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ABSTRACT

Columbia and Targhee ewes from five birth year groups at the Eastern Oregon Experiment Station, Union, were randomly divided into groups bred to lamb first at one year or at two years of age. Objectives of the experiment were to determine whether age at first lambing or ewe breed affected ewe performance at two years of age, whether and how much they affected cumulative lamb and wool production throughout life, and whether they affected longevity of the ewes. Mating ewes to lamb at one year of age did not decrease the number of lambs born or weaned, the kilograms of lamb weaned, or the kilograms of wool produced by ewes as two year olds. Lambing ewes at one year of age increased cumulative production of lambs and kilograms of lamb through 6½ years of age. Cumulative wool production was little affected by age at first lambing. In the first birth year group of ewes to enter the experiment, attrition was higher from ewes bred as lambs than from ewes bred as yearlings. In four other birth year groups, there was no consistent difference in attrition between ewes bred first as lambs and those bred first as yearlings. Columbia and Targhee ewes did not differ significantly for lamb and wool production at two years of age, but Columbias were consistently superior for longevity and for cumulative production of lambs, kilograms of lamb, and kilograms of wool.

Key words: age at first lambing, lamb, wool, longevity, Columbia, Targhee.

INTRODUCTION

Most commercial sheep growers mate replacement ewes at approximately 19 months of age to lamb first at two years of age. Thus, expenses for 27 to more than 30 months are accrued before the first lamb crop is marketed. During that time the ewe has produced two fleeces, but both the actual amount and proportion of total income from wool are low in modern, intensive sheep production systems (Kilkenny and Read, 1974; Hohenboken, 1976; Cedillo *et al.*, 1977).

Age at first behavioral estrus in medium wool and meat-type sheep has been reported to average from 205 to 254 days, depending upon breed and management conditions (Southam *et al.*, 1971; Dyrmundsson and Lees, 1972; Keane, 1974b; Dickerson and Laster, 1975; Cedillo *et al.*,

1977). Thus, ewe lambs are potentially capable of mating at seven months of age and of lambing at one year of age. This practice would allow them to produce a marketable lamb crop after accrual of expenses from 15 to 18 plus months rather than from 27 to 30 plus months. If production per ewe bred at seven months of age were high enough, and if there were no important detrimental effects on future production and longevity, the practice of breeding ewe lambs would increase the economic efficiency of sheep production.

Literature Review

The effects of lambing ewes at one year of age have been examined in a number of experiments. The earliest experiment to compare systematically the breeding of ewe lambs versus the breeding of yearlings was described by Bowstead in 1930. Major conclusions were that early breeding did not affect 18-month or mature weight of ewes but that it did result in more lambs raised per ewe bred. At 3½ years of age, ewes bred as lambs had produced 3.7 marketable lambs, compared to 2.6 from ewes bred as yearlings. No significant differences were found between groups in the number of deaths or in incidences of "respiratory or digestive disorders or diseases of the udder." First-year reproduction and lamb production of the group lambing first at two years of age exceeded first-year production of the ewe lamb group (at one year of age), but that was more likely due to age differences than to treatment differences (Dickerson and Glimp, 1975). When the two groups were compared at two and three years of age, the group bred as ewe lambs was more productive. This also may not have been due to treatment but rather the result of culling from the lamb group all ewes which failed to conceive as lambs. Bowstead concluded that breeding ewe lambs offered promise for generating additional net income.

Griswold (1932) compared production through five years of age of Hampshire x Rambouillet ewes mated to lamb first at one versus two years of age. He found that ewes bred as lambs were about 10 percent lighter at the end of their first lactation, but that at later ages the two groups did not differ in body weight. Likewise, first-year wool production was less for ewes bred as lambs, but later wool production was nearly equal for the two groups. No differences in mortality were evident by five years of age. Ewes lambing first at one year of age raised slightly more lambs at two through five years of age. Their lambs were slightly lighter, and a smaller proportion was ready for slaughter at weaning time, probably because the higher prolificacy lowered average weaned weights (Dickerson and Laster, 1975).

Briggs (1936) reported additional results from the same experiment. He concluded that ewes lambing at one year of age required approxi-

mately 10 months longer than yearling-bred ewes to reach the same mature size. Once mature weight was reached, however, the two groups did not differ through seven years of age. After six production years, the early bred ewes had produced an average of 6.7 lambs weighing 225 kilograms. The yearling-bred group produced an average of 6.0 lambs weighing 211 kilograms. At the end of seven years, the lamb-bred group had a higher proportion of ewes with unsound incisor teeth, and a higher proportion had been culled for broken mouths at six years of age.

Spencer (1942) compared performance through five years of farm flock Hampshire ewes lambing first at one versus two years of age. The results agreed in most aspects with previous studies. Ewes bred as lambs were lighter than their pair mates at 18 months of age, but the difference disappeared at later ages. Unlike other studies, wool production throughout the experiment of the early lambing ewes was slightly but significantly lower than that of ewes bred first as yearlings. No differences in death or culling losses were apparent. Likewise, lamb crop percentages did not differ between groups. At five years of age, the ewes which lambed at one year of age had produced 20 percent more lambs and 14 percent more kilograms of lamb than their pair mates bred first as yearlings.

Cannon and Bath (1969) compared production through five years of age of Australian Border Leicester x Merino ewes bred first at 10 to 11 months versus 20 to 21 months of age. They reported lower first-year wool production and lower yearling body weight for the former group. Later wool production and body weight, however, did not differ between groups, nor did reproduction, lamb production, or death loss. Early lambing increased cumulative lamb production per ewe at five years of age by 12 kilograms.

Southam *et al.* (1971) reported that Rambouillet, Targhee, and Columbia ewes successfully bred as lambs were not lower in yearling body weight and were not significantly lower in yearling fleece weight (4.8 versus 5.0 kilograms) than contemporary ewes not successfully bred as lambs. In their experiments, feeding levels throughout mating, gestation, and lactation had been quite liberal.

Finally, Keane (1974a) studied the effect of age at first mating (8 months versus 17 months) on production of Suffolk x Galway ewes in Ireland. Ewes bred as lambs were 11 percent lighter going into their second mating season, but the difference gradually decreased and had disappeared by the time the ewes were 30 months of age. At the second mating/lambing season, groups did not differ in date of first estrus, percent mated, fertility, lambing date, or fleece weight. Prolificacy at two years of age was lower (1.34 versus 1.56, not significant) for ewes bred as lambs.

Experimental Objectives

The pattern which emerged from most past studies was higher cumulative lifetime lamb production, lower yearling body weight and fleece weight, similar body weight and fleece weight past yearling age, and no apparent effect on mortality and longevity from the practice of breeding ewe lambs at from 7 to 10 months of age. Questions for which there have been variable results include: (1) What is the effect of lambing at one year of age on production the second year? (2) What is the magnitude of the effect of lambing at one year of age on cumulative lifetime production? (3) What is the effect of lambing at one year of age on longevity?

The experiment reported herein was designed to provide answers to these questions for Columbia and Targhee ewes raised under typical eastern Oregon farm flock conditions.

MATERIALS AND METHODS

Population

This experiment was conducted at the Eastern Oregon Experiment Station, Union, Oregon (location 45° 13'N latitude, 117° 52'W longitude, elevation 853 meters, annual rainfall 330 mm, average growing season of 120 days). The population was composed of straightbred Columbia and Targhee ewes born during the 1966 through 1970 spring lambing seasons. Each year replacement ewe lambs were selected at weaning based on type of birth and age-adjusted weaning weight. They were allowed to graze on irrigated fescue/Ladino clover or orchardgrass/alfalfa pastures from weaning through November. The wintering ration was *ad libitum* grass/legume hay. Replacement ewes were randomly alloted within breed to groups mated to lamb first at one year or at two years of age. Annual pro-

Table 1. Number of ewes per birth year, breed, and age at first lambing treatment group

Birth year	Breed	Age at first lambing	
		One year	Two years
1966	Columbia	16	24
	Targhee	15	6
1967	Columbia	11	12
	Targhee	11	12
1968	Columbia	18	17
	Targhee	8	8
1969	Columbia	17	20
	Targhee	10	13
1970	Columbia	18	18
	Targhee	14	14

duction of lamb and grease wool was recorded for each ewe through 1974 or until she died or was culled from the flock. For convenience, the group bred to lamb at one year of age will be called the "lamb" group; the ewes bred to lamb at two years of age will be called "yearlings." Numbers of ewes initially selected per birth year, breed, and treatment group are shown in Table 1. Of the 282 ewes involved in the experiment, 171 were Columbia and 111 Targhee; 138 were lambed first as lambs and 144 as yearlings.

Management

Ewes were managed as a typical western, intermountain area farm flock. Ewes bred at seven to eight months of age were exposed to Cheviot or Dorset rams from September 20 to November 1 each year. For all matings of yearling and older ewes, rams of the same breed as the ewes (Columbia and Targhee) were used, with mating from August 15 to November 1. Lambing was from January through March. Lambs were weaned at approximately 90 days of age, although there was some variability from year to year. The different breed and age groups were always managed alike within years, however. Throughout most of the year, both ewes and lambs were run on dryland or irrigated pastures or on hay stubble. Supplemental feeding of hay or hay plus grain was necessary during late gestation and early lactation.

The experiment terminated in 1974. Ewes born in 1966 and bred as lambs had eight potential production years (1967 through 1974). Each later birth year group of ewes had one less year of potential production.

Statistical Procedures

Weaning weight adjustments

Prior to subsequent analyses, individual weaning weight records of lambs were adjusted for sex (Scott, 1969) and to a common weaning age of 90 days. The latter adjustment was according to the formula:

$$\text{Age-adjusted weaning weight} = \frac{(\text{Actual weaning weight} - \text{birth weight})}{\text{Actual weaning age}} \times 90 + \text{Birth weight}$$

Lamb records were not adjusted for type of birth and rearing. Each ewe's annual production was the sum of adjusted weaning weights of all her lambs. Her cumulative lifetime production was the sum of annual production totals, including zeros for years in which she did not wean lambs and for potential production years after her culling or death.

Objective 1

To determine whether lambing a ewe at one year of age decreased her production when she lambed at two years of age, the total number of lambs born (dead and alive), the number of lambs weaned, kilograms of lamb weaned, fleece weight, and ewe weight of two-year-old ewes were subjected to least squares analysis of variance (Harvey, 1960). All variables were per ewe exposed (not per ewe lambing), so fertility differences are included in the comparisons. The factorial model included main effects for age at first lambing, breed of ewe, and birth year of ewe, as well as all two-factor interactions and the single three-factor interaction.

Objective 2

Ewes born in different years had different potential years of production. Ewes bred as lambs from all five birth year groups had at least four opportunities to lamb; ewes bred as lambs from the four earlier birth year groups (1966-1969) had at least five opportunities to lamb, etc. Therefore, different quantities of information were available to assess the magnitude of the effect of lambing at one year of age on cumulative production up to various ages. To extract as much information from the experiment as possible, seven least squares analyses of variance were performed.

In the first, all five birth year groups of ewes were included, but cumulative production was analyzed through only 2½ years of age. Thus, the first analysis compared production from two lamb crops of ewe lambs to production from one lamb crop of yearlings. The second analysis compared production through 3½ years of age. Again, all birth year groups were included. The ewe lamb group had reared three lamb crops; the yearling group had reared two. The third through seventh analyses compared production through 4½, 5½, 6½, 7½, and 8½ years of age, respectively. Beginning with the fourth analysis, fewer birth year groups of ewes were included, because fewer groups were old enough in 1974 to have reared the requisite number of lamb crops. The mathematical model included main effects for age at first lambing, breed of ewe, and birth year, plus all possible two-factor interactions and the single three-factor interaction.

Dependent variables were cumulative number of lambs born and weaned, cumulative kilograms of lamb weaned, and cumulative kilograms of wool produced. All the dependent variables were on a "per ewe entering the experiment" basis. Because of losses from death or culling, a ewe's actual years of production were often less than her potential years of production. Variation in the dependent variables, therefore, was caused partly by variation in fertility, prolificacy, milk production, wool production, and genetic potential for lamb viability and growth of individual ewes, and partly by variation in longevity.

Objective 3

Attempts to classify individual ewe losses according to whether they were caused by age at first lambing were not successful. Too many subjective judgments were involved. Therefore, in the analysis of the effect of age at first lambing on longevity, the cause of death or culling was ignored (except in one instance to be discussed).

Within each of the five ewe birth year groups and for each age at first lambing (breeds pooled) and each breed (age at first lambing groups pooled), percentages of ewes entering the experiment and still present after 2½ years through their final potential year of age were computed. These were plotted, and differences between groups were assessed visually. Because of limited numbers per group and the general similarity of most plots, the differences between percentages were not tested for statistical significance.

RESULTS AND DISCUSSION

Objective 1

Analyses of variance for the effects of age at first lambing and other variables on production of ewes at two years of age are presented in Table 2. Least squares means for age at first lambing and breed groups are presented in Table 3.

None of the main effects or interactions significantly influenced number of lambs born or weaned or kilograms of lamb weaned per ewe mated. The age at first lambing x ewe breed interaction approached significance for number of lambs born and kilograms of lambs weaned, however. Targhee ewes bred to lamb at one year of age actually had higher production at two years than did Targhee ewes bred first as yearlings (1.40 versus 1.25 for prolificacy and 39.8 versus 31.1 for kilograms of lamb weaned). This agreed with results of Bowstead (1930). For Columbia ewes, early lambing had a detrimental effect on prolificacy at two years (1.23 versus 1.38 lambs born per ewe bred), which is in agreement with Keane (1974a), but little effect on kilograms of lamb weaned (36.0 versus 36.8). Of ewes exposed to rams at seven months of age, 60 percent of Targhees and 69 percent of Columbias actually lambed. Some of the breed x age at first lambing interaction effect on second-year lamb production may have been caused by this difference in ewe lamb fertility.

For kilograms of wool produced, the age at first lambing x ewe breed interaction was significant ($P < .05$), but neither of the constituent main effects reached significance. Ray and Sidwell (1964) and Vesely *et al.* (1965) have documented the detrimental effects of pregnancy and lactation on wool production. Thus, age at first lambing x breed subgroups with

Table 2. Analyses of variance for effects of age at first lambing, ewe breed, birth year, and interactions on ewe production at two years of age

Effect	df	Mean square for: Number of lambs born	Number of lambs weaned	Kg of lamb weaned	Kg of wool produced	Ewe weight
Age at first lambing	1	.00	.97	896	1.0	14
Ewe breed	1	.02	.24	42	2.7	1,134**
Birth year	4	.46	.60	764	1.8	343**
Age x breed	1	1.41	.99	1,394	4.8*	0
Age x birth year	4	.56	.34	571	.4	65
Breed x birth year	4	.38	.58	867	2.7	77
Age x breed x birth year	4	.34	.63	491	1.0	17
Residual[a]	251	.52	.48	518	1.1	48

[a] Degrees of freedom for residual for ewe weight were 227, due to missing weights on some individuals.

* $P < .05$, ** $P < .01$.

Table 3. Least squares means for age at first lambing and ewe breed effects on ewe production at two years of age

Effect	No. of lambs born	No. of lambs weaned	Kg of lambs weaned	Kg of wool produced	Ewe weight
Overall average	1.31	1.08	35.9	5.1	72.6
Residual standard deviation	.72	.69	22.8	1.1	6.9
Ewe lamb lambers	1.31	1.14	37.8	5.1	72.8
Yearling lambers	1.31	1.02	34.0	5.2	72.3
Columbia ewes	1.30	1.11	36.3	5.2	74.8[a]
Targhee ewes	1.32	1.05	35.5	5.0	70.3[b]

[a,b] Means with different superscripts differ significantly at $P < .01$.

higher lamb production would have been expected to have lower wool production and vice versa. A reasonable biological expectation would have been for the wool interaction to be a mirror image of the interaction for kilograms of lamb weaned. Such was not the case. Targhees lambing first at one year of age had slightly higher wool production at two years of age than Targhees lambing first at two years (5.08 versus 4.93 kilograms), the same trend in means as for lamb production. Columbia ewes lambing the previous year produced significantly less wool than Columbia not bred as lambs (5.02 versus 5.43 kilograms), in agreement with findings of previous workers (Griswold, 1932; Spencer *et al.*, 1942; Cannon and Bath, 1969).

Ewe weight at two years of age was not affected by age at first lambing, but breeds and birth year groups differed significantly. Columbia ewes were 4.5 kilograms heavier than Targhees. There was a range of 6.6

kilograms in means of birth year groups, indicating that years and the differences in environment, handling, and management with which they were confounded accounted for more variation in ewe weight than did age at first lambing. None of the interactions approached significance.

Results of this phase of the study indicated that breeding ewes to lamb first at one year of age did not lower prolificacy, lamb-raising ability, wool production, or body weight during the ewes' second year of production. This was in general agreement with the findings of Bowstead (1930) and Southam *et al.* (1971), but other researchers (Griswold, 1932; Briggs, 1936; Spencer *et al.*, 1942; Cannon and Bath, 1969; and Keane, 1974a) reported detrimental effects of lambing at one year of age on lamb production, wool production, and/or weight at two years of age.

Objective 2

Analyses of variance for main effects of age at first lambing, ewe breed, and birth year on production of ewes after 2½ through 8½ years of production are presented for number of lambs born (Table 4), number of lambs weaned (Table 6), kilograms of lamb weaned (Table 8), and kilograms of wool produced (Table 10), per ewe entering the experiment. Since the two-factor interactions and the single three-factor interaction were neither significant nor important for lambs born, lambs weaned, or kilograms of lamb weaned, the interaction mean squares are not presented in the tables. Some interactions of age at first lambing x birth year were significant for kilograms of wool produced, so that interaction is included in the analysis of variance in Table 10. Least squares means for effects of age at first lambing and ewe breed on the four dependent variables are presented in Tables 5, 7, 9, and 11.

Table 4. Analysis of variance for effects of age at first lambing, ewe breed, and birth year on number of lambs born (per ewe entering the experiment) at 2½ through 8½ years of age

		Mean squares for numbers of lambs born through:						
Effect[a]	df	2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Age at first lambing	1	45.50**	47.86**	36.91**	26.85	5.95	.25	34.02
Ewe breed	1	.01	.54	3.26	19.05	22.02	16.71	10.90
Birth year[b]		1.07	2.26	6.18	19.73	19.83	10.24	
Residual[c]		.83	1.98	4.59	7.93	11.07	13.91	15.11

[a] Interactions were not significant or important and are not presented.

[b] Birth year degrees of freedom are 4 for 2½, 3½, and 4½ years analyses, 3 for 5½ years analysis, 2 for 6½ years analysis, 1 for 7½ years analysis, and 0 for 8½ years analysis.

[c] Residual degrees of freedom are 271 for 2½ and 3½ years analyses, 269 for 4½ years, 209 for 5½ years, 146 for 6½ years, 99 for 7½ years, and 57 for 8½ years.

** $P < .01$.

Table 5. Least squares means for effects of age at first lambing and ewe breed on number of lambs born (per ewe entering the experiment) at 2½ through 8½ years of age

Effect	Number of lambs born through:						
	2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Overall average	1.71	2.84	3.89	4.71	5.42	6.22	6.18
Residual standard deviation	.91	1.41	2.14	2.82	3.33	3.73	3.89
Ewe lamb breeders	2.13[a]	3.27[a]	4.27[a]	5.08	5.63	6.17	5.36
Yearling breeders	1.29[b]	2.41[b]	3.51[b]	4.34	5.21	6.27	7.00
Columbia ewes	1.72	2.87	4.00	5.02	5.82	6.64	6.65
Targhee ewes	1.70	2.69	3.78	4.40	5.02	5.80	5.72

[a,b] Means with different superscripts differ significantly at $P < .01$.

Table 6. Analysis of variance for effects of age at first lambing, ewe breed, and birth year on number of lambs weaned (per ewe entering the experiment) at 2½ through 8½ years of age

Effect[a]	Mean squares for number of lambs weaned through:						
	2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Age at first lambing	43.84**	50.11**	53.67**	27.69*	7.69	.38	14.10
Ewe breed	1.75	8.58*	23.87*	46.46*	45.59*	27.43	26.50
Birth year	.62	.38	2.63	11.55	15.61	2.12	
Residual	.78	1.89	4.00	6.86	9.86	12.04	13.49

[a] Interactions were not significant or important and are not presented. Degrees of freedom are identical to those for number of lambs born per ewe entering the experiment, presented in Table 4.

* $P < .05$, ** $P < .01$.

Table 7. Least squares means for effects of age at first lambing and ewe breed on number of lambs weaned (per ewe entering the experiment) at 2½ through 8½ years of age

Effect	Number of lambs weaned through:						
	2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Overall average	1.37	2.24	3.10	3.76	4.29	4.90	4.94
Residual standard deviation	.88	1.37	2.00	2.62	3.14	3.47	3.67
Ewe lamb breeders	1.78[c]	2.68[c]	3.55[c]	4.13[a]	4.52	4.96	4.41
Yearling breeders	.96[d]	1.80[d]	2.65[d]	3.39[b]	4.06	4.84	5.47
Columbia ewes	1.45	2.42[a]	3.40[a]	4.24[a]	4.86[a]	5.43	5.67
Targhee ewes	1.29	2.06[b]	2.80[b]	3.28[b]	3.72[b]	4.37	4.21

[a,b] Means with these superscripts differ significantly at $P < .05$.
[c,d] Means with these superscripts differ significantly at $P < .01$.

Table 8. Analysis of variance for effects of age at first lambing, ewe breed, and birth year on kilograms of lamb weaned (per ewe entering the experiment) at 2½ through 8½ years of age

Effect[a]	Mean squares for kg of lamb weaned through: 2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Age at first lambing ..	15,621°°	13,376°	20,840°	5,332	6	4,361	49,353
Ewe breed	768	5,273	27,209°	58,871°°	61,299°	45,950	31,571
Birth year	901	1,414	5,554	15,173	19,643	19	
Residual	633	2,485	4,511	7,871	11,066	13,610	15,195

[a] Interactions were not significant or important and are not presented. Degrees of freedom are identical to those for number of lambs born per ewe entering the experiment, presented in Table 4.

° $P < .05$, °° $P < .01$.

Table 9. Least squares means for effects of age at first lambing and ewe breed on kilograms of lamb weaned (per ewe entering the experiment) at 2½ through 8½ years of age

Effect	Kg of lamb weaned through: 2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Overall average	39.7	72.2	100.8	125.2	143.0	164.2	167.7
Residual standard deviation	25.2	49.8	67.1	88.9	105.1	116.9	123.2
Ewe lamb breeders	47.5[c]	79.3[a]	109.8[a]	130.5	143.2	157.4	136.3
Yearling breeders	32.0[d]	65.0[b]	91.9[b]	119.9	142.8	171.0	199.0
Columbia ewes	41.5	76.7	111.0[a]	142.3[c]	164.0[a]	186.1	192.8
Targhee ewes	38.0	67.7	90.6[b]	108.1[d]	122.0[b]	142.3	142.5

[a,b] Means with these superscripts differ significantly at $P < .05$.
[c,d] Means with these superscripts differ significantly at $P < .01$.

Table 10. Analysis of variance for effects of age at first lambing, ewe breed, birth year, and age at first lambing x birth year interaction on kilograms of wool produced (per ewe entering the experiment) at 2½ through 8½ years of age

Effect[a]	Mean squares for kg of wool produced through: 2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Age at first lambing	10.1	3.1	.0	49	142	69	738°
Ewe breed	29.2°°	83.8°	385°°	507°°	434°	149	131
Birth year	27.0°	40.0°	90°	69	116	79	
Age x birth year	9.1	33.0	88°	123	186	591°	
Residual	4.3	14.8	36	66	95	115	106

[a] Remaining interactions were not significant or important and are not presented. Degrees of freedom are the same as those presented in Table 4, and degrees of freedom for interaction equal degrees of freedom for birth year in all analyses.

° $P < .05$, °° $P < .01$.

Table 11. Least squares means for effects of age at first lambing and ewe breed on kilograms of wool produced (per ewe entering the experiment) at 2½ through 8½ years of age

Effect	Kg of wool produced through:						
	2½ years	3½ years	4½ years	5½ years	6½ years	7½ years	8½ years
Overall average	9.6	13.7	17.0	18.7	21.3	23.8	23.4
Residual standard deviation	2.1	3.8	6.0	8.1	9.8	10.7	10.3
Ewe lamb breeders	9.4	13.7	17.0	18.2	20.3	22.9	21.2[a]
Yearling breeders	9.8	13.8	17.0	19.2	22.3	24.6	27.2[b]
Columbia ewes	9.9[c]	14.3[a]	18.1[c]	20.3[c]	23.0[a]	25.0	25.0
Targhee ewes	9.3[d]	13.2[b]	15.9[d]	17.1[d]	19.5[d]	22.5	21.7

[a,b] Means with these superscripts differ significantly at $P < .05$.
[c,d] Means with these superscripts differ significantly at $P < .01$.

Number of lambs born

All records were measured per ewe entering the experiment. As time progressed, more ewes died or were culled. Thus, in later analyses, zero additions to cumulative number of lambs born became more common, and error variance increased substantially. This, coupled with decreasing error in degrees of freedom with time (as younger birth year groups dropped out), led to greater precision and more significant differences for analyses involving fewer production years and to less precision and fewer significant differences for analyses involving more production years. Examination of the pattern of group differences over time is more valid than examination of differences for a single production year. This observation is also true for analyses of number of lambs weaned, kilograms of lamb weaned, and kilograms of wool produced.

Ewes bred to lamb at one year of age had significantly more lambs from two through four production years. After that time, the difference decreased and was no longer significant. At seven and eight years of age the yearling group actually produced more cumulative lambs than did the ewe lamb group. This is most likely attributable to the higher attrition of ewe lamb than yearling group ewes for birth year 1966. Since only the ewes born in 1966 reached 8½ years of age, only that group contributed information to analysis for 8½ production years; and results of that analysis were dependent upon the attrition pattern peculiar to the 1966 ewes. This will be discussed in a later section.

Beginning with the analysis for 3½ years of production, Columbia ewes tended to be higher than Targhee ewes in cumulative number of lambs born. The difference between breeds increased with time (an average of 0.15 per year) but never reached significance.

Number of lambs born did not differ significantly among birth year groups.

Number of lambs weaned

Ewes lambing first at one year of age weaned more lambs per ewe entering the experiment than did ewes lambing first at two years of age. The difference was significant at 2½, 3½, 4½, and 5½ years of production. At 7½ years there was almost no difference between groups, and at 8½ years the yearling group was favored. For the 2½ through 5½ production years, the average advantage of the ewe lamb group was 0.84 lambs weaned per ewe entering the experiment. This agreed closely with Bowstead, 1930 (advantage of 1.1 lambs after three production years); Briggs, 1936 (advantage of 0.7 lambs after six production years); and Spencer *et al.*, 1942 (advantage of 20 percent or about 0.8 lambs after five production years).

From the 3½ through the 6½ year analyses, Columbia ewes weaned significantly more lambs than Targhee ewes. The difference increased in magnitude from an advantage of 0.16 lambs at 2½ years to an advantage of 1.46 lambs at 8½ years.

Birth year of the ewes was never a significant source of variation for number of lambs weaned.

Kilograms of lamb weaned

Differences among groups for kilograms of lamb weaned per ewe entering the experiment were very similar to those for number of lambs weaned. This was because of the high positive correlation between the two traits, with variation in weight of lamb being dependent upon variation in number of lambs.

Ewes bred first as lambs produced significantly more kilograms of lamb than ewes bred first as yearlings after 2½, 3½, and 4½ years of production. Thereafter, the difference gradually decreased and finally favored the yearling group at 7½ and 8½ production years. The average ewe lamb advantage of 14.6 kilograms cumulative lamb production between 2½ and 5½ production years agreed with results of Briggs, 1936 (14 kilograms after six years); Spencer *et al.*, 1942 (14 percent or about 18 kilograms after five years); and Cannon and Bath, 1969 (12 kilograms after five years).

Columbia ewes produced more kilograms of lamb than Targhee ewes at all stages. The difference between breed averages increased from 3.5 kilograms at 2½ years to 50.3 kilograms at 8½ years, an average increase of 7.8 kilograms per year. The cumulative difference was significant after 4½, 5½, and 6½ production years.

There was no significant difference among birth year groups for kilograms of lamb weaned.

Kilograms of wool produced

The age at first lambing × birth year interaction was significant for the analyses after 4½ and 7½ years of production. Plotting the least squares means for age at first lambing x birth year subgroups from each analysis revealed that the effect of age at first lambing on wool production differed depending on the birth year group of ewes being examined. The interactions were fairly large. Thus, no firm conclusion can be reached regarding the effect of age at first lambing on wool production. The average effect in this experiment favored ewes bred first as yearlings, with the cumulative advantage varying from 0.0 to 2.0 kilograms at various stages of production. Griswold (1932) and Cannon and Bath (1969) reported no difference in wool production after the second year of ewes bred as lambs versus yearlings. Spencer *et al.* (1942) reported slightly but significantly lower wool production from early lambing ewes through five years of age.

Columbia ewes consistently produced more wool than Targhee ewes, the difference being significant at 2½ through 6½ production years. The magnitude of the difference increased over time, from 0.6 kilograms at 2½ years to 3.3 kilograms at 8½ years.

Average kilograms of wool produced through 2½, 3½, and 4½ years differed significantly among birth year groups, but the differences are difficult to interpret in light of the birth year x age at first lambing interaction.

Objective 3

Percentages of ewe lamb versus yearling ewes entering the experiment and still present after 2½ through their final potential year of production are plotted in Figures 1 through 5 for 1966 through 1970 birth years, respectively. For birth year groups 1967, 1968, and 1969, there was no consistent difference between attrition of ewes bred first as lambs versus yearlings. For the 1970 birth year group, ewes bred first as yearlings actually had greater losses than ewes bred first as lambs. The difference was not large, however.

The only birth year for which attrition in the lamb group was greater than attrition in the yearling group was 1966. Three ewes (10 percent) from the lamb group were culled before 2½ years of age. Of these, two were culled because they failed to conceive when mated as lambs. Presumably, a like proportion of the yearling group would have been open and culled had they been mated as ewe lambs. Part of the difference between groups in attrition by 2½ years of age, therefore, resulted from a management decision and was not a treatment effect of lambing at one year of age.

After 2½ years, the ewe lamb group continued to have greater annual rates of attrition than the yearling group, especially at years 3½ and 6½.

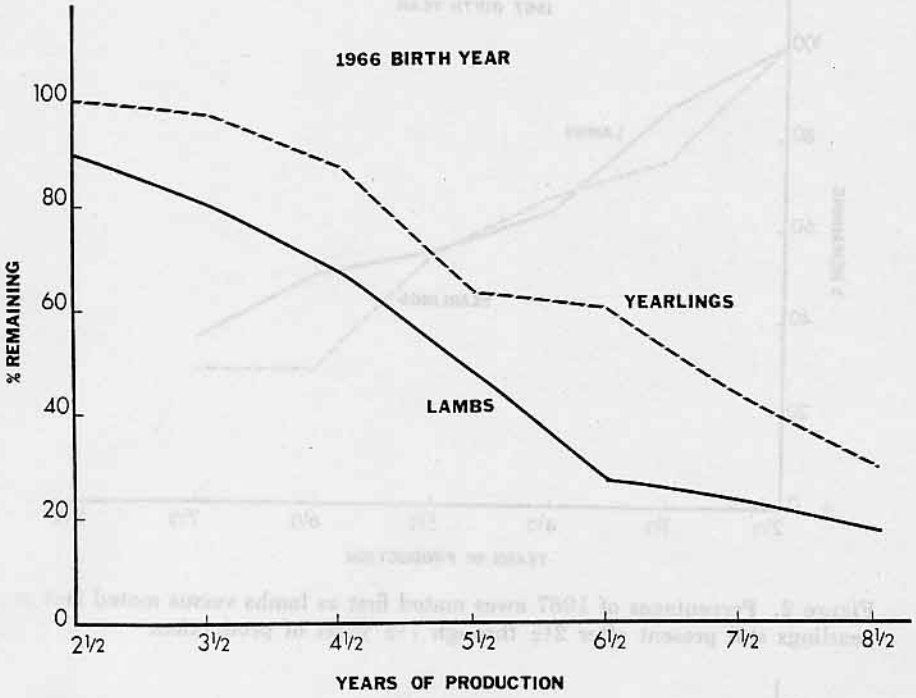

Figure 1. Percentages of 1966 ewes mated first as lambs versus mated first as yearlings still present after 2½ through 8½ years of production.

Examination of the culling records did not reveal differences between groups in frequencies of deaths, injuries, lambing difficulties, or illnesses; but there was a higher frequency of culling of open ewes from the ewe lamb group.

Since the ewes born in 1966 were the first group to enter the experiment, a possible explanation is that experiment station personnel were not experienced at that time in management systems for ewes lambing at one year of age. Nutrition may have been suboptimal, resulting in lower fertility for the ewe lamb group and higher culling in subsequent production years. If this were the proper explanation, management was apparently altered to alleviate the problem, since culling and attrition rates did not differ between lambs and yearlings for the other birth year groups.

Under certain conditions of management (1966 birth year group), mating ewes to lamb at one year of age might decrease longevity. It is certainly possible, though, to manage ewe lambs without altering their rate of attrition, as evidenced by results in the four remaining birth year groups. This conclusion is in agreement with Bowstead, 1930 (up to 3½

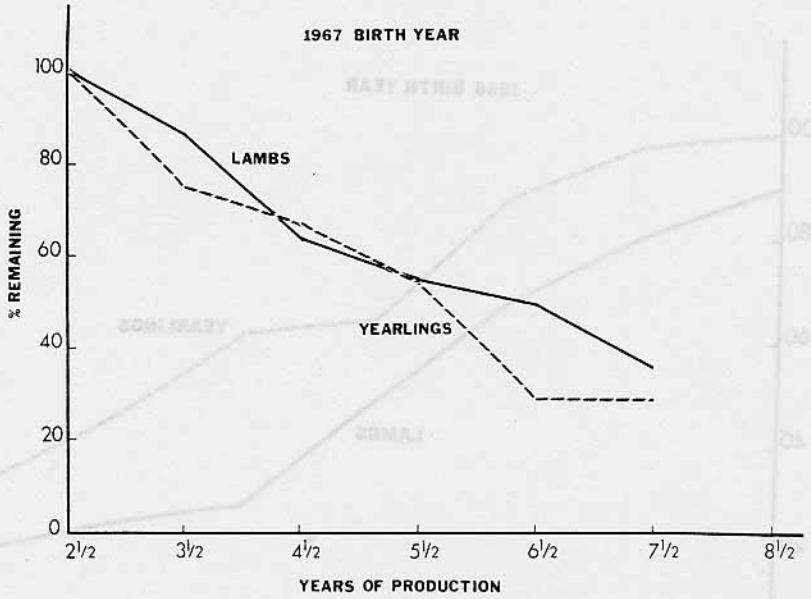

Figure 2. Percentages of 1967 ewes mated first as lambs versus mated first as yearlings still present after 2½ through 7½ years of production.

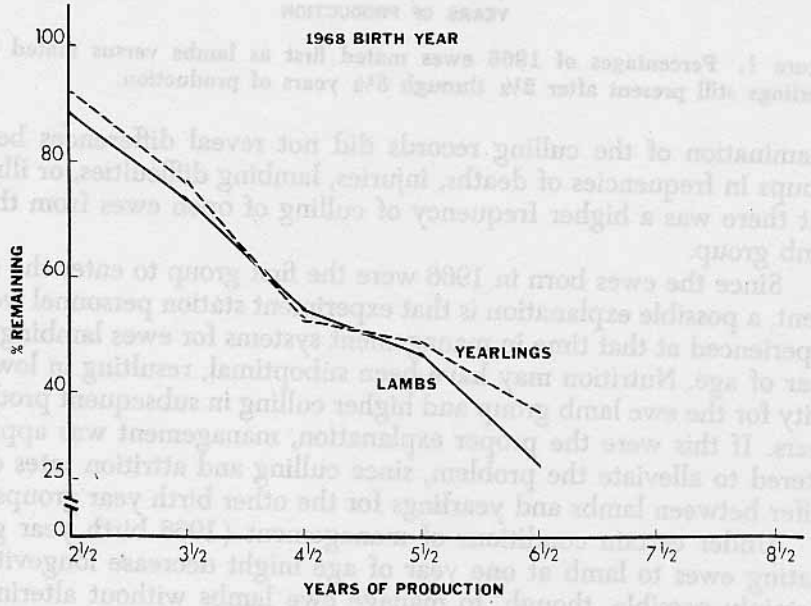

Figure 3. Percentages of 1968 ewes mated first as lambs versus mated first as yearlings still present after 2½ through 6½ years of production.

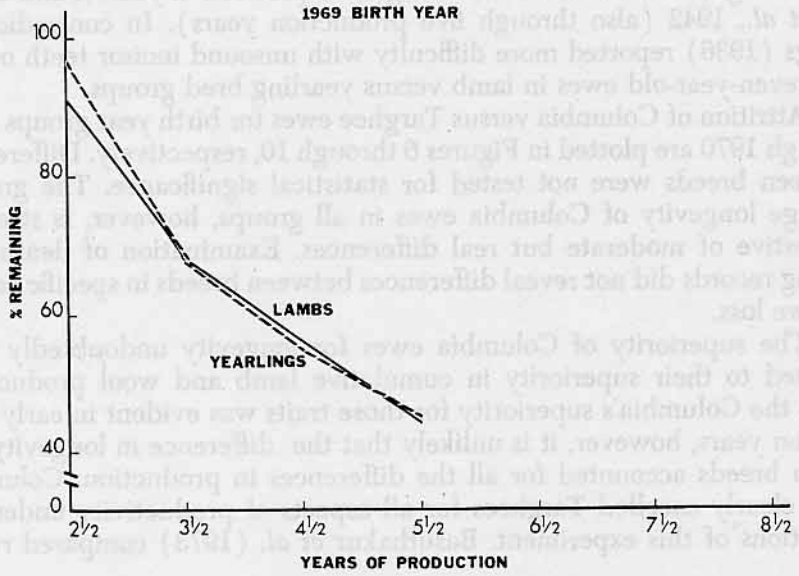

Figure 4. Percentages of 1969 ewes mated first as lambs versus mated first as yearlings still present after 2½ through 5½ years of production.

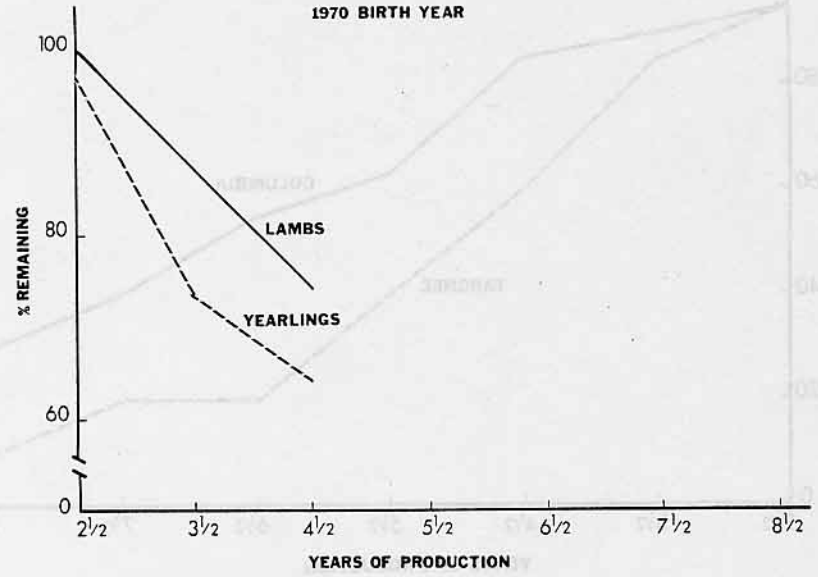

Figure 5. Percentages of 1970 ewes mated first as lambs versus mated first as yearlings still present after 2½ through 4½ years of production.

years of age); Griswold, 1932 (through five production years); and Spencer *et al.*, 1942 (also through five production years). In contradiction, Briggs (1936) reported more difficulty with unsound incisor teeth of six- and seven-year-old ewes in lamb versus yearling bred groups.

Attrition of Columbia versus Targhee ewes for birth year groups 1966 through 1970 are plotted in Figures 6 through 10, respectively. Differences between breeds were not tested for statistical significance. The greater average longevity of Columbia ewes in all groups, however, is strongly suggestive of moderate but real differences. Examination of death and culling records did not reveal differences between breeds in specific causes for ewe loss.

The superiority of Columbia ewes for longevity undoubtedly contributed to their superiority in cumulative lamb and wool production. Since the Columbia's superiority for those traits was evident in early production years, however, it is unlikely that the difference in longevity between breeds accounted for all the differences in production. Columbia ewes clearly excelled Targhees for all aspects of productivity under the conditions of this experiment. Basuthakur *et al.* (1973) compared range

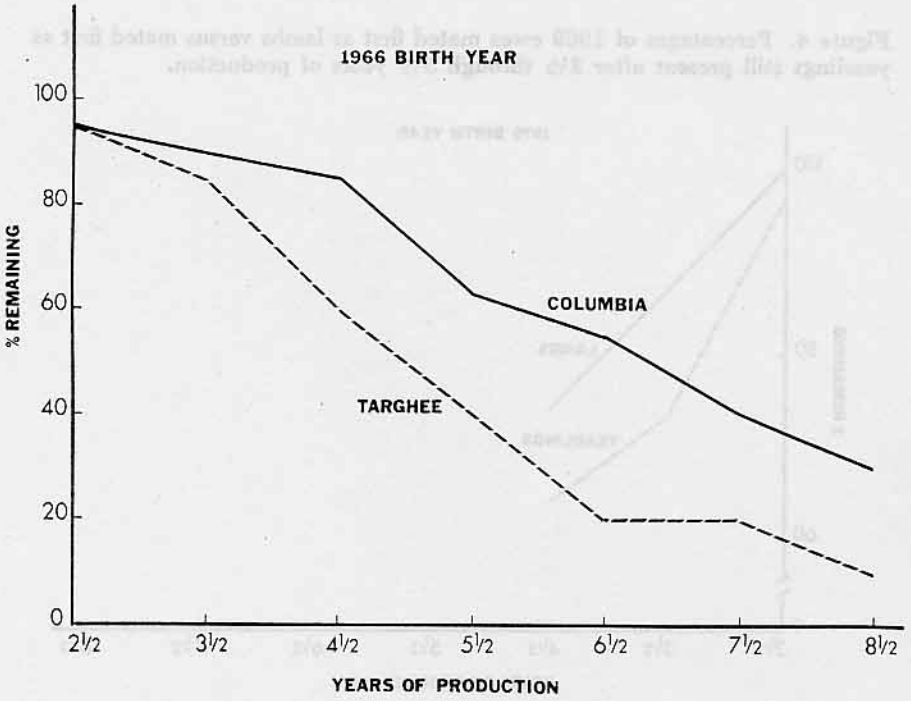

Figure 6. Percentages of 1966 Columbia versus Targhee ewes still present after 2½ through 8½ years of production.

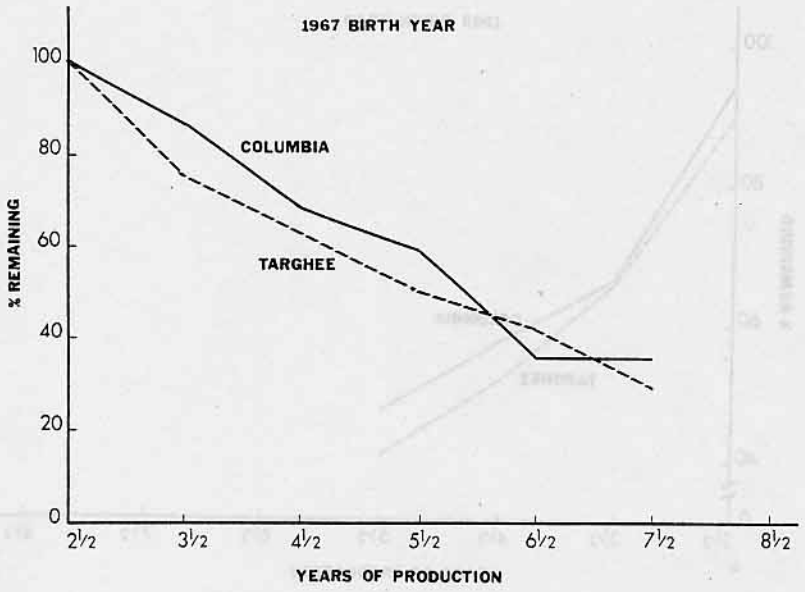

Figure 7. Percentages of 1967 Columbia versus Targhee ewes still present after 2½ through 7½ years of production.

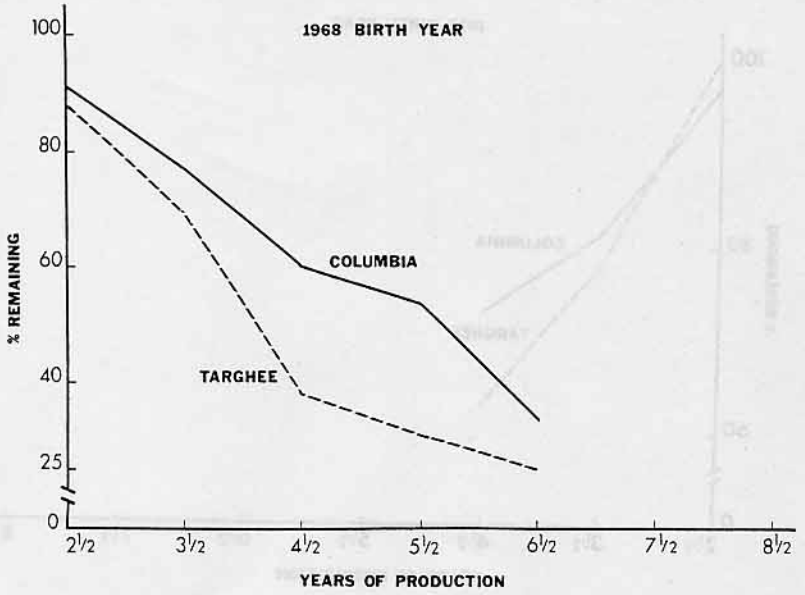

Figure 8. Percentages of 1968 Columbia versus Targhee ewes still present after 2½ through 6½ years of production.

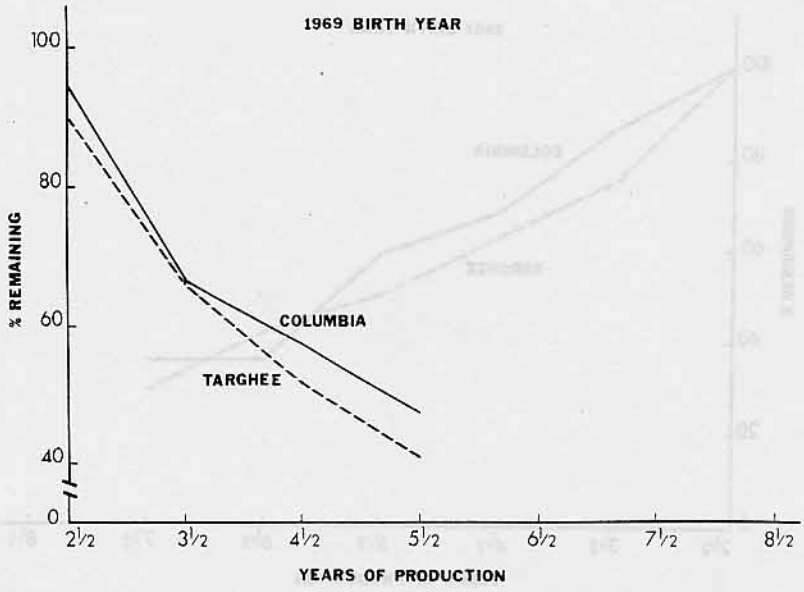

Figure 9. Percentages of 1969 Columbia versus Targhee ewes still present after 2½ through 5½ years of production.

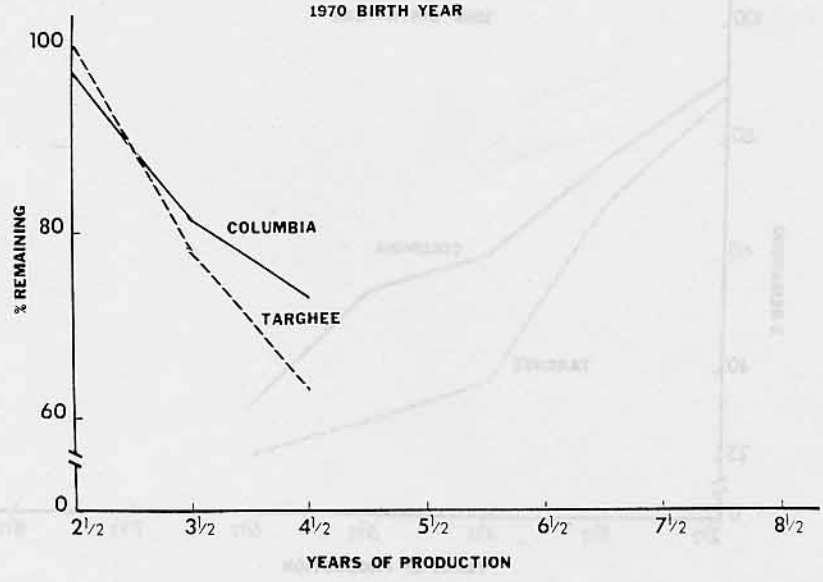

Figure 10. Percentages of 1970 Columbia versus Targhee ewes still present after 2½ through 4½ years of production.

Columbia and Targhee ewes for lifetime production in Montana. No significant differences existed between breeds for number of lambs born or weaned, for kilograms of lamb weaned, or for kilograms of grease wool produced.

SUMMARY AND CONCLUSIONS

In this study, Columbia and Targhee ewes at the Eastern Oregon Experiment Station, Union, were randomly divided within breed and birth year to groups mated to lamb first at one or at two years of age. Objectives of the experiment were to determine whether age at first lambing affected performance at two years of age, whether and how much it affected cumulative lamb and wool production throughout life, and whether it affected longevity of the ewes. The effects of breeds on these variables were also examined.

Mating ewes to lamb at one year of age did not decrease the number of lambs born or weaned, the kilograms of lamb weaned, or the kilograms of wool produced by the ewes as two year olds. In fact, the early mated group was higher for number of lambs and kilograms of lamb weaned (not significant). Ewe weight at 2½ years of age was not affected. Results clearly indicated that it was possible to mate ewe lambs without hurting their production the following year.

Lambing ewes at one year of age increased their cumulative production of lambs and kilograms of lamb at least through 6½ years of age. Cumulative wool production was little affected by age at first lambing, but ewes lambed first at two years of age had slightly higher lifetime wool production.

In the first group of ewes to enter the experiment, attrition was higher for ewes bred as lambs than it was for ewes bred as yearlings. In the other four birth year groups, there was no consistent difference in attrition between age at first lambing groups.

Columbia and Targhee ewes did not differ significantly for lamb and wool production at two years of age, but Columbia ewes were heavier at that age. Columbias were consistently superior for longevity and for cumulative production of lambs, kilograms of lamb weaned, and kilograms of wool produced.

Mating ewes to lamb first at one year of age can increase cumulative lamb production without decreasing production at two years of age, cumulative wool production, or longevity. Columbia ewes were more productive than Targhees under management and environmental conditions of the present experiment.

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