	2	2	yes	yes	yes
G- 5	1	35	4	5	yes	yes	yes
G- 7	1	7	5	11		yes	
O- 2	2	46	2	5	yes	yes	yes
O- 6	2	42	2	3	yes	yes	yes
O-18	3	37	9	27			yes
O-12	4	37	9	38		yes	yes
O- 7	6	25	4	5	yes	yes	yes
O- 8	6	15	9	58			
O-17	6	23	2	14		yes	
O- 4	7	13	1	3	yes	yes	yes
B-21	8	2	1	5	yes	yes	
O-16	A	1	2	13		yes	
B- 5	A	25	3	19			
B-13	A	25	3	11	yes	yes	yes
Totals			59		9	13	9
Means			$\bar{x} = 3.7$	$\bar{x} = 13.9$ (SE = 15.4)			

¹Goats designated by ear tag color (K = black, G = green, O = orange, B = blue) and number.

²Age at release (A = adult of unknown age).

³Number of months between release and last sighting (rounded to nearest month).

⁴Last sighting indicated that goat was within Lake Chelan drainage.

Males moved 10-42 linear km (\bar{x} = 19.8, n = 11, SE = 10.2) from their release sites. Females moved 2-58 linear km (\bar{x} = 13.9, n = 16, SE = 15.4) from release sites but half of them were never seen more than 3 km from their release sites. Distances moved by males and females were not statistically different ($P > 0.5$). There was no relationship (r = .11 for males; r = .26 for females) between age and distance that goats traveled (Table 1). Although our release group sizes were relatively small, there was a significant relationship (r = 0.65, $P > 0.05$) between release group size and the number of goats which stayed within 9 km of their release sites. Goats released in large groups tended to remain closer to release sites than did goats released in smaller groups.

Six or seven of the eight goats released at Box Canyon (Fig. 1) and five released at nearby Still Creek (Fig. 1) remained in that area and formed the nucleus of a band which now represents the furthest "downlake" goat band. That area was unoccupied by goats at the time of release. This was the only release in which enough goats remained to colonize a release area. A wildfire burned this area in 1978 and natural revegetation has provided good forage conditions. The burn may have enhanced conditions for goats and may be a reason that released goats colonized this area.

Only one of the 11 transplanted males which were resighted along Lake Chelan stayed within 9 km of its release site. This male, however, moved 22 km and then returned to the release site area. Nine of the 16 resighted females along Lake Chelan remained within 9 km of their release sites. One of these nine females was found dead within two months after release and a kid was only seen once, five days after release. The male and five of the females which remained within 9 km of their release sites were from the Box Canyon and Still Creek releases.

Under natural conditions, native mountain goats have relatively small home ranges (Adams *et al.* 1982). Dispersal movements from natal sites by native goats may be caused by males seeking females and females seeking improved nutritional conditions (Stevens 1983). Our study indicates that a large proportion of transplanted goats moved away from release sites and traveled further than normal dispersal movements of native goats.

The longest movement from a release site that we know of by one of the transplanted goats was 58 linear kilometers by a six-year-old female in which she crossed the Entiat and Wenatchee river drainages. An adult male (O-9) was seen 42 linear km from its release site 13 days after release. Seven days later, he was sighted 22 linear km closer to his release site. Sightings of an adult female (O-18) indicate a movement totaling a minimum of 67 linear km away from her release site over three years. She was released at Round Mountain on the north shore in 1983 and was seen there in 1984 with a kid. Later that summer, she and the kid were seen near Agnes Creek above the northwest end of the lake. In 1986, she was seen at Ice Lakes, south of Lake Chelan, with another kid. Another adult female, which had been transplanted with her kid, was seen (11 days after release) swimming from the south to the north shore of Lake Chelan in an area where the lake is about 1.8 km wide. Two weeks later, she was seen again in the same general area, swimming back to the south shore.

Five of the 11 resighted males and three of the 16 resighted females left the Lake Chelan drainage. Four of these eight goats (two from release sites at Pyramid Creek, one from Box Canyon, and one from Round Mountain) were eventually sighted in the Ice Lakes vicinity at the headwaters of the Entiat River. Three goats from the Still Creek release site moved to the west side of the Entiat Valley. One of these three eventually continued on to the Chiwaukum Mountains, west of the Wenatchee River. Another goat moved from the Chelan drainage northeast to the Methow River drainage (18 km from its release site). Two of the resighted goats which left the Chelan drainage were sighted within the drainage during their first year of release but were sighted outside the drainage two and three years after release.

Three of the 11 resighted males were seen with native goats, compared to nine of the 16 resighted females. All of these goats, except one male, were present along Lake Chelan for at least one breeding season. This would have allowed the addition of new genetic strains from the Olympic Mountains to the Lake Chelan population which is considered a transplant benefit.

At least ten kids were produced from transplanted nannies during the three summers following the initial release. Three kids were

produced in 1984, from the 13 nannies released in 1983, and two and five kids in 1985 and 1986, respectively, from transplanted nannies.

At least three transplanted goats have died since release. An adult female was found dead below a cliff 5 km from its release site, two months after its release. A yearling male and an adult female were shot by goat hunters after moving from the Lake Chelan area into areas open to goat hunting. The male was shot during the fall of its release and the female was shot during the fall of the year following its release.

We believe that the survival rate of transplanted kids was low. One of the three transplanted kids was seen once five days after release. Two of the three nannies which had been transplanted with kids were seen within one and six months of release and neither of them was with a kid. During the winter of 1983-84 goat surveys along the lake, we emphasized examining kids for ear tags, but saw none.

Kids may experience poor survival after capture and transplant because of muscle myopathy (C. Robbins and S. Parrish, Wa. St. Univ., pers. comm.) or separation from their nannies. If other needs for kids exist (i.e., zoos, wildlife research), they might be better utilized than in transplants.

Collaring and ear tagging released goats provided an inexpensive method of monitoring movements and individual behavior. Collars and

numbered ear tags were still identifiable four years after goats were released.

The Lake Chelan goat transplant should be considered successful. Goat numbers were increased along the lake. Goats released at Box Canyon colonized that previously unoccupied area. Most released goats which moved from their release areas joined existing bands in other areas within the Lake Chelan drainage. During the summers of 1984-86, a minimum of ten kids were born to nannies transplanted along Lake Chelan.

Acknowledgements

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