Bienn. Symp. North. Wild Sheep
and Goat Counc. 3:92-105

CUTOFF BIGHORN TRANSPLANT: THE FIRST TWO YEARS

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ABSTRACT

A herd of Rocky Mountain bighorn sheep (Ovis canadensis canadensis) was transplanted from Wildhorse Island to the Cutoff area near Paradise, Montana in January, 1979. Six of the 41 sheep were radio-collared, and several others were marked with rope collars or neck bands. Six sheep immigrated to the Cutoff area from a nearby herd, and 5 more rams were transplanted to the area in February, 1981. The population was estimated at 70 during winter 1980-81. The ewe:lamb ratio was 100:42 at the end of winter 1980-81. Reasons for the apparently low productivity are discussed. Daily movements averaged 0.6 km for ewes and 1.0 km for the radioed ram. Ewe daily movements were relatively constant through the year. The ram showed distinct seasonal variations, moving 1.6 km per day during the rut and 0.3 km per day in winter. Home ranges averaged 541 ha for the ewes and 798 ha for the ram. Ewe home ranges were the smallest during lambing (47 ha) and largest during fall (273 ha). The ram's home range was 21 ha in winter and 305 ha in spring. Ewe standard diameters were lowest during lambing (1.8 km), and the ram's standard diameter was lowest in winter (1.7 km). Both sexes ranged farthest during the rut, when the standard diameters were 5.0 for the ram and 3.1 for the ewes. Protostrongylus spp. larvae were present in feces at an average level of 1.7 larvae per gram. The pattern of range recolonization and dispersal is discussed.

INTRODUCTION

In January 1979, 41 bighorn sheep were transplanted from Wildhorse Island in Flathead Lake to an area in northwestern Montana generally known as the Cutoff. My study was initiated to gather information on seasonal home range and habitat use, migration routes, population parameters, and patterns of colonization of the newly-transplanted herd. The information gained from this study may contribute to understanding the complexities of establishing bighorn sheep herds.

The primary objectives of this study were to:

(1) locate and map seasonal ranges and movements;

(2) census the herd; and

(3) assess productivity

Funding was provided by the Montana Department of Fish, Wildlife and Parks in cooperation with the Montana Cooperative Wildlife Research Unit through Pittman-Robertson Project W-120-R-12 (5895) B.G.-7.0, Job No. 1.

STUDY AREA

The study area was situated along the Clark Fork River approximately 85 km northwest of Missoula, Montana (Figure 1). During the study, the sheep herd inhabited a strip of land approximately 1.6 km wide and 13 km long. The area along the river was predominantly rock outcrops and scree slopes. Several steep, rocky slopes and a few grassy basins were present. Areas above 1,340 m elevation and most of the shaded ravines were steep and rocky and supported open forest cover. Elevations ranged from 805 m along the river to 2,084 m at the top of Patrick's Knob.

Ponderosa pine (Pinus ponderosa) and Douglas fir (Pseudotsuga menziesii) were the major tree species on the study area. Tree canopy cover on most slopes was sparse, but ranged from 10 to 20 percent on higher elevations and in moist ravines. The canopy cover in the lower part of the Patrick Creek Drainage and on some level areas along the Clark Fork River was from 40 to 60 percent. Graminoids comprised less than 50 percent of the forest understory. Shrub density varied from 15 to 60 percent in forested areas. In unforested areas, graminoids accounted for 10 to 25 percent of the ground cover. Shrub cover in these areas ranged from 15 to 25 percent.

METHODS

DEMOGRAPHY

The number of sheep in each sex and age class was estimated from the highest number of sheep seen in each class on a single day during each season. Seasons were defined as: spring, 1 March-30 April; lambing, 1 May-31 May; summer, 1 June-30 September; fall, 1 October-31 December; and winter, 1 January-28 February. Seasonal ewe:lamb ratios were calculated by totaling the number of ewes and lambs seen during each season regardless of duplication.

MOVEMENTS

When the sheep were transplanted to the Cutoff, 6 were radio-collared, 6 marked with individually identifiable rope collars, and 14 were marked with red or blue neckbands. Five transmitters continued to work throughout the study, and I attempted to locate the radio-collared sheep at least

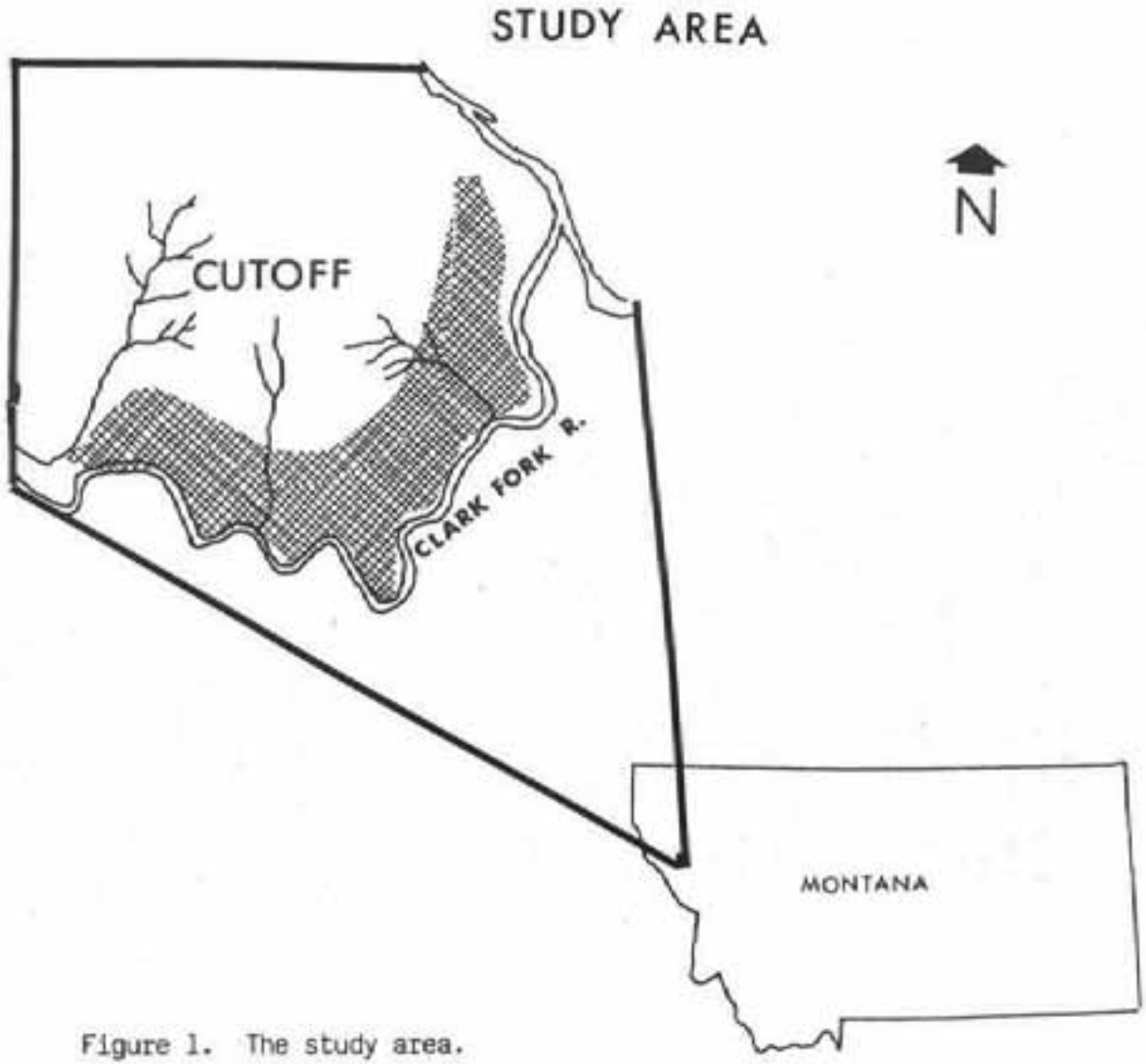

Figure 1. The study area.

twice weekly. Locations of radioed sheep were plotted on a 7.5-minute series topographic map. Seasonal and annual modified minimum home range sizes (Harvey and Barbour 1965) were plotted. The modified minimum method was chosen because the study area was crescent-shaped, and the minimum home range size method (Hayne 1949) would have included large, unused areas. Seasonal and annual centers of activity (Hayne 1949) and standard diameters (Harrison 1958) were calculated for each radio-collared sheep.

PARASITES

Fecal pellets were collected in April, 1980 from pellet groups on the Cutoff area and on Wildhorse Island. These samples were analyzed by the Veterinary Research Laboratory in Bozeman, Montana, for the presence of lungworm (Protostrongylus spp.) larvae.

RESULTS

CENSUS

The herd was estimated to contain 57 sheep during spring 1980, 73 during summer 1980, and 65 during winter 1981. The calculated ewe:lamb ratio was 100:57 during summer and declined to 100:42 by the following winter. Approximately 70 percent of the lambs known to be born in 1980 were alive by the end of the following winter. About 80 percent of the yearlings present in the herd during the summer were known to be alive by the end of the winter.

DAILY AND SEASONAL MOVEMENTS

The 4 radio-collared ewes and 1 ram were observed on consecutive days 142 times. Average daily movements during each season were calculated from those observations. Ewe groups moved an average of 0.6 km per day with relatively little seasonal variation (Table 1). The collared ram averaged 1.0 km per day during the year. Average daily movements were least during winter (0.3 km per day) and most extensive during fall (1.6 km per day).

No distinct seasonal movements or migrations were noted for the ewes. Winter centers of activity averaged 0.6 km distant from summer centers of activity, and winter ranges were contained within their summer ranges.

The ram's winter center of activity was 4.4 km distant from his summer center of activity, and his winter range did not overlap any of his other seasonal ranges. Movement to the winter range was not a direct migration, but more of a "drift" beginning shortly after the end of the breeding season.

HOME RANGE

The radio-collared ewes were each located an average of 90 times during

Table 1. Daily movements of radio-collared sheep.

Season	Average movement (km/day)	Range	Sample size
		Ewes	
Spring	0.6	0 - 1.2	8
Lambing	0.6	0 - 2.4	19
Summer	0.7	0 - 2.2	50
Fall	0.6	0 - 2.0	33
Winter	0.7	0 - 1.6	18
Total 1980-81	0.6	0 - 2.4	128
		Ram	
Spring	1.2	0.4 - 3.2	4
Summer	0.7	0 - 1.0	4
Fall	1.6	0 - 3.6	6
Winter	0.3	0 - 1.2	4
Total 1980-81	1.0	0 - 3.6	18

the study, and the average home range was 541 ha (Table 2). Average seasonal home range sizes for the ewes were smallest during lambing (47 ha) and largest during fall (237 ha). The radioed ram was located 69 times during the study and had a home range of 798 ha. Most of the area of the summer home range of the ram was separate from that of all radioed ewes, but some overlap occurred. The ram was 3 years old at the time of the study and not fully mature and was still occasionally associated with ewe groups. Also, he was the smallest ram of the 4 in his age class on the study area, and he was seen with ewe groups more often than were the other rams. His winter range was separate from those of all radioed ewes, but other ewes were seen wintering in the same area. Because of the nature of the terrain and vegetation on his wintering area, he was sighted infrequently during winter, and he was never actually seen with the ewe group. The ram's seasonal home range was the largest during spring (305 ha) and smallest during winter (21 ha). A comparison of the 1979 and 1980 home ranges of individual sheep indicated no apparent shift of home ranges or major range extensions.

STANDARD DIAMETERS

Standard diameters (Harrison 1958) for the ewes averaged 2.8 km during 1979 and 2.5 km during 1980 (Table 3). The ram's standard diameter was 3.9 km during 1979 and 4.0 km during 1980. Ewes moved the least during the lambing season when the standard diameter averaged 1.8 km. The ram moved the least during winter; the standard diameter then was 1.7 km. Both sexes ranged farthest during the fall breeding season when the standard diameter was 5.0 km for the ram and 3.1 km for the ewes.

PARASITES

Pellet analysis revealed a low level of lungworm (Protostrongylus spp.) infestation in the Cutoff herd. Larvae were present in 11 of the 20 samples collected at an average level of 1.7 larvae per gram of feces (range 0 - 13.4). Pellets from the Wildhorse Island herd averaged 16.1 larvae per gram of feces (range 0 - 70.6). Only 2 of the 34 samples collected contained no larvae. The lungworm level of both herds can be considered low, but the infestation level of the Wildhorse Island herd was significantly higher than that of the Cutoff herd ($t=3.66$, 52 d.f., $p < 0.0005$).

DISCUSSION

CENSUS

The Cutoff herd was estimated at 70 sheep at the end of winter 1981. However, 5 of these were added as a supplemental transplant, and at least 5 immigrated to the Cutoff from a nearby herd. If those 10 sheep are subtracted from the estimate, 60 sheep were present that were either members of, or produced by, the original transplant group. In spring 1980,

Table 2. Seasonal home range sizes (ha) of radio-collared sheep, 1979 and 1980-81.

	Ewe 6		Ewe 7		Ewe 8		Ewe 9		$\bar{X}$ Ewes		Ram	
	Size	N	Size	N	Size	N	Size	N	Size	N	Size	N
1979	88	13	165	13	77	13	106	11	109	12	124	13
1980-81												
Spring	42	11	145	16	135	14	97	13	104	14	305	18
Lambing	46	12	51	12	32	9	60	8	47	10		*
Summer	181	35	179	34	181	36	268	28	202	33	245	21
Fall	214	20	285	19	264	20	186	19	273	20	222	18
Winter	44	13	57	11	62	13	80	13	61	13	21	13
1980-81	417	91	621	92	570	92	554	81	541	89	798	70

* Locations during the lambing season were combined with spring locations for the ram.

Table 3. Seasonal standard diameters (km) of home ranges of radio-collared sheep, 1979 and 1980-81.

	Ewe 6		Ewe 7		Ewe 8		Ewe 9		$\bar{X}$ Ewes		Ram	
	Size	N	Size	N	Size	N	Size	N	Size	N	Size	N
1979	2.1	14	2.9	13	2.2	13	4.1	11	2.8	13	3.9	13
1980-81												
Spring	2.0	12	3.2	16	3.1	14	3.1	13	2.8	14	3.5	18
Lambing	1.6	12	1.7	12	1.8	9	2.1	8	1.8	10	*	
Summer	2.0	35	2.1	34	2.1	37	2.7	28	2.2	34	3.7	21
Fall	3.0	20	3.5	19	2.8	20	3.4	19	3.1	20	5.0	18
Winter	1.7	13	2.4	11	1.8	13	1.4	13	1.8	13	1.7	12
Total 1980-81	2.1	92	2.6	92	2.4	93	2.7	81	2.5	90	4.0	69

* Locations during the lambing season were combined with spring locations for the ram.

the population was estimated at 57, a 39 percent increase since the 1979 transplant of 41 sheep. Without immigration and the supplemental transplant, only a 5 percent increase would have occurred from spring 1980 to the end of winter 1981.

Several factors contributed to the low rate of increase during the second year after the transplant. At least 2 adult ewes, 1 ram, and 1 yearling died during the second year, and one other ram was reported hit by a train but was never found. At least 2 adult ewes left the Cutoff area and joined a nearby herd. Those 6 or more sheep lost from the small population represented a substantial portion of the herd.

Slightly less than 70 percent of the lambs born in 1980 were alive by the end of the following winter. The summer ewe:lamb ratio was 100:57, indicating either a relatively high degree of lamb mortality shortly after birth or non-breeding by some ewes. Summer ewe:lamb ratios of 100:100 and lamb survival over 90 percent have been reported for vigorous herds (Brown 1974, VanDyke 1978, Butts 1980). I believe that not all ewes in the Cutoff herd had lambs durng 1980, and that the 19 lambs I observed were about all that were born.

The Wildhorse Island sheep used as transplant stock may have been of low vigor and have had inherently low reproductive and lamb survival rates. The 1979 summer ewe:lamb ratio in the Wildhorse Island herd was 100:18 and that for 1980 was 100:4. Also, several of the transplanted ewes were quite old. Geist (1971) stated that "a population of low-quality females with an intrinsically low death rate would cause a low birth rate, and would also lag or perpetuate itself in the face of improving forage conditions.": However, even if the adult ewes are "low-quality" sheep, the lambs born on the study area appear vigorous. Horn growth on yearlings is good. The horn and body size of 1-year-old males is noticeably larger than that of adult ewes, and about as large as those of 1-1/2-year-old males from a less vigorous herd I studied in the Petty Creek, Montana drainage. The male lambs on the Cutoff are noticeably larger than the female lambs in both horn and body size by approximately 10 months of age.

The summer ewe:lamb ratio from the Cutoff herd is much higher than those reported from Wildhorse Island in recent years, but I believe that the "lag (in productivity) in the face of improving forage conditions" which Geist (1971) postulated for transplants from poor quality populations is occurring. Yearling breeding, indicative of a vigorous herd, was once common on Wildhorse Island (Woodgerd 1964), so sheep from there apparently have that potential. Given the apparent vigor of the sheep born on the Cutoff since the transplant, the change from low to high quality will probably occur as more Cutoff lambs reach breeding age. Appparenty, initial productivity may be influenced by the quality and vigor of the transplant stock, but I believe that the released herd's quality can change in a few years, and that habitat quality at the transplant site is more important in determining the long-term success of the herd.

PARASITES

Bighorn herds studied in Montana generally have low levels of lungworm (Protostrongylus spp.) infestation (less than 100 larvae per gram of feces) and infestation rates of around 75 to 100 percent (Couey 1950, Forrester and Senger 1964, Berwick 1968, Brown 1974, Klaver 1978). The infestation rate in the Cutoff herd is significantly lower than that in the Wildhorse Island herd. Both herds had infestation levels that were very low although both areas were sampled in early spring when larval output is the greatest (Forrester and Senger 1964). The difference is probably a reflection of the fact that the Cutoff sheep were introduced to an area that had been without bighorns for several years, and infectious stage larvae were not present in the intermediate hosts. Thus, a low infestation level would be expected for a newly transplanted herd until the rate of infestation of the intermediate host increases.

DISPERSAL AFTER REINTRODUCTION

The pattern of range colonization is illustrated by location of the radioed ram from the transplant date to the end of the study (Figure 2). Movements eastward from the release site were gradual, but he continuously expanded his range throughout the study. The Cutoff herd has expanded its range 3 km west and 11 km east of the release site since they were transplanted. Most of the sheep remained within 2 km of the release site during the first year, but a few occasionally moved 4 to 5 km east of the release site. The 2-year-old ram that was radio-collared was located approximately 7 km east of the release site 5 months after the release.

Sheep have dispersed 3 km west of the release site to near the Patrick Creek drainage. That drainage and most of the others to the west of the study area are timbered and appeared to be a barrier to further dispersal in that direction. However, sheep have been sighted recently near Sesame Creek, 2 km west of the area occupied by sheep during my study.

During the spring and early summer of 1980, sheep were rarely seen east of Sheep Creek (6.5 km east of the release site). As summer progressed, sheep were sighted there more frequently, and they eventually moved northeast along the Clark Fork River to near its junction with the Flathead River. During January and February 1981, a group of sheep wintered in that area. The following spring, the radioed ram and a yearling were sighted 2 km farther north along the Clark Fork near the mouth of Kennedy Creek.

In early March 1981, a marked adult ewe from the Cutoff herd was sighted near Knowles Creek on the north side of the Flathead River with a herd that had been transplanted near Perma (Figure 3). That herd was also transplanted from Wildhorse Island during the winter of 1979. Later, another marked ewe from the Cutoff was sighted with the Perma herd, and both apparently stayed with these at least through the lambing season. Those sightings were approximately 6.5 km from the release site. Movement from the Cutoff to

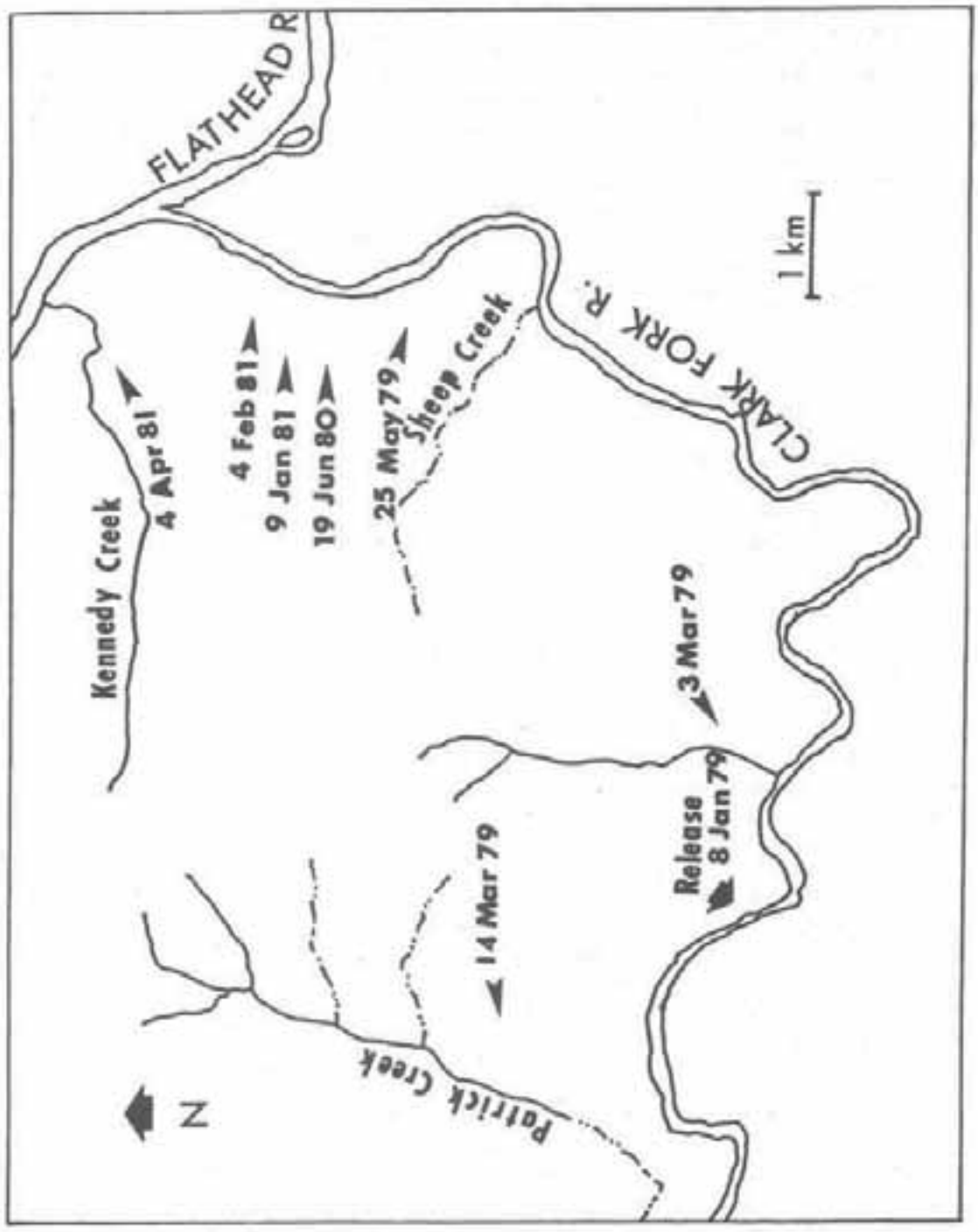

Figure 2. Pattern of range colonization by radio-collared ram.

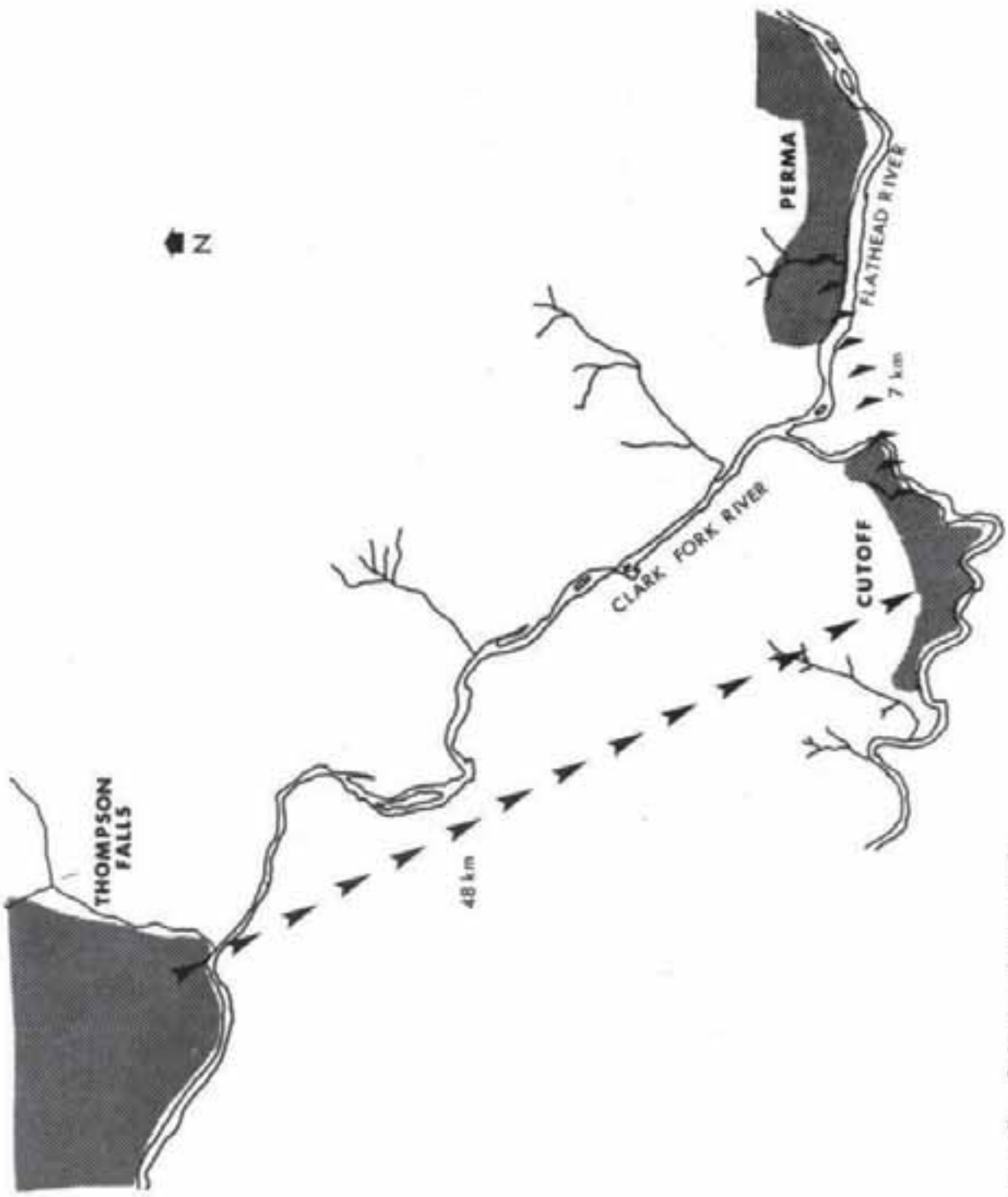

Figure 3. Interherd movement.

Knowles Creek entailed crossing at least 1, and probably 2, major rivers.

Sheep are occasionally sighted far from known sheep ranges. Geist (1971) conceded that, even though sheep do not normally disperse, rams have a "vestigial dispersal period" during their third summer and may leave their traditional range. He further stated that the presence of other sheep is necessary for habitat to appear suitable to the dispersing animals. Thus, if the dispersing sheep fail to find another herd with which to associate, they either return to their original herd or die as a result of not finding suitable habitat.

A group of sheep that was believed to have dispersed from the Thompson Falls herd, 48 km north of the study area, joined the Cutoff herd. A group consisting of 4 2-year-old males and 2 2-year-old females was sighted on the Cutoff in late May 1980. Later in the summer, a 2-year-old male was found dead and a 2-year-old female was captured. Both were too old to have been born since the transplant, and neither sheep was ear-tagged as were all members of the transplant group. The sheep could not have come from the recently transplanted Perma herd because all sheep in those sex and age classes in that herd were accounted for at that time.

The fact that immigration from the Thompson Falls herd and movement from the Cutoff to the Perma herd have occurred has several management implications. If movement between these herds occurs on a regular basis, suitable habitat between the herds may eventually be utilized by the sheep, and the herds may merge into one continuous population. Also, genetic interchange would preclude retarded vigor resulting from extensive inbreeding, which Berwick (1968) postulated as a contributing factor to the decline of the Rock Creek, Montana, herd. Even if more interchange does not occur, the immigrants have knowledge of areas outside of the present limits of the Cutoff herd's range, and that may facilitate range extension. The re-establishment of sheep herds in relatively close proximity to other herds may also eliminate some juvenile mortality by increasing the chances that dispersing sheep will find other herds.

CONCLUSION

The Cutoff transplant appears to be successful. The herd is increasing, and the sheep appear healthy and vigorous. The proximity of the Cutoff to other sheep herds resulted in herd interchange, and inter-herd movement may allow sheep to exploit available habitat between the herds' present ranges.

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