



Production of two-year-old ewes
by Kenneth L Colman

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Animal Industry at Montana State College
Montana State University
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Abstract:

The purpose of the investigation of these data was to explore the possibilities of relationships existing between the body weights of the ewes during their early life and their subsequent lamb and wool production as two-year-olds. The effects of environmental influences, such as type of birth and age at weaning, on the growth of ewe lambs and their production as two-year-olds were studied.

The growth of two-hundred and fifty-nine ewes was measured by body weights taken at irregular intervals from birth to twenty-three months of age. Records of the individual lamb and wool production of these ewes were tabulated with the body weights.

Results showed that the effect of type of birth and age at weaning, on body weights of ewe lambs was reduced as the lambs progressed toward maturity from weanling age. It was also found that the birth weights, weaning weights, and fall yearling weights of the ewes were significantly related. The fall yearling weight of the ewes was most indicative of two-year-old lamb and wool production. A significant relationship was found between the birth weights of the Rambouillet ewes and the pounds of lamb born per ewe as two-year-olds. The relationship between the birth weights of the Targhee ewes and the pounds of lamb born per ewe was not significant nor was this relationship significant for the birth weights of the Columbia ewes and the pounds of lamb born per ewe.

The early single-born lambs were consistently lighter at birth than the late single-born lambs; however, at weaning time, the early single-born lambs were consistently heavier than the late single-born lambs. The average daily gain of the early single-born lambs and the late single-born lambs was about the same.

The weaning weights of the ewes and their yearling fleece weights were significantly and positively related. The difference between the yearling fleece weights of the ewes and their two-year-old fleece weights was significant, the yearling fleece weights being the heaviest.

It is evident from this study that valuable genetic breeding stock may be lost if suitable precautions are not taken to adjust for environmental conditions affecting the size of ewe lambs at weaning time when most replacements are selected.

According to these data and that published previously by other workers, a sounder method of selecting higher producing replacements is to retain a larger number of ewe lambs at weaning and to make final selections at fall yearling age. Since production factors are closely related to body weight at fall yearling age, the heavier ewes of similar breeding will be better producers than the lighter ewes if selections are made at this age.

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Submitted to the Graduate Faculty

in

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Master of Science in Animal Industry

at

Montana State College

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ABSTRACT

The purpose of the investigation of these data was to explore the possibilities of relationships existing between the body weights of the ewes during their early life and their subsequent lamb and wool production as two-year-olds. The effects of environmental influences, such as type of birth and age at weaning, on the growth of ewe lambs and their production as two-year-olds were studied.

The growth of two-hundred and fifty-nine ewes was measured by body weights taken at irregular intervals from birth to twenty-three months of age. Records of the individual lamb and wool production of these ewes were tabulated with the body weights.

Results showed that the effect of type of birth and age at weaning, on body weights of ewe lambs was reduced as the lambs progressed toward maturity from weanling age. It was also found that the birth weights, weaning weights, and fall yearling weights of the ewes were significantly related. The fall yearling weight of the ewes was most indicative of two-year-old lamb and wool production. A significant relationship was found between the birth weights of the Rambouillet ewes and the pounds of lamb born per ewe as two-year-olds. The relationship between the birth weights of the Targhee ewes and the pounds of lamb born per ewe was not significant nor was this relationship significant for the birth weights of the Columbia ewes and the pounds of lamb born per ewe.

The early single-born lambs were consistently lighter at birth than the late single-born lambs; however, at weaning time, the early single-born lambs were consistently heavier than the late single-born lambs. The average daily gain of the early single-born lambs and the late single-born lambs was about the same.

The weaning weights of the ewes and their yearling fleece weights were significantly and positively related. The difference between the yearling fleece weights of the ewes and their two-year-old fleece weights was significant, the yearling fleece weights being the heaviest.

It is evident from this study that valuable genetic breeding stock may be lost if suitable precautions are not taken to adjust for environmental conditions affecting the size of ewe lambs at weaning time when most replacements are selected.

According to these data and that published previously by other workers, a sounder method of selecting higher producing replacements is to retain a larger number of ewe lambs at weaning and to make final selections at fall yearling age. Since production factors are closely related to body weight at fall yearling age, the heavier ewes of similar breeding will be better producers than the lighter ewes if selections are made at this age.

INTRODUCTION

The popular method of selecting replacement ewe lambs for future production is limited primarily to the size of the ewe lamb in relation to those from which she is to be selected. In small flocks or in pure-bred flocks, it is feasible to obtain individual records of production which may aid in the selection of replacement ewes.

In commercial production, the first method is relied upon heavily because it is the most convenient. The method, itself, is reasonably reliable, if suitable precautions are taken to correct for factors influencing body size at early ages, which are environmental in nature.

Assuming that the replacements are selected as weanling lambs, probably the most common commercial practice, then environmental factors of importance which affect body weights are, first, the type of birth of the lamb; second, the age of the dam; and third, the age of the lamb at weaning. The folly of selecting replacements from a group of weanling ewe lambs, in which these three factors are not considered independently, becomes obvious. The inherited ability of a ewe lamb to grow may be masked or enhanced by environmental factors.

Generally speaking, the early, single lambs, born to mature ewes would be the first selected replacements. Genetically, these lambs are not superior to younger lambs or to twin lambs. It is essential then to provide an alternate method which will improve selection techniques and still remain practical.

An applicable method suggested in the past, to limit environmental influence on selection, is to segregate the ewe lambs by type of birth, age of dam (two-year-old or mature), and age at weaning at the time replacements are to be selected. This may be accomplished if the lambs are identified at birth by a series of ear notches or by the use of ear-tags. From each of these groups, the most desirable lambs should be selected as replacements.

With this basic method in mind, this study was made to determine relationships, if any, of two-year-old production to body weights taken at intervals from birth to first lambing, to enhance selection of replacements at an early age.

These data were then studied to see what periods the body weights were the most reliable in predicting future production.

REVIEW OF LITERATURE

Phillips, et al., (1940) reported that single lambs remain heavier on the average throughout the first year than twin lambs. Corriedale and Rambouillet ram lambs made somewhat greater gains up to weaning than the ewe lambs. The ram lambs made much more rapid gains after weaning than the ewe lambs when given supplemental feeding. There was a decided decrease in rate of gain in both sexes following weaning. The rate of growth of the ewe lambs was low during the remainder of the year due to conditions of management and feeding. The need of adequate feed for range ewe lambs after weaning was emphasized and deemed necessary to develop desired size for reproduction at two years of age.

Hazel and Terrill, (1946) studied the effects of sex, age of dam, type of birth, age at weaning and inbreeding on Columbia, Corriedale, and Targhee lambs. The difference in weaning weight between ram lambs and ewe lambs, single lambs and twin lambs, lambs from two-year-old dams and mature dams were 10.8, 11.7 and 8.7 respectively.

Sidwell and Grandstaff, (1949) studied the lifetime production of four hundred and fourteen Navajo ewes. The two-year-old ewes weaned the lightest lambs, the four to seven-year-old ewes weaned the heaviest lambs and the eight to eleven-year-old ewes weaned intermediate lambs. The weaning weight of the ewe lambs was 4.4 pounds less than ram lambs. Single lambs were 11.2 pounds heavier than twin lambs, and 2.9 pounds heavier than lambs born as twins and raised as singles. A regression coefficient of weaning weight on age at weaning was 0.37 pounds per day.

Kincaid, (1943) observed that with the increasing age of the ewe, from two to six; the birth weight of her lambs increased at an average of 0.63 pounds per year.

Esplin, et al., (1940) reported that greater gains were made by ewe lambs when wintered under farm conditions during their first winter. It was also stated that "the percentage of ewes lambing at two years of age, of those alive at breeding, was 64.7 in the group that was fed and 45.5 in a range-fed group".

Phillips and Dawson (1940) found with Hampshires, Shropshires and Southdowns, that the selection of animals considered suitable for breeding was affected by type and time of birth and birth weight. It was observed that single lambs were preferred to twin lambs, early lambs were preferred to late lambs and lambs heavy at birth were preferred to lambs light at birth in selecting ewe lambs by size. Because these factors were a result of environment, some possible genetic advantages were disregarded.

No consistent differences were found in the survival of single and twin lambs. Early lambs tended to survive better than late lambs. A significantly higher proportion of the lambs heavy at birth survived over the lighter ones. No difference was found in the survival of males and females.

It was also found that type of birth, time of birth and birth weight were related to the weight of the lambs at three months of age. The weight advantages shown favored single, early and heavy lambs, respectively. The effects of these factors on weights were lessened at six months of age and tended to disappear at twelve months of age.

The male lambs were significantly heavier than the female lambs at birth in all but one group. The difference between the ram lambs and ewe lambs became more pronounced with increasing age.

Terrill and Stoehr (1939) noted a steady increase in fertility of ewes up to five years of age. There was also a direct correlation between the change in weight of ewes during breeding and their fecundity. Ewes which gained weight during breeding produced about six percent more twins than did those which lost weight during breeding.

Phillips et al., (1945) reported an increased productive capacity in range ewe lambs wintered in feed lots.

Terrill and Stoehr (1942) found that the fall body weight of yearling ewes, Rambouillets, Corriedales, and Columbias, just prior to breeding was closely related to their lifetime lamb and wool production. The heavier yearlings consistently weaned more pounds of lamb per ewe during their lifetime than did the lighter yearlings. The difference in lamb production between ewes born as singles and as twins was not consistent. There was a variation in lamb production within groups of ewes born as singles and as twins when associated with their yearling body weight. Selection for increased lamb production based on yearling body weight would be about as effective within breeds as between breeds. When considered independently of yearling body weight, the average lifetime body weight of the ewe was inversely related to the pounds of lamb weaned per ewe year. The ewes which were heavier as yearlings had a slight advantage in fleece weights, but the yearling body weight had little effect on fleece lengths.

Dickson and Barnum (1934) reported that Rambouillet yearling ewes made greater summer gains after being wintered on limited rations. Larger lambs in both the limited fed group and the full fed group gained less during the summer than the lighter lambs. There was no difference in the weights, as yearlings, at the end of the summer pasture period for lambs with initial weights up to 79 pounds prior to the winter feeding period, even with the different rations. The lambs with initial weights of 80 to 99 pounds, which were fed better rations during the winter feeding period, retained from four to six pounds of their weight increase as yearlings over those on limited feed. This relationship was maintained by these ewes as two-year-olds.

It was stated that although the lambs with lower initial weights overcame the handicap due to limited winter rations as two-year-olds, the heavier lambs on the same ration maintained a weight advantage to two years of age. This indicates that a heavy ewe lamb will also be a heavy two-year-old.

The progressive increase in fleece weights from smaller ewes to larger ewes indicated a relationship of the two factors. The winter feed treatments had little effect on the yearling fleece weights except from the lambs weighing over 90 pounds.

There was some indication that the full-fed ewes had a higher grease content in their fleeces, and that there was actually little difference in scoured fleece weights.

Phillips (1936) found that Southdown lambs weighing six pounds or

over have a better chance of survival than those lambs weighing less than six pounds at birth. He found that thirty-two percent of the lambs weighing less than six pounds were born dead or died within a month after birth, compared to only seven percent in the lambs weighing over six pounds at birth. The heavier lambs at birth made greater gains during their first year of life than lambs which were light at birth.

In a later paper, Phillips (1937) reported a difference of 8.3 pounds in weight at four months of age for lambs weighing under and over 8.0 pounds at birth and a difference of 9.4 pounds at one year of age, favoring the heavier lambs at birth.

Kiser and Christgan (1940) separated a group of Shropshire ewes according to their type of birth, into two groups, twins and singles. If the ewe did not produce lambs of the type of birth for which she was selected she was culled. After six lamb crops, they concluded that a higher level of production was maintained in the twin group, although there was a question as to whether the difference was genetic. It was believed that the method of selecting stud rams offset the effectiveness that may have been accomplished in the ewe selection.

Henderson (1953) showed that with Romney lambs raised from birth to fifty-two weeks of age on contrasting planes of nutrition, future total wool production of the lambs depended on body size and that the early plane of nutrition of the lambs did not permanently affect the efficiency of the processes of wool growth. Good feeding was important to allow maximum growth.

Short (1955) reported that most secondary wool follicles are initiated prior to birth and although they mature post-natally, any adverse pre-natal environment would probably restrict the number of secondary follicles initiated. Since these follicles mature shortly after birth, between seven and twenty-eight days, the number of producing follicles may be permanently affected by early post-natal environment. Reduction in future wool production could be the result of adverse environment at this early age.

Jones, et al., (1944) reported that fiber diameter of wool produced by Rambouillet ewes during the first year of life average slightly but significantly finer than the fleeces produced during subsequent years. The fiber diameter remained relatively unchanged after the first year. It was also reported in this study that the correlations of grease fleece weights and body weights were highly significant.

Hazel and Terrill (1946, 1947) found that yearling single ewes and ewes from mature dams had heavier grease fleeces, more clean wool and longer staple length than twin yearling ewes and ewes from two-year-old dams. The yearling ewes from mature dams had heavier bodies than the yearling ewes from two-year-old dams.

Lambert et al., (1938) obtained results indicating useful predictive values of certain weanling characteristics for yearling fleece characteristics, namely staple length, and percent clean wool, but not for density or fineness of fiber.

MATERIALS AND METHODS

The data used in this study were obtained from records kept on the purebred ewe band owned by the Montana Agricultural Experiment Station. The band consists of three breeds--Rambouillets, Targhees, and Columbias. There are six slightly inbred lines of Rambouillets, five lines of Targhees, and three lines of Columbias. There is also a group of high-grade Columbias.

The band was lambed during April and May of 1949; the lambs were weighed, docked and ear-tagged within twelve hours after birth. A system of ear-tagging was used for identification of lambs by breed, age, line within a breed and the individual lamb. This was accomplished by using a letter and four numbers, for example, T9230. The "T" indicates the breed, Targhee; the "9" indicates the year, 1949; the "2" indicates the line and the "30" is the individual lamb's number.

As the lambs were weighed and ear-tagged, a number was painted on the ewe and her lamb for identification as they were moved through the "doubling up pens". Three sets of doubling up pens were used, one set for mature ewes with single lambs, one set for mature ewes with twin lambs, and one set for two-year-old ewes and their lambs.

The ewes and lambs were moved to the spring range in groups of two hundred to two hundred and fifty head, the ewes with early singles in one band, the ewes with early twins in another band, followed by a band of late singles and a band of late twins. These bands remained separated until shearing time, the first week in June.

The lambs were weighed July 7, 1949, two days before the band was moved to the forest grazing allotment. The lambs were weighed and weaned the 26th of August, then moved to a fall pasture. The ewe lambs to be held for replacements remained on pastures until supplemental feeding was necessary. The ewe lambs were used in a feeding experiment designed to determine the comparative value of cottonseed meal pellets made from two different processes, the Solvent process and the Hydraulic process, during the first winter.

As yearlings, the ewes were moved to the spring range with the dry band. At shearing time, during the first week in June, the fleece from each ewe was weighed and graded. The band was moved to the summer range about a month later.

About three hundred head of replacement ewe lambs were held until September 20, 1950. At this time they were culled. This culling was based on body weight, type and the important factors of wool production. Two hundred and fifty-nine of the original three hundred head of fall yearlings were weighed and added to the breeding band.

The band remained on the fall range until breeding time, the second week in November. At breeding time, the Rambouillet ewes were put into breeding pens according to their line of breeding. Two or more sires were used in about one-half of the breeding pens, depending upon the number of ewes in the line. The general procedure was to have the first set of rams in their respective pens for a period of eight days; because breeding harnesses with chalk were used, the marked ewes were removed

before the second set of rams were put in the pens. The second set of rams remained in the pens for the next ten-day period. As the marked ewes were taken from the breeding pens they were put with Hampshire rams. All of the marked ewes were exposed to black-faced rams for a period of eight to eighteen days. The ewes were then put with Targhee rams for an eight-day period to allow two full heat periods for breeding.

Due to watering and feeding problems, the Targhee and Columbia ewes were herded on the range during the day and cut into their respective pens at night for breeding. A number was painted on the individual ewes to facilitate the separation of the lines at night. The management of the rams was similar to that of the Rambouillets.

The band remained on the fall range until the middle of December. On the 20th of December, the ewes were weighed and divided at random into four equal groups. The groups were equalized as nearly as possible by age, breed and weight for the winter feeding experiment.

The groups of ewes were separated each morning during the period of December 20, 1950 to March 27, 1951, and fed as shown in Table I.

The ewes were not separated into groups for feeding during the ten days prior to lambing to eliminate possible injury to the ewes during the chute cutting operation. During this ten-day period and lambing, the ewes were fed one-half pound of the 20% protein pellet per head per day and hay.

The ewes started lambing the first week in April. The ewes and lambs were managed in a manner similar to the methods previously discussed for the ewes when they were lambs.

Table I. Winter feeding program for ewes for 1950-1951

Group	Feed per head per day	
I	Alfalfa hay <u>ad lib.</u>	No pellets until 30 days before lambing. Then 1/2 pound of 20% protein pellets.
II	Alfalfa hay <u>ad lib.</u>	1/3 pound of 20% protein pellets.
III	Alfalfa hay <u>ad lib.</u>	1/3 pound of 1/2 20% protein pellet and 1/2 dehydrated alfalfa pellet.
IV	Alfalfa hay <u>ad lib.</u>	1/3 pound of dehydrated alfalfa pellet.

The composition of the supplemental concentrates is shown in Table II, according to the groups.

Table II. Composition of concentrates

Ingredient	Group number			
	I	II	III	IV
		%	%	%
Barley	---1/	21.95	10.98	---
Oats	---	21.95	10.98	---
Dried molasses beet pulp	---	21.95	10.98	---
Soybean oil meal	---	29.27	14.63	---
Cane molasses	---	4.88	2.44	---
Dehydrated alfalfa	---	---	<u>50.00</u>	<u>100.00</u>
		100.00	100.00	100.00

1/ Group I received a commercial 20% protein pellet.

two-year-old fleece grade, two-year-old fleece length, ewe index (as a lamb), date of birth of lamb, type of birth of lamb, live lamb, sex, card number, birth weight of lamb, lamb loss, sire of lamb, weight of lamb on forest, weight of lamb off-forest, lamb index, cottonseed meal lot (first winter for ewes), and dehydrated alfalfa lot (second winter for ewes).

A code system was set up to reduce the number of necessary columns, and also to get data on the work sheet, which was not itself a number or numbers. The code was as follows:

Ewe number-----The ear-tag number of the ewe.

Sheep number---All ewes received a code number starting at 9000 and ending at 9258.

Breed-----Rambouillet (1), Targhee (2), Columbia (3).

Line-----	Rambouillet -	2000 (02)	6000 (06)
		3000 (03)	7000 (07)
		5000 (05)	8000 (08)
	Targhee -	0 (00)	6 (06)
		2 (02)	8 (08)
		4 (04)	
	Columbia -	0 (00)	4 (04)
		2 (02)	4K (09)

Type of birth--Single (1), twin (2), triplet (3), dry (4), slink (5), born twin, raised single (9).

Date of birth--(ewe) Year and day of year.

Weights-----All weights are actual weights in pounds.

Fleece grade---Fine (1), 1/2 blood (2), 3/8 blood (3), 1/4 blood (4), low 1/4 blood (5).

Fleece length--Staple (1), french (2), clothing (3).

Date of birth--(lamb) Day of year.

Sire-----H2025 (1), H2046 (2), K3003 (3), etc.

Card number-----(1) Single or first lamb. 1/
 (2) Second lamb.

Live lambs-----(1) Single, alive.
 (2) Twins, both alive.
 (3) Single, grafted to another ewe.
 (4) Single, lamb died.
 (5) Single, lamb died, another grafted on.
 (6) Single, born dead.
 (7) Twins, born dead.
 (8) Twins born, one alive, one dead.
 (9) Twins born, one died.
 (10) Twins born, one died after on forest.
 (11) Twins born, both died.
 (12) Twins born, one grafted to another ewe.
 (13) Twins born, lambs died, another lamb grafted to her.

Lamb loss----- (0) Not lost.
 (1) At birth.
 (2) In lambing book.
 (3) Before on-forest.
 (4) While on-forest.
 (9) Slink.

Sex-----Ewe (1), Ram (2).

Index-----Actual index for both ewe and lamb.

The data were transferred from the Master IBM work sheets to the regular IBM cards. Each card contained the entire record of one ewe from her birth to the weaning weight of her first lamb.

Standard IBM procedure was used in sorting the cards and tabulation of data.

1/ Each ewe that gave birth to two lambs had two different cards, one for each lamb. The ewe data was put on both cards.

RESULTS AND DISCUSSION

Growth of the Ewes from Birth to Twenty-three
Months of Age

Records of the growth of two hundred and fifty-nine purebred ewe lambs selected for replacement ewes in the band, were collected and analyzed in an effort to associate some factors of growth or development with the subsequent production of the ewes as two-year-olds.

The growth of these ewe lambs was measured by body weights taken at irregular intervals from birth to twenty-three months of age. Dates of weighing conform to approximate dates which might be convenient and practical for the commercial range operator.

The body weights of the ewes, from birth to twenty-three months of age, are shown in Table III, by breed and lines within the breeds.

The line of breeding had little effect on the growth rate of the Rambouillet ewe lambs. The ewe lambs in the 8000 line were slightly heavier at birth than the other five lines. The 8000 line lambs maintained this advantage for seven months; however, the advantage was lost before the lambs reached twenty-three months of age.

The line of breeding had an effect on the rate of growth of the Targhee ewe lambs. The ewe lambs in the 0 line were the lightest of the five lines from birth to twenty-three months of age, with only one exception, when, at one year of age, they were slightly heavier than the lambs in the 2 and 4 lines. The ewe lambs in the 8 line were the heaviest of the five lines from birth to twenty-three months of age. At birth, the ewe lambs in the 0 line weighed 8.5 pounds compared to ewe lambs in the 8

Table III. Growth of ewes as shown by body weights

Date weighed	Rambouillet lines					
	2000	3000	5000	6000	7000	8000
Birth	9.5	9.6	9.5	10.0	9.2	12.0
July 7, 1949	46.3	49.2	49.8	50.3	47.6	51.1
Aug. 26, 1949	67.8	71.3	71.9	72.2	71.2	73.3
Dec. 1, 1949	82.7	85.1	85.7	84.3	84.3	86.7
April 5, 1950	100.5	97.6	103.1	102.1	97.8	101.6
Sept. 20, 1950	118.7	120.6	121.5	122.0	122.8	123.0
Dec. 20, 1950	122.5	125.9	123.8	126.1	125.2	124.2
Mar. 27, 1951	127.9	129.2	127.5	130.1	131.1	125.4

Date weighed	Targhee lines				
	0	2	4	6	8
Birth	8.5	9.6	9.0	9.4	10.4
July 7, 1949	45.3	47.8	51.1	49.5	52.5
Aug. 26, 1949	66.1	71.3	73.3	72.7	76.0
Dec. 1, 1949	80.9	81.7	83.7	85.8	92.0
April 5, 1950	95.2	94.5	94.7	99.1	108.5
Sept. 20, 1950	121.4	123.5	126.4	129.9	130.3
Dec. 20, 1950	121.0	121.0	124.7	128.5	131.1
March 27, 1951	122.1	125.3	127.0	129.9	138.5

Table III con't.

Date weighed	Columbia lines			
	0	2	4	4K
		Pounds		
Birth	10.4	9.6	10.0	9.1
July 7, 1949	54.8	53.5	59.0	46.2
Aug 26, 1949	77.8	77.6	83.3	73.4
Dec. 1, 1949	87.4	90.0	94.3	80.0
April 5, 1950	105.4	107.3	110.7	97.9
Sept. 20, 1950	132.6	130.2	133.0	126.1
Dec. 20, 1950	132.0	127.6	133.5	124.1
March 27, 1951	135.8	133.7	134.8	129.9

line that weighed 10.4 pounds at birth. The weight of the ewes in the 0 and 8 lines was 122.1 pounds and 138.5 pounds respectively at twenty-three months of age.

The 0 line of Columbia ewe lambs were the heaviest of the four lines at birth and at twenty-three months of age. The ewe lambs in this line were not consistently heavier than the other lines throughout the period, however. The ewe lambs in the 4K line were consistently the lightest of the four lines from birth to twenty-three months of age. The lambs in the 0 line weighed 10.4 pounds at birth compared to the lambs of the 4K line that weighed 9.1 pounds at birth. The weight of the ewes at twenty-three

of age for the O and 4K lines were 135.8 pounds and 129.9 pounds, respectively. The 4K line is not a purebred line.

The average body weight of the ewes in the different lines within breeds have been combined and are shown in Table IV.

Table IV. Growth of Rambouillet, Targhee, and Columbia ewes as shown by body weights

Date weighed	Age in mo.	Rambouillet avg. lbs.	Targhee avg. lbs.	Columbia avg. lbs.
Birth	0	9.5	9.4	9.4
July 7, 1949	2	49.2	49.1	49.2
Aug. 26, 1949	4	71.3	71.6	75.1
Dec. 1, 1949	7	84.9	84.6	83.3
April 5, 1950	11	101.4	98.3	101.1
Sept. 20, 1950	16	121.3	125.7	128.0
Dec. 20, 1950	19	124.4	124.7	126.2
Mar. 27, 1951	23	128.4	128.2	131.5

The Columbia ewe lambs were approximately 4.0 pounds heavier at weaning than were the Rambouillet or Targhee lambs. The weaning weight advantage shown by the Columbias diminished during the first winter feeding period, but was apparent again through the grazing season, from April to September. During the second fall, the weights of the Columbia ewes dropped, contrary to weights of the Rambouillet ewes. The Targhee ewes

also dropped in weight during the second fall, but less than did the Columbia ewes.

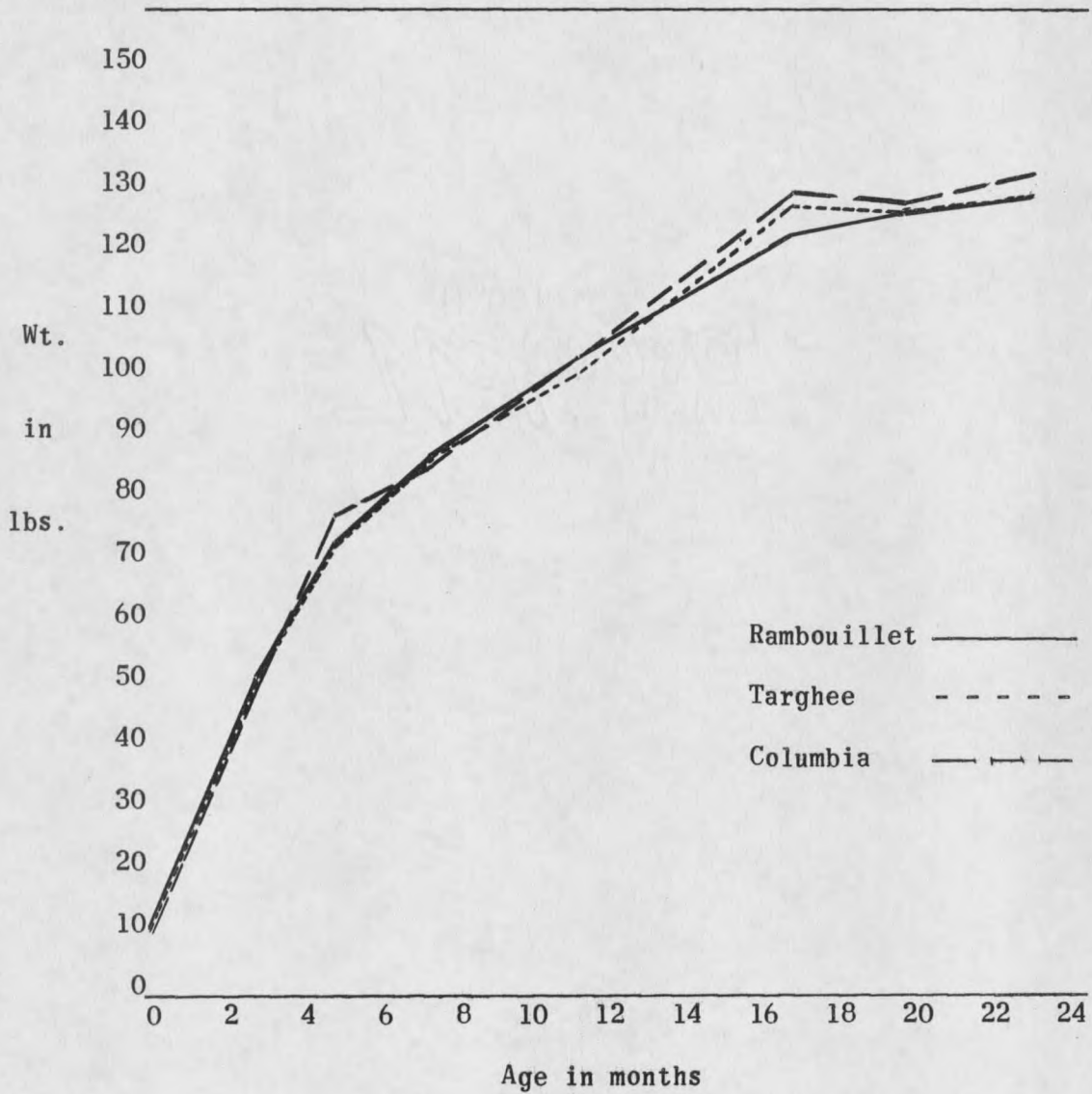


Figure 2. The growth of the Rambouillet, Targhee, and Columbia ewes from birth to twenty-three months of age. See Table IV.

Table V. Growth of Rambouillet lines by type of birth

Line Type	2000				3000			5000	
	1	2	9 <u>1</u> /	1	2 <u>1</u> /	9	1	2	9
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	10.8	8.0	6.2	10.6	9.8	8.4	10.0	8.8	8.3
July 7, 1949	50.9	38.6	44.0	50.6	45.0	48.5	51.7	43.3	49.0
Aug. 26, 1949	72.2	59.8	68.0	72.8	67.0	70.5	73.7	66.7	71.4
Dec. 1, 1949	85.8	78.0	78.0	84.4	83.0	86.5	86.3	82.7	86.3
Apr. 5, 1950	102.4	97.4	98.0	95.8	96.0	100.2	103.9	99.7	103.6
Sept. 20, 1950	120.9	115.8	114.0	117.6	131.0	121.8	121.4	121.9	121.3
Dec. 20, 1950	124.4	119.0	123.0	124.2	131.0	126.8	123.9	122.9	124.4
Mar. 27, 1951	130.4	124.6	122.0	129.2	136.0	127.5	128.4	128.1	123.4

Line Type	6000			7000			8000		
	1	2	9	1	2 <u>1</u> /	9	1	2	9 <u>1</u> /
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	11.1	8.0	9.2	9.7	9.2	7.2	12.1	---	11.2
July 7, 1949	54.0	45.5	47.0	51.9	42.0	35.5	53.8	---	35.0
Aug. 26, 1949	75.9	69.0	68.5	76.4	62.0	57.5	76.8	---	52.0
Dec. 1, 1949	88.4	82.5	79.5	89.2	74.0	75.0	88.7	---	75.0
Apr. 5, 1950	106.6	98.0	97.5	102.3	86.0	90.0	103.7	---	89.0
Sept. 20, 1950	125.1	115.5	120.0	127.4	115.0	110.5	124.8	---	112.0
Dec. 20, 1950	129.4	123.0	122.8	129.0	116.0	116.5	125.0	---	120.0
Mar. 27, 1951	133.9	122.5	127.5	136.7	117.0	118.5	126.0	---	122.0

1/ One ewe.

Table VI. Growth of Targhee lines by type of birth

Line Type	1	0 2	9	1	2 2	9	1	4 2	9
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	8.8	8.1	8.3	10.1	8.0	8.0	9.1	9.0	8.9
July 7, 1949	48.5	38.9	49.3	49.8	37.0	46.7	52.2	45.0	55.0
Aug. 26, 1949	69.2	59.5	71.7	72.6	66.3	68.7	74.8	66.7	75.0
Dec. 1, 1949	80.9	79.5	83.5	82.5	78.0	81.0	85.8	76.0	81.5
Apr. 5, 1950	93.8	94.2	102.0	94.5	97.0	89.5	94.8	87.7	105.0
Sept. 20, 1950	120.0	124.5	119.8	124.7	119.5	120.3	127.3	121.7	127.0
Dec. 20, 1950	119.9	121.9	122.8	122.0	119.0	116.3	125.4	120.0	127.0
Mar. 27, 1951	117.2	128.1	125.8	121.6	125.2	118.0	127.2	122.7	132.0

Line Type	1	6 2	9 <u>1</u> / 2	1	8 2	9
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	10.2	8.8	6.6	10.6	9.1	---
July 7, 1949	52.9	46.8	40.0	52.8	50.0	---
Aug. 26, 1949	75.9	71.0	59.0	76.5	72.7	---
Dec. 1, 1949	89.7	82.6	74.0	92.4	89.7	---
Apr. 5, 1950	102.9	96.6	85.0	109.0	105.0	---
Sept. 20, 1950	134.6	127.6	109.0	130.0	132.0	---
Dec. 20, 1950	134.0	124.6	110.0	130.8	133.3	---
Mar. 27, 1951	133.1	128.4	115.0	138.2	140.0	---

1/ One ewe.

Table VII. Growth of Columbia lines by type of birth

Line Type	1	0 2 <u>1</u> / ₂	9	1	2 2	9 <u>1</u> / ₂
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	10.8	8.6	---	10.1	---	5.6
July 7, 1949	57.8	43.0	---	55.0	---	43.0
Aug. 26, 1949	81.2	64.0	---	78.9	---	67.0
Dec. 1, 1949	90.8	74.0	---	90.5	---	86.0
Apr. 5, 1950	110.2	86.0	---	107.8	---	104.0
Sept. 20, 1950	136.2	118.0	---	130.2	---	130.0
Dec. 20, 1950	135.0	120.0	---	127.9	---	125.0
Mar. 27, 1951	142.5	109.0	---	135.9	---	134.0

Line Type	1	4 2 <u>1</u> / ₂	9	1	4K 2	9
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	10.2	9.5	---	9.3	8.8	8.4
July 7, 1949	61.3	52.0	---	45.8	52.5	46.2
Aug. 26, 1949	85.5	79.0	---	73.3	81.5	70.6
Dec. 1, 1949	93.0	97.0	---	79.2	100.5	76.0
Apr. 5, 1950	108.0	116.0	---	96.0	126.0	97.2
Sept. 20, 1950	128.3	147.0	---	124.9	146.5	125.0
Dec. 20, 1950	128.3	149.0	---	122.3	152.5	122.0
Mar. 27, 1950	133.0	140.0	---	127.6	166.0	128.2

1/ One ewe.

The greatest spread in average weights of the three breeds at a particular time was at approximately sixteen and one-half months, when the Columbia ewes weighed 128.0 pounds; the Targhees, 125.7 pounds; and the Rambouillets, 121.3 pounds; a difference of 6.7 pounds between the Columbias and Rambouillets.

The growth curve of the Rambouillets, Targhees, and Columbias was quite similar for the twenty-three month period. The Columbia ewes were four pounds heavier at weaning time, which could be important if the lambs were to be marketed at that time. The Columbias were 6.7 pounds heavier in the fall, as yearlings.

Type of birth has been designated by the numbers 1, 2, and 9, which will be used throughout this paper. Type 1 refers to lambs born single and raised single; type 2 refers to lambs born twin and raised twin; and type 9 refers to those lambs which were born as twins and raised as singles. The type 9 classification are any lambs which were born as a twin and did not have a mate living at weaning time. In the tables presented herein, Tables V, VI, and VII, for example, the type 9 lambs have been classified by themselves. In such cases, all birth weights and some of the "on-forest" weights actually include the average weights of twin lambs, which means that all lambs in this classification are not raised as singles from birth to weaning.

The weights shown in Table III are average weights for the lines; however, the ratio of the types of births within lines varies considerably as shown in Table VIII, thus the average weight of the line may be raised

Table VIII. Number of ewes by breed, line, and type of birth

Rambouillet	2000	3000	5000	6000	7000	8000	Total
Type 1	9	5	27	8	7	6	62
Type 2	5	1	7	2	1	-	16
Type 9	1	4	7	6	2	1	21
Total	15	10	41	16	10	7	99
Targhee	0	2	4	6	8		Total
Type 1	13	21	14	7	20		75
Type 2	8	4	3	5	3		23
Type 9	4	3	2	1	-		10
Total	25	28	19	13	23		108
Columbia	0	2	4	4K			Total
Type 1	4	8	3	27			42
Type 2	1	-	1	2			4
Type 9	-	1	-	5			6
Total	5	9	4	34			52
Grand total							259

1/ The number of ewes given in this table is the total number of ewes within the given classification; however, in working with sheep that are managed under range conditions, some of the sheep are lost from time to time, and are not weighed, therefore some of the average weights given in this paper are computed from fewer numbers of sheep than are shown in this table.

or lowered, depending upon the number of single born lambs in the line compared to the number of twin born lambs.

Considerable variation was found in the average weights of the ewes within lines, between the three types of births as shown in Tables V, VI, and VII. The relationship of the weights of the ewes of the different types of births, within lines, varies from one date to another.

The lambs born as singles (type 1) had weight advantages of varying amounts in all lines of the three breeds over the lambs born as twins. In most cases they retained this advantage until twenty-three months of age. The two major exceptions to this condition occurred in the Targhee 0 line and the Columbia 4K line. At twenty-three months of age, the type 2 and type 9 ewes of the Targhee 0 line had a weight advantage of 10.9 pounds and 8.6 pounds respectively over the type 1 ewes of this line.

The type 2 and type 9 ewes of the Columbia 4K line had weight advantages of 38.4 pounds and 0.6 pounds respectively over the type 1 ewes at twenty-three months of age. The large advantage shown in the type 2 ewes was apparently due to individuals, since there were only two ewes of this type in the 4K line. The number and weight of the fetuses in the ewes may have had some effect on the differences in weight between the three types of ewes.

Commercial application of selection based on body weights would depend upon two factors of significant importance; (1) the earliest stage of maturity when body weights could be correlated to production, and (2) a time that the sheep could be handled and weighed with the greatest

economy and practicability for the producer.

The time of culling, or selection of replacements varies from one ranch to another; however, most commercial operators must make some selection at weaning time, whether further selections are made at a later age or not. Some operators may carry an excess of ewe lambs to fall yearling age, then make their final selection along with the culling of the ewe bands. For this reason, the weaning weight of the ewe lambs and their weight at fall yearling age have been correlated with their two-year old production.

The average birth weight of the Rambouillet type 1, type 2 and type 9 lambs were 10.5, 8.6, and 8.5 pounds respectively as shown in Table IX. The weight differences between the types were magnified by weaning time, when the lambs were approximately four months old. The type 1 lambs averaged 74.3 pounds; the type 2 lambs, 64.0 pounds; and the type 9 lambs, 68.0 pounds; at weaning. When the Rambouillet ewes reached sixteen and one-half months of age, or fall yearling age, the difference in average weight of the three types of birth was reduced to approximately 3.3 pounds. The type 1 ewes weighed 122.5 pounds compared to 119.3 and 119.2 pounds respectively in types 2 and 9.

The type 1 Targhee lambs weighed 9.8 pounds at birth compared to 8.1 pounds for the type 2 and type 9 lambs. At weaning time, the type 1 lambs weighed 73.6 pounds; the type 2 lambs, 65.8 pounds; and the type 9 lambs weighed 69.4 pounds. The difference between the type 1 lambs and the type 2 lambs was 4.2 pounds, with the type 2 lambs being the lightest.

At fall yearling age, the type 1 Targhee ewes weighed 126.7 pounds and the type 2 ewes, 124.9 pounds, a difference of 1.8 pounds. The type 9 ewes weighed 120.3 pounds, 6.4 pounds lighter than the type 1 ewes and 4.6 pounds lighter than the type 2 ewes.

Table IX. Weights of ewes by breed and type of birth

Breed Type	Rambouillet			Targhee			Columbia		
	1	2	9	1	2	9	1	2	9
Date weighed	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Birth	10.5	8.6	8.5	9.8	8.1	8.1	9.7	9.0	7.9
July 7, 1949	52.0	42.1	46.1	51.2	42.8	47.9	49.7	50.0	45.7
Aug. 26, 1949	74.3	64.0	68.0	73.6	65.8	69.4	75.8	76.5	69.8
Dec. 1, 1949	86.9	80.7	82.4	86.2	80.8	81.4	83.2	93.0	77.7
Apr. 5, 1950	103.2	97.7	99.0	99.2	95.8	98.0	100.2	113.5	98.3
Sept. 20, 1950	122.5	119.3	119.2	126.7	124.9	120.3	127.2	139.5	125.8
Dec. 20, 1950	125.4	121.8	123.4	125.7	123.2	120.4	125.0	143.5	122.5
Mar. 27, 1951	130.2	126.1	124.7	128.7	128.5	123.6	130.5	145.2	129.1

The average birth weight of the Columbia type 1, type 2, and type 9 lambs were 9.7 pounds, 9.0 pounds, and 7.9 pounds respectively. The type 1 Columbia ewes weighed 75.8 pounds at weaning, the type 2 ewes weighed 76.5 pounds, and the type 9 ewes weighed 69.8 pounds. The type 2 ewes were 0.7 pounds heavier than the type 1 ewes, and the type 9 ewes were 6.0 pounds lighter than the type 1 ewes at weaning. At fall yearling age, the type 1

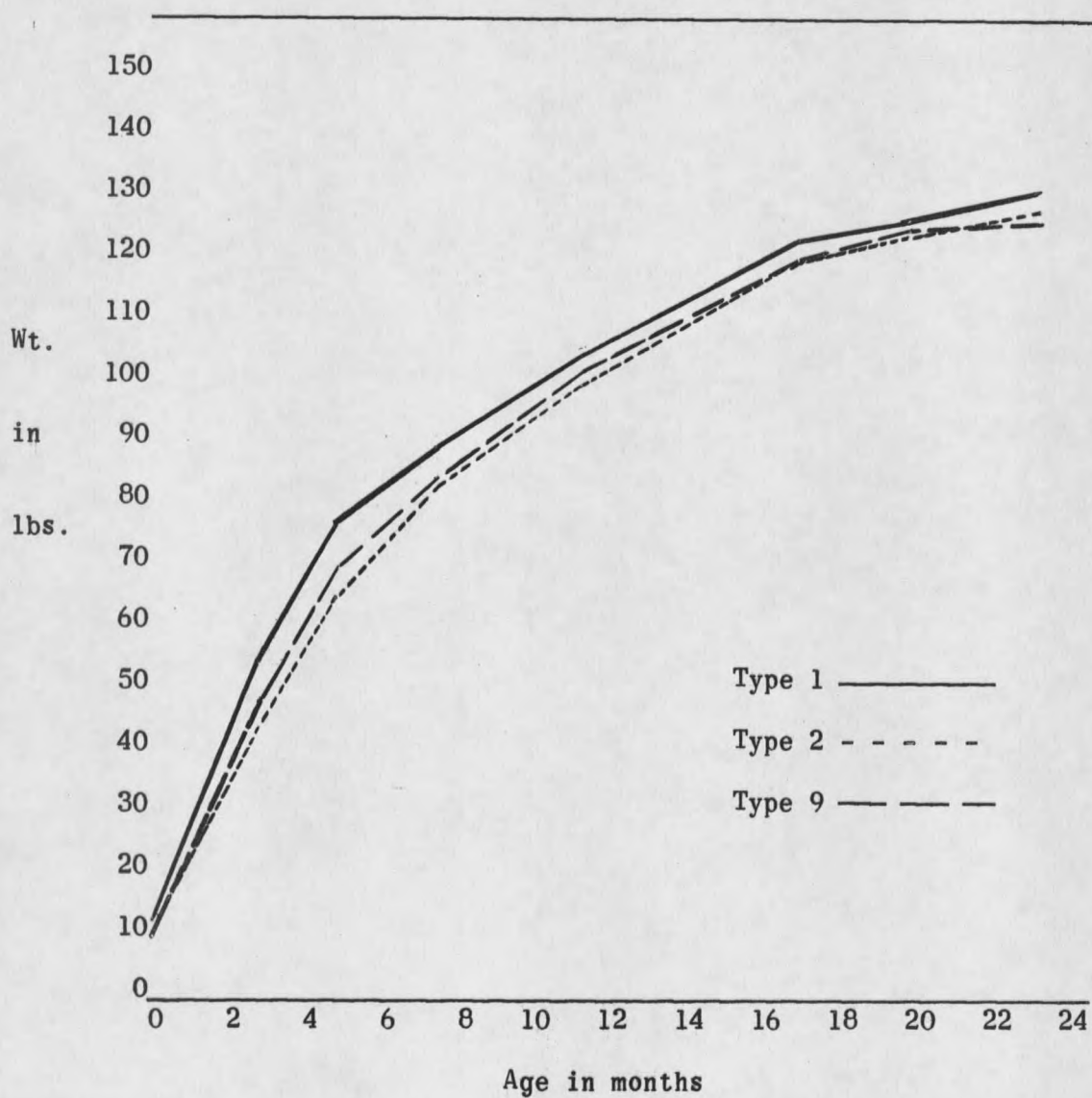


Figure 3. The growth of the Rambouillet ewes from birth to twenty-three months of age. The ewes have been grouped by type of birth as shown in Table IX.

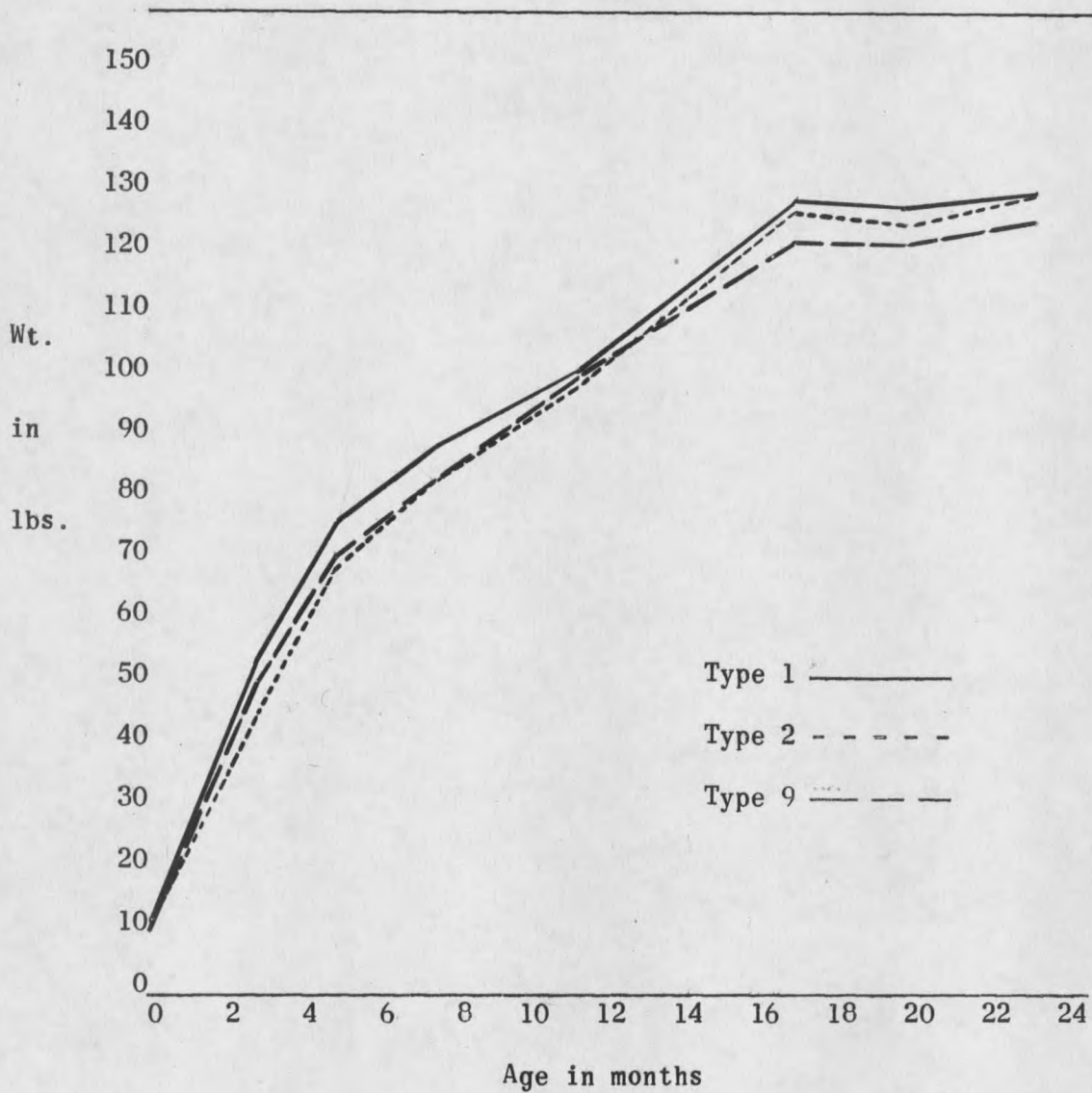


Figure 4. The growth of the Targhee ewes from birth to twenty-three months of age. The body weights were taken from Table IX.

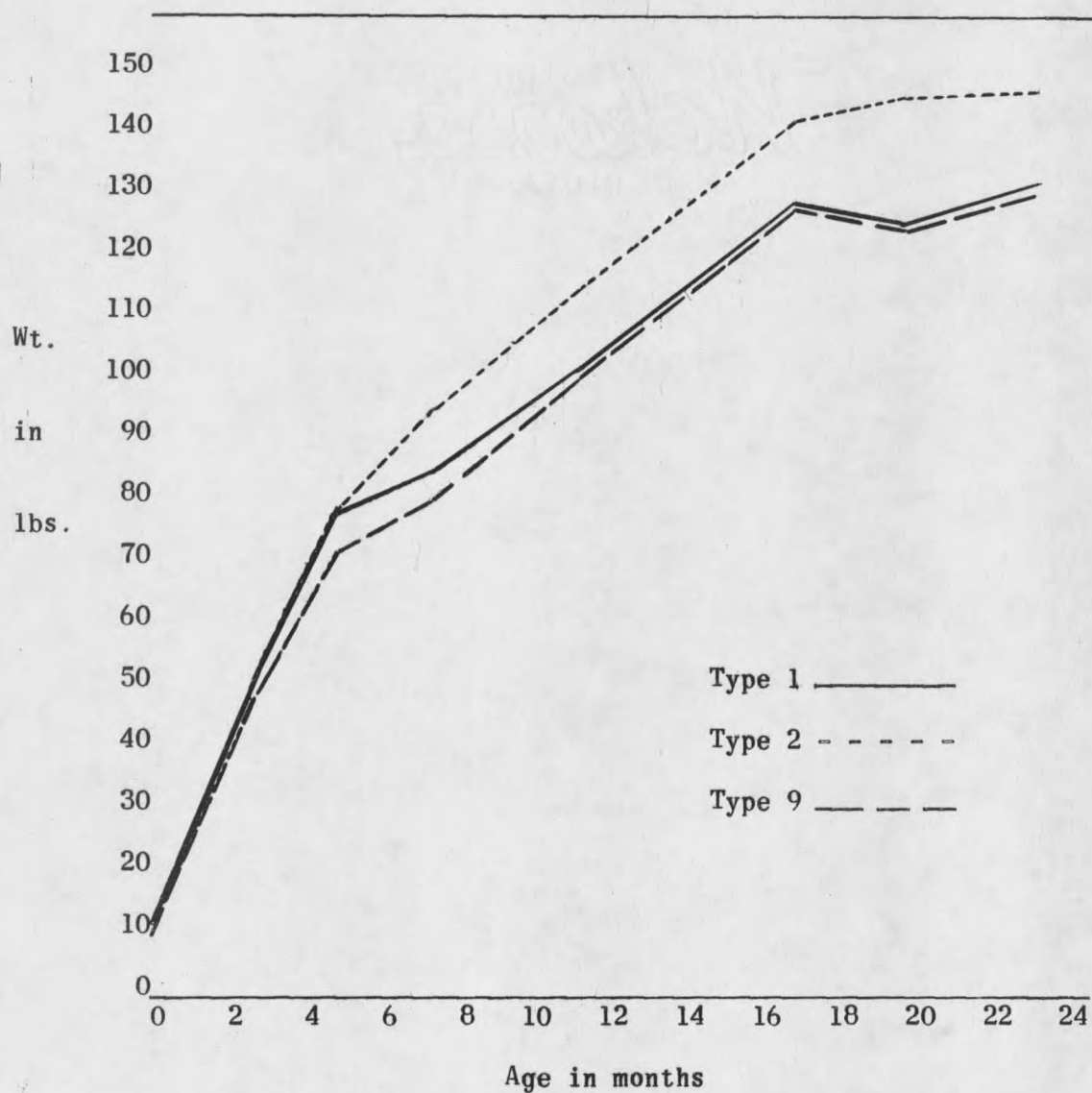


Figure 5. The growth of the Columbia ewes from birth to twenty-three months of age. The body weights were taken from Table IX.

Columbia ewes weighed 127.2 pounds; the type 2 ewes, 139.5 pounds; and the type 9 ewes, 125.8 pounds.

The 12.3 pound difference in weight of the type 2 and type 1 Columbia ewes is probably partially due to the limited number of ewes in the type 2 classification. However, only six of the 42 ewes in the type 1 classification were heavier than the average of the type 2 ewes at fall yearling age.

The growth of the Rambouillet, Targhee, and Columbia ewes, as determined by body weights, are shown in figures 3, 4, and 5 by the type of birth of the ewes. The weights used in the figures were taken from Table IX.

Effect of Sires on Body Weights of the Ewes

The weights of the Rambouillet ewes at birth, weaning, and fall yearling age are given in Appendix Table I by line, sire, and type of birth. The 2000, the 6000, and the 7000 lines had only one sire per line, so the sire effect cannot be separated from the line effect. The ewes in the 3000 line were sired by four rams, and because of limited numbers of ewes from each sire, individual differences between ewes are probably greater than the sire differences.

In the 5000 line, the type 1 lambs sired by ram 7 (the code number of the rams will be used, rather than the actual number for brevity) weighed 10.3 pounds at birth, 75.0 pounds at weaning and 126.8 pounds at fall yearling age. The type 2 lambs sired by ram 7 weighed 9.8 pounds at birth, 74.3 pounds at weaning and 134.0 pounds at fall yearling age. The type 9

lambs sired by ram 7 weighed 8.6 pounds at birth, 71.3 pounds at weaning and 125.0 pounds at fall yearling age.

The lambs sired by ram 8, a second ram used in the 5000 line, were consistantly lighter than the lambs sired by ram 7. The type 1 lambs sired by ram 8 weighed 10.0 pounds at birth, 73.3 pounds at weaning and 119.5 pounds at fall yearling age, or 0.3 of a pound lighter at birth, 1.7 pounds lighter at weaning and 7.3 pounds lighter at fall yearling age than the lambs sired by ram 7.

The type 2 lambs sired by ram 8 weighed 8.1 pounds at birth, 58.5 pounds at weaning, and 112.8 pounds at fall yearling age. The type 9 lambs sired by ram 8 weighed 8.0 pounds at birth, 71.5 pounds at weaning, (0.2 of a pound more than the lambs of the corresponding type, sired by ram 7) and 118.5 pounds at fall yearling age.

The type 1 lambs sired by ram 11 in the 8000 line were heavier at birth and at fall yearling age than the type 1 lambs sired by ram 12. At birth, the type 1 lambs sired by ram 11 weighed 12.3 pounds or 0.4 of a pound more than the lambs of the corresponding type sired by ram 12. At weaning, however, the lambs sired by ram 12 were 5.0 pounds heavier than the lambs sired by ram 11. At fall yearling age the lambs sired by ram 11 weighed 128.0 pounds, 6.3 pounds heavier than the lambs sired by ram 12.

The limited number of lambs sired by some rams in the five Targhee lines makes it difficult to compare rams within lines, because of individual differences. The code number, 99, indicates that the sires of the individual lambs are not known; therefore, making comparisons of the

progeny would be comparing line-bred progeny to out-bred progeny.

The weights of the Targhee ewes are shown in Appendix Table II by line, sire, and type of birth. The weights of the Columbia ewes at birth, weaning, and fall yearling age are shown in Appendix Table III by line, sire, and type of birth.

Comparisons of rams within lines may be confounded with selection pressure, since the lambs were a selected group of replacements. However, if all other selection differentials were equal, the body weight of the progeny, at birth, weaning, or fall yearling age, might be considered a valid method of evaluating the sires.

Birth Weight of Lambs

The birth weight of lambs was significantly affected by the type of birth. The importance of the difference in birth weights of single and twin lambs was probably most evident in its relation to the growth of the lambs during early age.

Phillips (1937) reported an 8.3 pound difference in weight at four months of age for lambs under and over 8.0 pounds at birth, and a 9.4 pound difference at one year of age, favoring the heavier lambs at birth. In a later report, Phillips and Dawson (1940) stated that type of birth, time of birth and birth weight were all related to the weight of the lambs at three months of age. The weight advantages were in favor of singles, early, and heavy lambs respectively. The differences, however, became less evident with increasing age. Differences in male and female lambs became

more pronounced with increasing age.

The effect of birth weight on the survival of lambs probably varies to a degree with the different breeds of sheep. Phillips (1936) found that Southdown lambs weighing 6.0 pounds or over, had a better chance of survival than lambs weighing less than 6.0 pounds. Of lambs weighing 6.0 pounds or less, thirty-two percent were born dead or died within a month after birth, compared to a seven percent loss in lambs weighing over 6.0 pounds. This study would indicate that survival of lambs is related to the type of birth when considering the difference in birth weight of single and twin lambs. Phillips and Dawson (1940) reported no consistent difference in mortality of single and twin lambs. The survival of early lambs tended to be greater than the late lambs, the difference was not significant, however.

The average birth weight of the Rambouillet, type 1 lambs (those lambs born to the two-year-old ewes in this study) not living to weaning time was 11.4 pounds, 0.3 of a pound heavier than the average birth weight of all the Rambouillet lambs of this type of birth. The average birth weight of the Rambouillet type 2 lambs not living to weaning time was 7.8 pounds, 0.7 of a pound lighter than the average of this type.

The average birth weight of the Targhee type 1 lambs not living to weaning age was 10.1 pounds, 1.0 pound less than the average for this type of birth. The average birth weight of the Targhee type 2 lambs not living to weaning age was 7.4 pounds, 1.4 pounds less than the average of this type.

It is apparent that the birth weights of the lambs in this study had

little or no relationship to the mortality of the lambs, since the average birth weights of the lambs not living to weaning age were very near the average of the type classification in which the losses occurred.

The average birth weight of the Rambouillet type 1 lambs varied from 10.5 pounds in the 5000 line to 12.3 pounds in the 8000 line. The type 2 lambs in the 7000 line had the lightest average birth weights, 7.6 pounds, while the type 2 lambs in the 6000 line were the heaviest, 9.6 pounds, at birth. The differences in the birth weights of the lambs of the six Rambouillet lines were highly significant. There was a highly significant difference in the birth weight of the type 1 and type 2 Rambouillet lambs.

The variation in average birth weight of the lambs of the five Targhee lines was less than 1.0 pound. The type 1 lambs of the 0 and 2 lines averaged 10.8 pounds at birth, while the lambs of the 4 line averaged 11.7 pounds at birth. The type 2 lambs of the 0 line averaged 8.2 pounds at birth and the lambs of the 8 line averaged 9.1 pounds at birth. The difference in the birth weights of the lambs of the five Targhee lines was not significant. There was a highly significant difference in the birth weights of the type 1 and type 2 Targhee lambs.

The Columbia type 1, line 2 lambs were from 1.0 to 1.3 pounds heavier than the type 1 lambs of the other Columbia lines. Although the average birth weights of the type 2 Columbia lambs varied more than the type 1 lambs, the difference between the four lines was not significant. The difference in average birth weight of the type 1 and type 2 lambs was highly significant.

The Rambouillet type 1 lambs averaged 11.1 pounds at birth and the type 2 lambs averaged 8.5 pounds at birth, with an average of 10.7 pounds for all Rambouillet lambs born to the two-year-old ewes.

The Targhee type 1 lambs averaged 11.1 pounds at birth and the type 2 lambs averaged 8.8 pounds at birth with an average birth weight of 10.5 pounds for all Targhee lambs.

The average birth weight of all Targhee lambs was slightly lower than the average birth weight of all Rambouillet lambs due to almost twice as many twin born lambs in the Targhee breed.

The average birth weight of the type 1 Columbia lambs was 10.6 pounds, 0.5 of a pound less than either the Rambouillet or Targhee type 1 lambs. The type 2 Columbia lambs averaged 9.2 pounds at birth, 0.7 of a pound.

Table X. Average birth weight of Rambouillet lambs by line and type of birth

Line	Type 1		Type 2		All types	
	lbs.	no.	lbs.	no.	lbs.	no.
2000	11.6	14	8.0	2	11.1	16
3000	11.1	7	8.1	6	9.7	13
5000	10.5	36	9.4	4	10.4	40
6000	11.7	14	9.6	2	11.5	16
7000	10.9	9	7.6	2	10.3	11
8000	12.3	7	---	-	12.3	7
Average	11.1	87	8.5	16	10.7	103

Table XI. Average birth weight of Targhee lambs by line and type of birth

Line	Type 1		Type 2		All types	
	lbs.	no.	lbs.	no.	lbs.	no.
0	10.8	22	8.2	2	10.5	24
2	10.8	22	8.6	8	10.2	30
4	11.7	13	8.8	10	10.4	23
6	11.5	11	8.8	2	11.1	13
8	10.9	17	9.1	8	10.4	25
Average	11.1	85	8.8	30	10.5	115

Table XII. Average birth weight of Columbia lambs by line and type of birth

Line	Type 1		Type 2		All types	
	lbs.	no.	lbs.	no.	lbs.	no.
0	10.4	3	8.6	2	9.7	5
2	11.5	7	10.0	2	11.2	9
4	10.2	3	8.2	2	9.4	5
4K	10.5	30	9.4	6	10.3	36
Average	10.6	43	9.2	12	10.3	55

heavier than the type 2 Rambouillet lambs and 0.4 of a pound heavier than the type 2 Targhee lambs. The average birth weight of all Columbia lambs was 10.3 pounds.

The average birth weights of the lambs are shown in Tables X, XI, and XII by breed, line and type of birth. The analysis of variance of these birth weights are shown in Appendix Table IV.

A highly significant difference (1% level) exists between lines, in the average birth weight of the Rambouillet lambs. The difference in the birth weight of the Rambouillet type 1 lambs and type 2 lambs was highly significant (1% level).

The birth weights of the lambs in the five Targhee lines were not significantly different; however, the difference in the birth weights of the Targhee type 1 lambs and type 2 lambs was highly significant (1% level).

There was no significant difference in the birth weight of the lambs in the four Columbia lines. The difference in the birth weights of the Columbia type 1 lambs and type 2 lambs was highly significant (1% level).

There was no significant difference in the birth weight of the lambs from the Rambouillet, Targhee, and Columbia ewes.

Birth Weight of Ewes and Birth Weights of Their Lambs

The average birth weights of the ewes of the three breeds were lower than the average birth weights of the lambs they produced as two-year-olds. The Rambouillet type 1 ewes weighed 10.5 pounds at birth compared to type 1 lambs weighing 11.1 pounds at birth. The Rambouillet type 2 lambs and type 9 lambs weighed 8.8 pounds and 8.4 pounds respectively, compared to 8.6 and 8.5 pounds for the birth weights of the ewes of the same types.

The average birth weight of the type 1, type 2 and type 9 Targhee ewes



Figure 6. Ear-tagging, docking and the recording of birth weights of new-born lambs.

9.8 pounds, 8.1 pounds and 8.1 pounds respectively, compared to 11.1 pounds, 9.0 pounds, and 8.4 pounds for the birth weights of the lambs of the same breed and types.

The average birth weight of the type 1, type 2, and type 9 Columbia ewes were 9.7, 9.0, and 7.9 pounds respectively compared to the Columbia lambs, which weighed 10.6, 8.4 and 9.6 pounds respectively for types 1, 2, and 9.

In the previous comparisons of birth weights of ewes and their lambs, no correction has been made for sex of lamb. No consistent difference was found in the average birth weight of the type 2 male and female lambs. The type 1 ram lambs were consistently heavier at birth than the type 1 ewe lambs in averages for the breeds, and in part explains what otherwise might seem important genetic progress.

An average of 12.6 pounds of lamb was born per ewe in the Rambouillet 3000 line, 2.2 pounds more lamb per ewe than the 5000 line. In the 3000 line, three of the ten ewes gave birth to twin lambs, and there were no dry ewes in the line. In the 5000 line, two of the forty-one ewes gave birth to twin lambs, and there were two dry ewes in this line. The average pounds of lamb born per ewe in the remaining four lines of Rambouillet ewes fell between the extremes of the 3000 and the 5000 line.

The number of ewes within lines are given in Table XIII with their lambing records, the number of ewes lambing, the number of dry ewes, the number of single and multiple births and the pounds of lamb born per ewe.

Table XIII. Lambing records of Rambouillet ewes by lines

Line	2000	3000	5000	6000	7000	8000
No. of ewes	15	10	41	16	10	7
No. of ewes lambing	15	10	39 <u>1</u> /	15	10	7
No. of dry ewes	0	0	2	1 <u>2</u> /	0	0
No. of single births	14	7	37	14	9	7
No. of multiple births	1	3	2	1	1	0
No. of lambs born	16	13	41	16	11	7
Lbs. of lamb born per ewe	11.9	12.6	10.4	11.5	11.4	12.3

The average pounds of lamb born per ewe in the Targhee 4 line was 13.3 pounds, while the ewes in the Targhee 0 line gave birth to 10.1 pounds of lamb per ewe, a difference of 3.2 pounds per ewe. Five of the nineteen ewes in the 4 line had twin lambs, compared to one set of twin lambs from twenty-five ewes in the 0 line. Two of the twenty-five ewes in the 0 line were dry. There were no dry ewes in the 4 line. The numbers of ewes in the five Targhee lines are given in Table XIV with the lambing records.

The ewes in the Columbia 0 line gave birth to 12.1 pounds of lamb

- 1/ The birth weights of one single lamb that died shortly after birth was excluded; however, the ewe was included in this number. The lamb was included in the number of single births and in the number of lambs born, but neither the ewe or the lamb were included in calculating the pounds of lamb born per ewe.
- 2/ This ewe lost her lamb prematurely. The ewe was included in calculating the pounds of lamb born per ewe.

Table XIV. Lambing records of Targhee ewes by lines

Line	0	2	4	6	8
No. of ewes	25	28	19	13	23
No. of ewes lambing	23	28 <u>1</u> /	19 <u>2</u> /	12	21
No. of dry ewes	2	0	0	1	2
No. of single births	22	23	14	11	17
No. of multiple births	1	5	5	1	4
No. of lambs born	24	33	24	13	25
Lbs. of lamb born per ewe	10.1	11.8	13.3	11.1	11.3

per ewe, 2.2 pounds more than the lightest producing Columbia line, the 4K line. The difference between the three small purebred lines was less than one pound per ewe. One dry ewe in the 2 line was largely responsible for the low average pounds of lamb born per ewe in the three purebred lines.

One set of twins was born in each of the three purebred lines. There were three sets of twins and one dry ewe in the 4K line. The 4K line consisted of thirty-four ewes, twice as many ewes as the three purebred lines combined.

1/ The birth weights of one single lamb and a set of twin lambs were not taken because of death shortly after birth; therefore, the two ewes and their lambs were omitted in calculating the pounds of lamb born per ewe. The numbers are, however, included in the table.

2/ One ewe included in this number lost her lamb shortly after birth and no birth weight for the lamb was recorded; hence, the ewe was omitted in calculating the pounds of lamb born per ewe. The ewe and her lamb are included in the numbers given in the table.

The number of ewes within lines is given in Table XV with the lambing records of the ewes. The number of ewes lambing, the number of dry ewes, the number of single and multiple births and the pounds of lamb born per ewe are also given.

Table XV. Lambing records of Columbia ewes by lines

Line	0	2	4	4K
No. of ewes	5	9	4	34
No. of ewes lambing	5 <u>1</u> /	8	4	33
No. of dry ewes	0	1	0	1
No. of single births	4	7	3	30
No. of multiple births	1	1	1	3
No. of lambs born	6	9	5	36
Lbs. of lamb born per ewe	12.1	11.2	11.8	10.9

Nine of the two hundred and fifty-nine ewes were dry (3.5 percent), five ewes lost their lambs shortly after birth, and one ewe lost her lamb prematurely.

The differences in pounds of lamb born per ewe, (based on the type of birth of the ewes) between lines within a breed, and between breeds were not significant. There were no significant differences in pounds of lamb

1/ The birth weight of a single lamb born to one of the ewes was not recorded; however, the lamb was alive. The lamb and the ewe are included in the numbers given in the table, but are not included in the pounds of lamb born per ewe.

born per ewe between the three types of rearing of the ewes (Appendix Table V).

The correlation of the birth weights of the Rambouillet ewes to the pounds of lamb born per ewe were, with two exceptions, nonsignificant, when individual lines were considered. When the lines were combined, with type of birth of the ewes as the only varying factor, the correlation of the birth weight of the ewes to the pounds of lamb born per ewe was highly significant in the case of the type 2 ewes. The correlation was not significant in the case of the type 1 and type 9 ewes; however, the correlation coefficients were closely approaching significance. The correlation of the birth weight of the ewes to the pounds of lamb born per ewe was significant (5% level) as may be seen in Appendix Table VI, when the influence of lines and type of birth were not considered as varying factors.

The correlation of the birth weights of the Targhee ewes to the pounds of lamb born per ewe was, with two exceptions, nonsignificant. The correlation remained nonsignificant when the lines were combined, with type of birth the only variable considered. As a result of this, when both lines and type of birth were disregarded, the correlation of the birth weights of the Targhee ewes to the pounds of lamb born per ewe was nonsignificant. The correlation coefficients were small, but mostly positive.

The Columbia ewes had a lower correlation of birth weight to pounds of lamb born per ewe than did the Targhee ewes. The correlation of the birth weights of the ewes to the pounds of lamb born per ewe in the Columbia breed was slightly negative.

When the correlation coefficients of birth weight of ewes and the pounds of lamb born per ewe were compared; Rambouillet, .24*; Targhee, .06; and Columbia, -.05; the relationship of the two factors appeared to be associated with either the breeds, or breed characteristics. There was no significant difference in the pounds of lamb born per ewe between the three breeds.

Growth of Lambs

It is commonly accepted that there are many factors affecting the growth of lambs, and several of considerable importance. A few of these factors are evident at birth; the birth weight, and closely associated with this, the type of birth of the lamb, single or twin, and the sex of the lamb. Other factors of importance are the milking ability and the mothering instinct of the dam, both of which are associated with the age of the dam. Still other factors such as freedom from disease, weather conditions, ability of herdsman, and available feed for both the ewes and the lambs, affect the growth of the lambs.

Phillips (1936, 1940) states that the heavier lambs at birth make greater gains during the first year of life and that the difference in weight of sexes tends to become more pronounced with increasing age. Phillips and Dawson (1937), Hazel and Terrill (1946) and Sidwell and Grandstaff (1949), report differences in weaning weight of single and twin born lambs. These workers also found differences in the weaning weight of lambs from two-year-old ewes and mature ewes.

The average weights of the lambs at birth, two and one-half months,

and four and one-half months of age are given in Table XVI by breed and line. A comparison of the birth weight and weaning weight of the lambs indicate a relationship between the two factors. The relationship is most apparent in the five Targhee lines. The weights of the lambs at two and one-half months of age show less relationship to either the birth weights or the weaning weights than do the birth weights to the weaning weights.

The average weight of lambs given in Table XVI are the weights of the type 1 lambs only. The number of type 2 lambs varied between lines; thus, in small lines, the presence of a set of twins lowered the average weight more so than a single set of twins in a larger line. In the six Rambouillet lines there were three sets of twins and five type 9 births. In the five Targhee lines there were ten sets of twins and five type 9 births. There were two sets of twins and four type 9 births in the four Columbia lines.

The type 1 lambs in the 8000 line were the heaviest of the six Rambouillet lines. At birth, these lambs weighed 12.3 pounds and at weaning, 90.5 pounds. The type 1 lambs in the 5000 line were the lightest of the six Rambouillet lines, with an average birth weight of 10.5 pounds and an average weaning weight of 82.7 pounds.

The type 1 lambs in the Targhee 4 line were the heaviest of the five Targhee lines, 11.7 pounds. At weaning time, the type 1 lambs in the 6 line were the heaviest of the five lines. The type 1 lambs in the 0 and 2 lines weighed 10.8 pounds, the lightest type 1 Targhee lambs, at birth.

The Targhee lambs in the 2 line remained the lightest to weaning age, with an average weight of 83.9 pounds.

The type 1 lambs in the Columbia 4 line weighed 10.2 pounds at birth, the lightest of the four lines; however, these lambs were the heaviest at weaning time with an average weight of 94.7 pounds. The type 1 lambs in the 2 line were the heaviest of the four lines with an average of 11.5 pounds at birth. The Columbia lambs with the lowest average weaning weight were the 0 line lambs with an average weight of 88.2 pounds.

The average weights of the lambs were classified according to breed and their type of birth in Table XVII. The type 1 lambs were the heaviest at birth of the three types and remained so until weaning time. The type-2 lambs were the lightest at weaning in all three breeds. The weaning weight of the type 9 lambs fell between the other two types in the Rambouillet and Targhee breeds. This was not true, however, with the Columbias, which was probably due to the small numbers.

In Table XVIII, the lamb weights are grouped according to age and type of birth. The average weaning weight of the lambs by type of birth were: type 1, 86.0; type 9, 85.1; and type 2, 76.6 pounds; a difference of 9.4 pounds between the two extremes.

The Columbia lambs were the lightest of the three breeds, at birth, and the heaviest at weaning as is shown in Table XIX. The Rambouillet lambs were the heaviest at birth and the lightest at weaning. The birth weight and weaning weight of the Targhee lambs were between those of the Rambouillets and Columbias.

Table XVI. Weights of type 1 lambs from two-year-old ewes, by breed and line, at birth, two and one-half months, and four and one-half months of age

Rambouillet lines	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
2000	11.6	59.5	86.6
3000	11.1	57.8	84.8
5000	10.5	54.9	82.7
6000	11.7	57.2	82.8
7000	10.9	58.4	86.4
8000	12.3	60.8	90.5
Targhee lines	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
0	10.8	57.4	86.1
2	10.8	55.1	83.9
4	11.7	57.8	86.3
6	11.5	55.5	89.0
8	10.9	55.7	86.0
Columbia lines	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
0	10.4	60.5	88.2
2	11.5	61.3	89.2
4	10.2	59.7	94.7
4K	10.5	59.8	88.4

Table XVII. Weights of lambs from two-year-old ewes, by breed and type of birth, at birth, two and one-half months, and four and one-half months of age

Breed and type	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
Rambouillet			
Type 1	11.1	57.0	84.5
Type 2	8.8	40.3	68.5
Type 9	8.4	51.4	80.4
Targhee			
Type 1	11.1	56.3	86.0
Type 2	9.0	48.2	79.0
Type 9	8.4	56.8	83.8
Columbia			
Type 1	10.6	60.3	89.0
Type 2	8.4	48.2	76.2
Type 9	9.6	62.5	92.8

The three types of Rambouillet lambs, type 1, type 2, and type 9, were lighter at weaning than the same three types of both the Targhee and Columbia lambs. This result may be attributed to breed differences. Because the Targhee breed is largely a cross of the Rambouillet and Columbia breeds, the weaning weights of the Targhee lambs, as might be expected, fell between the average weaning weight of the two parent breeds.

Table XVIII. Weights of all lambs from two-year-old ewes, by type of birth, at birth, two and one-half months, and four and one-half months of age

Type of birth	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
1	11.0	57.4	86.0
2	8.9	46.6	76.6
9	8.7	56.5	85.1

Table XIX. Weights of lambs from two-year-old ewes, by breed, at birth, two and one-half months, and four and one-half months of age

Breed	Birth lbs.	2 1/2 months lbs.	4 1/2 months lbs.
Rambouillet	10.7	55.6	83.1
Targhee	10.5	54.8	84.5
Columbia	10.3	59.5	88.2

The weaning weights of the type 1 lambs were affected by the birth weights of the lambs. The lambs which were heavier at birth tend to be heavier at weaning time. The time of birth of the lambs, whether early or late, did not appear to affect the relationship of the birth weights and weaning weights. The correlation of the birth weights and the weaning weights of the early-born type 1 Rambouillet lambs was significant at the 5% level ($r=.32^*$). The correlation of the births weights and weaning

weights of the late-born type 1 Rambouillet lambs was significant ($r=.38^*$). The correlation of the birth weights and weaning weights of all type 1 Rambouillet lambs was highly significant ($r=.30^{**}$).

The correlation of the birth weights and weaning weights of both the early-born and late-born Targhee type 1 lambs was significant at the 1% level ($r=.51^{**}$ and $r=.54^{**}$ respectively). The correlation of the birth weight and weaning weight of all type 1 Targhee lambs was highly significant ($r=.46^{**}$).

The correlation of birth weights and weaning weights of the early-born type 1 Columbia lambs was highly significant ($r=.56^{**}$). The correlation of birth weights and weaning weights of the late-born Columbia lambs was significant at the 5% level ($r=.48^*$). The correlation of birth weights and weaning weights of all Columbia type 1 lambs was highly significant ($r=.48^{**}$).

The correlation coefficients of the birth weights and weaning weights of the Rambouillet and Targhee lambs are shown in Appendix Table VII, by lines. Due to the few numbers of Columbia lambs within lines, correlations were made only on all of the lines combined.

The birth weight of the type 2 lambs did not appear to affect the weaning weights to the extent observed in the type 1 lambs. The type 2 Rambouillet lambs showed a slight negative correlation ($r=-.16$) between birth weights and weaning weights. There were only three sets of Rambouillet type 2 lambs, and these could not be divided to make estimates of the effect of time of birth on the birth weight-weaning weight relationship.

The birth weights of the early-born type 2 Targhee lambs were

significantly correlated to their weaning weights ($r=.78^{**}$), showing that the heavier lambs at birth were also heavier at weaning. The late-born type 2 lambs did not show a significant correlation between birth weights and weaning weights ($r=.13$). When the early-born and late-born type 2 Targhee lambs were combined in one group, the correlation of the weights was not significant ($r=.24$).

The weights of each pair of twin lambs were combined to determine whether the total birth weight was related to the total weaning weight. The correlation of the total birth weight and total weaning weight of the Targhee type 2 lambs was not significant ($r=.20$). There was little or no tendency for heavier sets of twins, at birth, to be heavier at weaning.

The birth weights and weaning weights of the type 1 Rambouillet ewes were significantly correlated ($r=.45^{**}$), as is shown in Appendix Table VIII. The correlation coefficients of the birth weights and weaning weights of the type 1 Targhee ewes indicated a tendency for the ewes that were heavier at birth to be heavier at weaning ($r=.60^{**}$). Considerable variation in correlation coefficients was found between lines; however, this was probably due, to a large extent, to the small numbers of ewes within lines.

The correlation of the birth weights and weaning weights of the Columbia type 1 ewes was highly significant ($r=.70^{**}$).

Because the birth weight of the lamb does, to a certain extent, affect the weaning weight, then it would appear that the effect might remain with the lamb to a later age. This could be assumed only in the case of lambs within a particular type of birth, since the genetic ability of a lamb to

gain weight is masked, to some degree, by environmental factors, particularly in the case of lambs born and raised as twins.

In Appendix Table IX, the correlation coefficients of birth weights and fall yearling weights of the type 1 Rambouillet and Targhee ewes are shown.

The type 1 ewes which were heavier at birth were also heavier at fall yearling age. The correlation coefficients of the birth weights and fall yearling weights of the Rambouillet, Targhee and Columbia type 1 ewes were $r=.36^{**}$, $r=.57^{**}$, and $r=.47^{**}$, respectively.

The birth weights of the type 1 lambs were affected by the sex of the lambs. The type 1 ram lambs were 0.9 of a pound heavier at birth than the type 1 ewe lambs. The Rambouillet type 1 ram lambs were 0.7 of a pound heavier at birth than the corresponding ewe lambs. The Targhee type 1 ram lambs were 1.0 pound heavier at birth than the ewe lambs of the same breed and type of birth. The Columbia type 1 ram lambs were 1.2 pounds heavier at birth than the Columbia type 1 ewe lambs.

The type 1 ram lambs were 7.7 pounds heavier at weaning than the type 1 ewe lambs. The difference in weight of the ram and ewe lambs at weaning was 7.8, 8.5, and 6.6 pounds respectively for the Rambouillets, Targhees, and Columbias.

The ram lambs of types 2 and 9 were not consistently heavier at birth or weaning than the ewe lambs of the two types.

The difference in weight of the ram lambs and ewe lambs found in this study was approximately 3.1 pounds less than that found by Hazel and

Table XX. Average weights of lambs by breed, type of birth and sex, at birth, two and one-half months and four and one-half months of age

	Type 1		Type 2		Type 9	
	Ram	Ewe	Ram	Ewe	Ram	Ewe
Rambouillet	Average lbs.					
Birth	11.5	10.8	9.0	8.6	8.7	8.1
2 1/2 months	58.1	56.3	39.0	41.7	52.3	50.0
4 1/2 months	89.2	81.4	66.7	70.3	82.0	78.0
Targhee						
Birth	11.5	10.5	8.9	9.2	8.0	8.9
2 1/2 months	58.2	54.0	50.8	46.1	53.3	62.0
4 1/2 months	90.0	81.5	84.0	75.0	79.7	90.0
Columbia						
Birth	11.3	10.1	8.0	8.8	9.7	9.2
2 1/2 months	62.5	58.9	46.0	50.5	61.7	65.0
4 1/2 months	93.0	86.4	73.0	79.5	92.0	95.0
All breeds						
Birth	11.5	10.6	8.8	9.0	8.8	8.6
2 1/2 months	58.9	56.1	47.6	45.8	55.8	57.8
4 1/2 months	90.3	82.6	78.7	74.7	84.6	86.2

Terrill (1946) with Columbia and Corriedale lambs. The difference was, however, approximately 3.3 pounds more than that found by Sidwell and Grandstaff (1949) with Navajo lambs.

The average weights of the lambs are given in Table XX by sex, breed, and type of birth.

The effect of time of birth on the weights of lambs at three months, six months and twelve months has been shown by Phillips and Dawson (1940). Regression coefficients shown by these workers indicate that each day's difference in time of birth resulted in lower weights of lambs at three months of age. The effect, however, tended to become less as the lambs increased in age. It was also found in this study that a positive relationship existed between birth weights and weights at three months, and that as the lambs increased in age, to twelve months, the relationship became less significant. At twelve months of age, the majority of the regression coefficients were negative.

The type 1 lambs born to the two-year-old ewes in this study were divided into two groups, the early-born lambs and the late-born lambs. The early group of lambs ranged from 132 to 142 days in age at weaning time and the late group ranged from 101 to 131 days in age at weaning. The average age of the early group of lambs at weaning was 137.5 days and the average age of the late group of lambs at weaning was 124.4 days.

At birth, the early-born type 1 Rambouillet lambs weighed an average of 10.8 pounds compared to an average birth weight of 11.4 pounds for the late-born type 1 lambs. The difference of 0.06 of a pound in the average birth weight of the two groups was not significant. The early-born type 1 Targhee lambs weighed 10.6 pounds at birth compared to 11.5 pounds for the late-born type 1 lambs. The difference in the birth weights of the early

and late-born type 1 Targhee lambs was highly significant (1% level). The average birth weight of the early-born type 1 Columbia lambs was 10.5 pounds, while the average birth weight of the late-born type 1 Columbia lambs was 10.8 pounds. The difference of 0.3 of a pound in the birth weights of the two groups was not significant.

The average weaning weights of the early-born type 1 Rambouillet lambs and the late-born type 1 lambs were 86.9 pounds and 81.3 pounds respectively, a difference of 5.6 pounds which was significant (5% level).

The early-born type 1 Targhee lambs weighed 87.4 pounds at weaning and the late-born type 1 lambs weighed 84.9 pounds. The difference of 2.5 pounds between the average weaning weights of the early-born and late-born type 1 Targhee lambs was not significant.

The early-born type 1 Columbia lambs weighed 91.1 pounds at weaning compared to an average weaning weight of 86.3 pounds for the late-born type 1 lambs. The difference of 4.8 pounds between the two groups was not significant.

The difference in weight of the early-born and late-born lambs at weaning was due primarily to the difference in their birth dates. The average daily gain of the groups of lambs were as follows: early-born and late-born Rambouillet lambs, .56 pounds; early-born Targhee lambs, .56 pounds; late-born Targhee lambs, .59 pounds; early born Columbia lambs, .58 pounds; and late-born Columbia lambs, .59 pounds.

The type 1 Rambouillet and Targhee ewes were also divided into two groups by age at weaning. The ranges in age at weaning for the two groups

were the same as that previously shown for the lambs they produced as two-year-olds.

No significant difference was found in the average birth weights of the early-born and late-born groups of Rambouillet ewes. The early-born group weighed 10.5 pounds at birth and the late-born group weighed 10.3 pounds at birth.

At weaning time the difference in the average weight of the early-born ewes and the late-born ewes was 4.8 pounds, which was significant (5% level). The average weaning weight of the early-born group was 76.4 pounds compared to 71.6 pounds for the late-born group.

The early-born type 1 Targhee ewes weighed 9.2 pounds at birth and the late-born type 1 ewes weighed 10.2 pounds, a difference of 1.0 pound. This difference in average weight was significant (5% level). A difference of 2.9 pounds existed between the average weaning weight of the early-born group of ewes and the late-born group of ewes, the advantage in favor of the early-born group. The early-born group and the late-born group weighed an average of 76.0 pounds and 73.1 pounds respectively at weaning.

The effect of the age difference of the two groups remained apparent in the type 1 Rambouillet and Targhee ewes to fall yearling age. The early-born group of Rambouillet ewes weighed 124.1 pounds at fall yearling age compared to 120.6 pounds for the late-born group. The difference of 3.5 pounds between the two groups was not significant.

A difference of 0.9 of a pound existed between the early-born group of Targhee ewes and the late-born group at fall yearling age. The early-born

group weighed 127.3 pounds and the late-born group weighed 126.4 pounds. The difference was not significant.

The early-born type 1 Columbia ewes weighed 9.5 pounds at birth and the late-born type 1 ewes weighed 9.8 pounds at birth. The difference of 0.3 pounds in favor of the late-born group was not significant. At weaning time, the early-born group weighed 77.5 pounds and the late-born group weighed 73.7 pounds, a difference of 3.8 pounds which was not significant. The early-born group of Columbia ewes weighed 126.1 pounds at fall yearling age and the late-born group weighed 128.4 pounds. The difference of 2.3 pounds between the two groups was not significant.

The average birth weights and weaning weights of the early-born and late-born type 1 Rambouillet and Targhee lambs are shown by line in Appendix Tables X and XI respectively. The analysis of variance of the birth weights and weaning weights of these lambs, by time of birth, are shown in Appendix Table XIV.

The average birth weights, weaning weights and fall yearling weights of the type 1 Rambouillet and Targhee ewes are given in Appendix Tables XII and XIII by line and time of birth. The analysis of variance of the birth weights, weaning weights, and fall yearling weights of these ewes are shown in Appendix Tables XV and XVI.

The average birth weights and weaning weights of the early-born and late-born type 1 Columbia lambs are not given by lines, due to limited numbers within lines. The lines were combined, but divided into two groups according to time of birth. The weights of the two groups were discussed

previously. The analysis of variance of the birth weights and weaning weights of these two groups are shown in Appendix Table XVIII.

The numbers of Rambouillet, Targhee, and Columbia lambs (with weights) are shown in Appendix Tables XIX, XX, and XXI, respectively, by line, type of birth, and age when weighed.

The numbers of lambs given in these tables do not include one type 1 Rambouillet lamb, two type 1 Targhee lambs, two type 2 Targhee lambs and one type 1 Columbia lamb not having birth weights. One aborted Rambouillet lamb was not included in the table. The lambs that were dead at birth or died before ear-tagging, in addition to those mentioned above, were not weighed at birth.

The relation of the weaning weights of the type 1 Rambouillet lambs to their age at weaning, as shown by a regression coefficient, gives an advantage of .3490* pounds, \pm .1534 pounds for each additional day in age at weaning.

The relation of the weaning weight of the type 1 Targhee lambs to their age at weaning as shown by a regression coefficient, gives an advantage of .2649 pounds, \pm .1385 pounds for each additional day in age at weaning.

A .3881 pound advantage, \pm .2215 pounds, was found for each additional day in age at weaning for the type 1 Columbia lambs.

The numbers of lambs occurring within breeds and types are shown in Appendix Table XXII, with the corresponding regression coefficients.

The regression coefficients indicate that the age of the Targhee and

Columbia lambs at weaning, does not significantly affect weaning weight. Although some of the regression coefficients of the type 2 and type 9 lambs of these breeds show a significant advantage in weaning weight with additional age, caution should be used in interpretation of the data because of limited numbers. The larger numbers of type 1 lambs would appear to yield more valid estimates.

The regression coefficients of the type 1 lambs of the three breeds are slightly lower than those found by Hazel and Terrill (1945). In the analysis of the data, the effects of the sex of the lambs, the age of the dams, and the type of birth of the lambs were corrected for under the assumption that the various factors were additive in nature. The data presented by Hazel and Terrill show an advantage of more than 0.4 pounds in weaning weight per additional day in age at weaning. Since these data were adjusted to mature ewe production levels, it is doubtful that they are directly comparable to the two-year-old production in this study.

By calculation from weights and ages reported by Foster (1926), the average daily gain of lambs of four mutton breeds was approximately 0.4 pounds per day to twenty-five weeks of age. This was slightly higher than that shown by Phillips and Brier (1940), when they combined Foster's data with other similar data collected. These workers reported that the average daily gain of lambs to weaning age was affected by breed, type of birth, sex, time of birth, and birth weight when other factors such as mothering instinct, and the milking ability of the dam are considered equal. The lambs born to two-year-old ewes are at an additional disadvantage since the

two latter factors mentioned are not usually comparable in the two-year-old and mature ewes.

The weaning weight distribution of the type 1, Rambouillet, Targhee and Columbia, lambs by age at weaning are shown in Figures 7, 8 and 9, respectively.

The analysis of variance of the regression coefficients of weaning weight by age at weaning of the lambs are shown in Appendix Tables XXIII, XXIV and XXV.

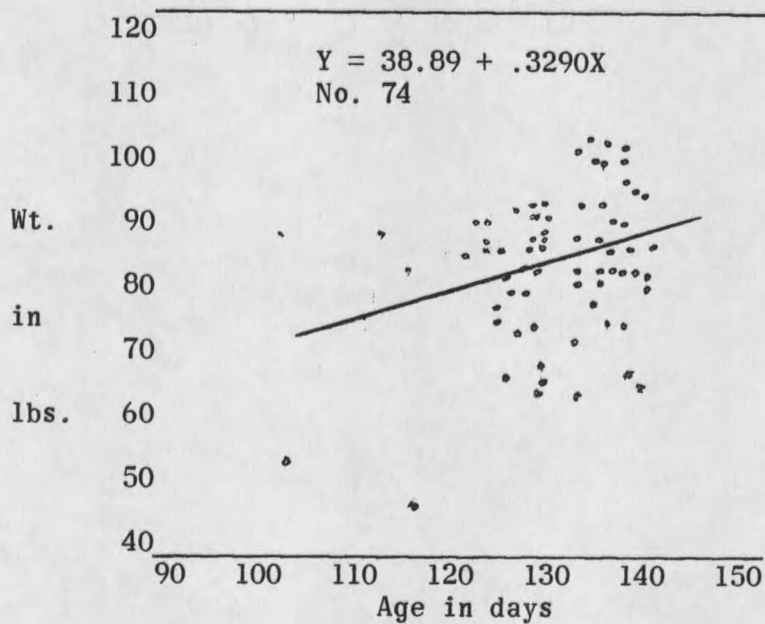


Figure 7. Weaning weight distribution of Rambouillet type 1 lambs by age at weaning time.

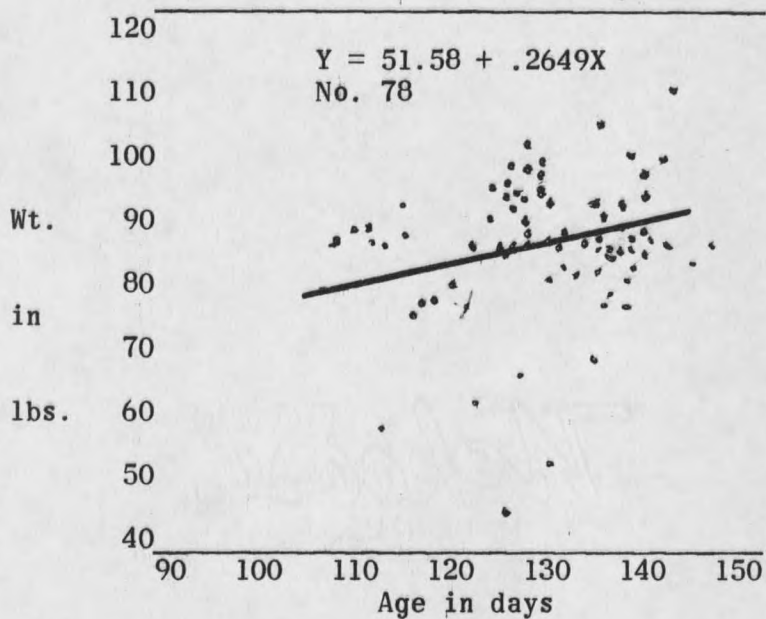


Figure 8. Weaning weight distribution of Tar-gee type 1 lambs by age at weaning time.

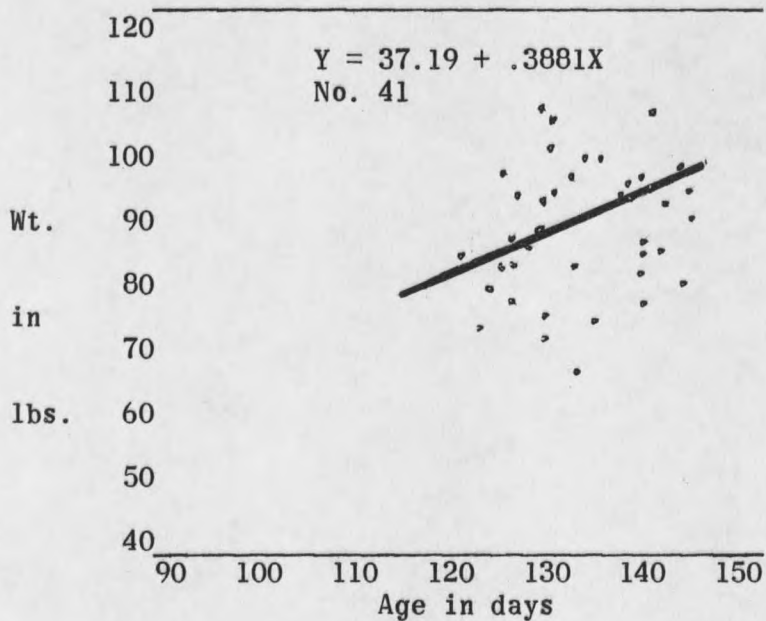


Figure 9. Weaning weight distribution of Columbia type 1 lambs by age at weaning time.

Growth of Two-year-old Ewes and Their Lambs
from Birth to Weaning

The lambs born to the two-year-old ewes were generally heavier at birth, two and one-half months and four and one-half months of age than their dams at corresponding ages. The type 2 Columbia lambs were consistently lighter from birth to weaning than the corresponding type of Columbia ewes. The average weights of the ewes and lambs are shown in Table XXI by their own types of birth. In making comparisons in this table, three factors should be kept in mind: (1) the lamb weights include the weights of both ewe lambs and the ram lambs; (2) the ewes were the select lambs from a larger group of ewe lambs held for replacements in the flock; and (3) the ewes were born to ewes of various ages, rather than strictly to two-year-olds, as were the lambs .

To eliminate one of these variables, the average weights of the ewes as lambs and their ewe lambs are shown in Table XXII by age and type of birth. In this table it may be noted that the ewe lambs, with only two exceptions, were consistently heavier at the various ages than the ewes of the same breed and type of birth.

It is felt that a large portion of the difference in the average weights of the ewes and the lambs was due to better management and feeding at lambing time. A portion of the weight advantage of the lambs was probably due to yearly differences.

The growth of the ewes and the lambs, by their own type of birth, are shown graphically in Figures 10, 11, and 12.

Table XXI. Average weights of ewes and their lambs at birth, two and one-half months, and four and one-half months of age by their own type of birth

	Birth		2 1/2 months		4 1/2 months	
	Ewe	Lamb	Ewe	Lamb	Ewe	Lamb
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Rambouillet						
Type 1	10.5	11.1	52.0	57.0	74.3	84.5
Type 2	8.6	8.8	42.1	40.3	64.0	68.5
Type 9	8.5	8.4	46.1	51.4	68.0	80.4
Targhee						
Type 1	9.8	11.1	51.2	56.3	73.6	85.9
Type 2	8.1	9.0	42.8	48.2	65.8	79.0
Type 9	8.1	8.4	47.9	56.8	69.4	83.8
Columbia						
Type 1	9.7	10.6	49.7	60.3	75.8	89.0
Type 2	9.0	8.4	50.0	48.2	76.5	76.2
Type 9	7.9	9.6	45.7	62.5	69.8	92.8

Table XXII. Average weights of ewes and their ewe lambs at birth, two and one-half months, and four and one-half months of age by their own type of birth

	Birth		2 1/2 months		4 1/2 months	
	Ewe	Ewe lamb	Ewe	Ewe lamb	Ewe	Ewe lamb
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Rambouillet						
Type 1	10.5	10.8	52.0	56.3	74.3	81.4
Type 2	8.6	8.6	42.1	41.7	64.0	70.3
Type 9	8.5	8.1	46.1	50.0	68.0	78.0
Targhee						
Type 1	9.8	10.5	51.2	54.0	73.6	81.5
Type 2	8.1	9.2	42.8	46.1	65.8	75.0
Type 9	8.1	8.9	47.9	62.0	69.4	90.0
Columbia						
Type 1	9.7	10.1	49.7	58.9	75.8	86.4
Type 2	9.0	8.8	50.0	50.5	76.5	79.5
Type 9	7.9	9.2	45.7	65.0	69.8	95.0

Table XXIII. Average daily gains of ewes, as lambs, and the lambs 1/
by breed and type of birth

	Birth to 2 1/2 months	Ewes 2 1/2 mo. to 4 1/2 months	Birth to 4 1/2 months	Birth to 2 1/2 months	Lambs 2 1/2 mo. to 4 1/2 months	Birth to 4 1/2 months
Pounds per day						
Rambouillet						
Type 1	0.52	0.44	0.49	0.63	0.47	0.56
Type 2	0.42	0.43	0.43	0.42	0.49	0.45
Type 9	0.49	0.43	0.47	0.59	0.50	0.54
Targhee						
Type 1	0.54	0.44	0.50	0.63	0.51	0.58
Type 2	0.43	0.45	0.44	0.58	0.53	0.56
Type 9	0.52	0.42	0.48	0.61	0.47	0.55
Columbia						
Type 1	0.53	0.51	0.52	0.66	0.49	0.59
Type 2	0.53	0.52	0.52	0.52	0.49	0.51
Type 9	0.50	0.47	0.49	0.67	0.52	0.61

1/ The lambs by their own breed and type of birth. The average daily gain of the lambs includes that of both the ewe lambs and the ram lambs.

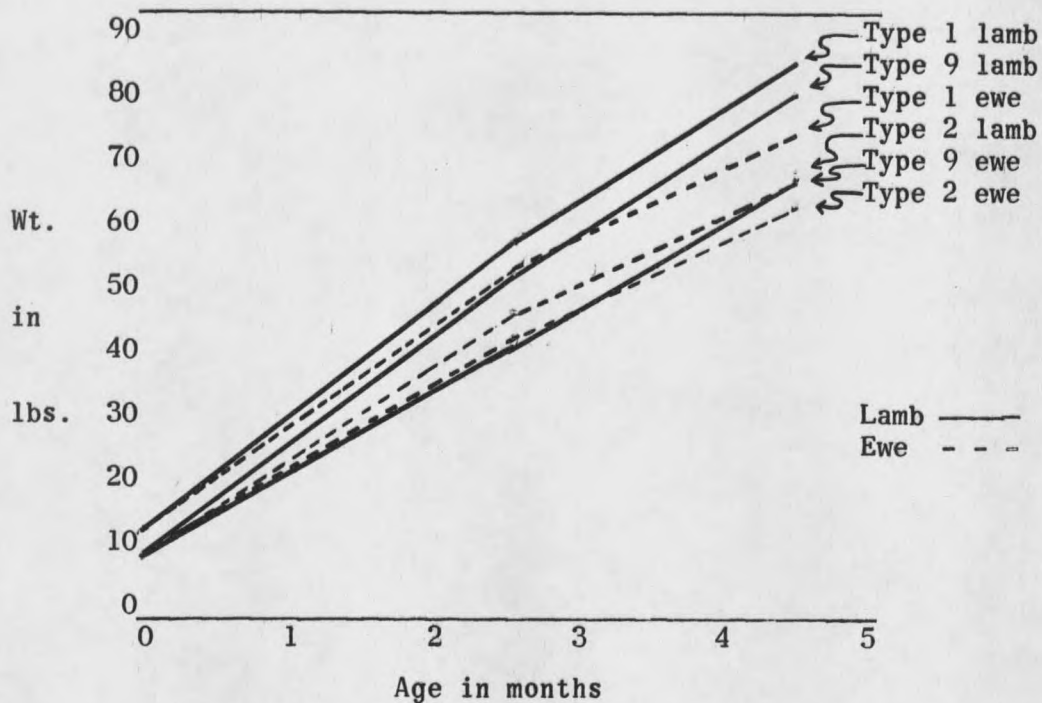


Figure 10. The growth of the Rambouillet ewes as lambs and their lambs, from birth to weaning, by their own type of birth.

The average daily gain of the lambs from birth to weaning was greater than that of the ewes of the same breed and type of birth with the exception of the type 2 Columbias. When the period of birth to weaning was separated into two parts, birth to two and one-half months, and two and one-half months to four and one-half months, the Rambouillet and Targhee lambs maintained an advantage in average daily gain over the ewes. The type 1 Columbia ewes gained slightly more while on forest (two and one-half months to four and one-half months) than the lambs of the same

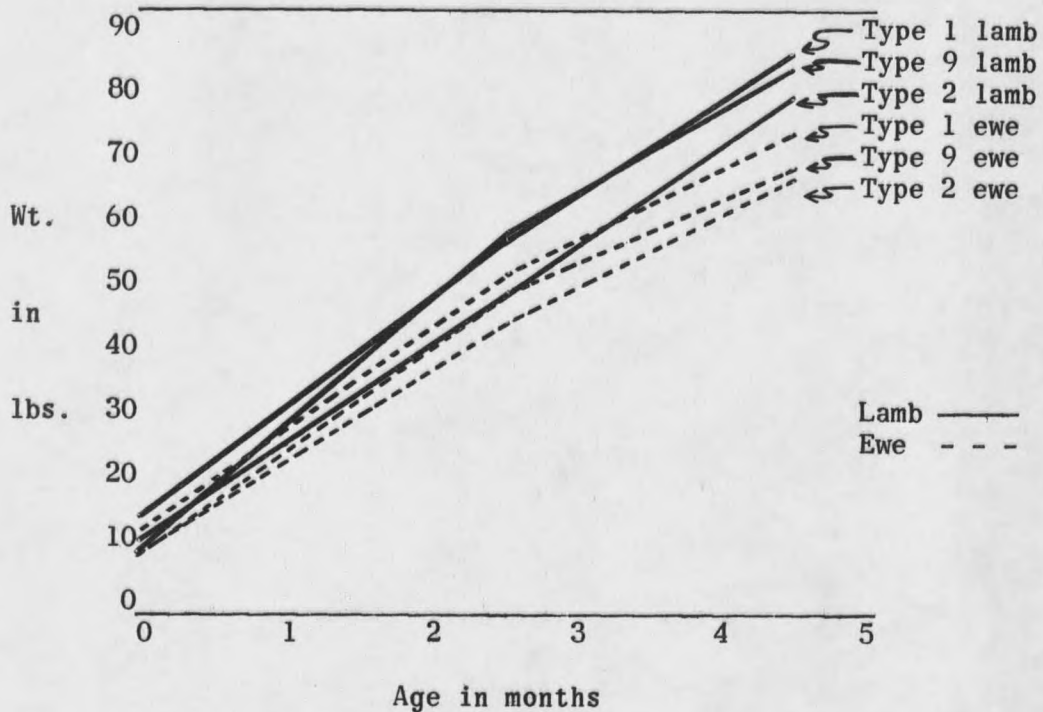


Figure 11. The growth of the Targhee ewes as lambs and their lambs, from birth to weaning, by their own type of birth.

type, and the type 2 Columbia ewes gained more during both periods than did the type 2 Columbia lambs.

As would be expected, all type 1 and type 9 ewes and lambs had higher average daily gains during the period of birth to two and one-half months than during the period of two and one-half months to four and one-half months. The type 2 ewes and lambs were not consistent in this respect. The type 2 Rambouillet ewes and lambs showed lower gains during the first period than during the second period. The same was true for the

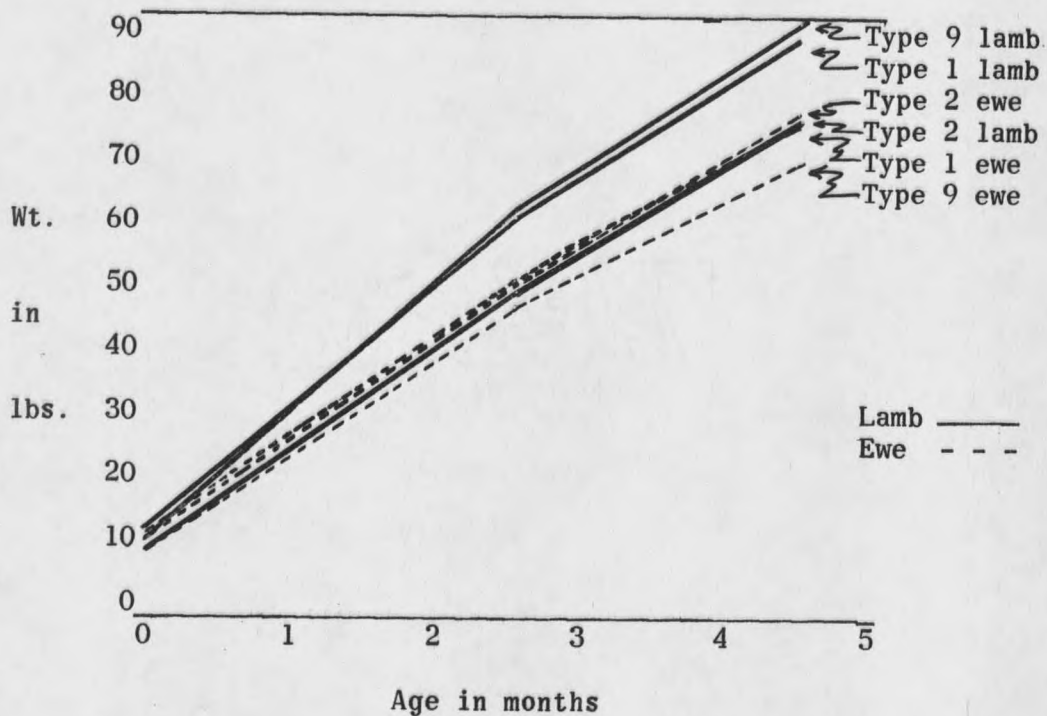


Figure 12. The growth of the Columbia ewes as lambs and their lambs, from birth to weaning, by their own type of birth.

type 2 Targhee ewes. The type 2 Targhee and Columbia lambs and the type 2 Columbia ewes made greater average daily gains during the first period than during the second period.

The average daily gains of the ewes, as lambs, and the lambs are shown in Table XXIII by breed, type of birth and period of growth.

Effect of Sires on Growth of the Lambs

The type 1 lambs in the 2000 line sired by ram 1 weighed 11.7 pounds at birth, 63.8 pounds at two and one-half months of age and 92.8 pounds at weaning. The progeny of ram 2, of the corresponding type, weighed 10.9 pounds at birth, 0.8 of a pound less than those sired by ram 1. At two and one-half months of age, the lambs sired by ram 2 weighed 55.2 pounds, 8.6 pounds less than the lambs sired by ram 1. By weaning time, the difference between the two groups of progeny had increased to 11.6 pounds, the lambs sired by ram 1 being the heaviest.

In the 5000 line, the type 1 lambs sired by ram 6 weighed 10.0 pounds at birth, 0.4 of a pound less than the type 1 lambs sired by ram 7. At two and one-half months, the lambs sired by ram 6 were 5.3 pounds heavier than the lambs sired by ram 7, and at weaning they were 10.6 pounds heavier than the lambs sired by ram 7.

The differences in weights of the progeny from the two sires, 8 and 9, in the 6000 line were small. The birth weight, weight at two and one-half months, and weaning weight of the type 1 lambs sired by ram 8 were 11.6 pounds, 57.0 pounds and 82.3 pounds respectively, compared to 11.4 pounds, 56.8 pounds and 83.2 pounds for the lambs sired by ram 9.

The sex ratios and the age at weaning of the lambs from the different sires were about equal, showing that large differences in weights of progeny may exist between sires within lines.

The weights of the Rambouillet lambs are given in Appendix Table XXVI by line, sire and type of birth.



Figure 13. Weanling Rambouillet ram lambs from the same line and different sires. In the upper picture, the first ram on the left is a single born and the pair next to him are twins.

The type 1 Targhee lambs in the 4 line sired by ram 19 weighed 12.2 pounds at birth, 66.0 pounds at two and one-half months, and 95.8 pounds at weaning. These type 1 lambs were 0.3 of a pound heavier at birth, 3.3 pounds heavier at two and one-half months, and 3.5 pounds heavier at weaning than the type 1 lambs sired by ram 18.

The two rams used in the 4 line were also used in the 8 line. The type 1 lambs sired by ram 19 in the 8 line were 1.4 pounds lighter at birth, 9.7 pounds lighter at two and one-half months, and 12.2 pounds lighter at weaning than his type 1 lambs in the 4 line. The two rams were from ewes in the 8 line, indicating that some of the weight advantage found in the lambs in the 4 line may have been partially due to hybrid vigor.

In two of the Targhee lines, only one sire was used per line and in two lines, the number of progeny per ram was insufficient for comparing rams. The weights of the Targhee lambs are given in Appendix Table XXVII by line, sire and type of birth.

Only one ram was used per line in the four Columbia lines, hence sire effect cannot be separated from line effect in this study. The weights of the lambs are given by line, sire and type of birth in Appendix Table XXVIII.

Weaning Weights

The weaning weights of lambs and the pounds of lamb weaned per ewe are probably the most important measures of lamb production sheep. The importance of high weaning weights is not limited to the income received from lambs sold, but is also important in determining the future productivity of the flock. It is a common practice among sheepmen to select their replacements at weaning time and the larger ewe lambs are inevitably chosen. It is important, then, to predetermine the environmental factors that affect the size of the lambs at weaning, and to adjust for them, prior to selection.

Environmental factors known to directly affect the size of lambs at weaning are type of birth and rearing of the lambs, the age of the dam, and the age of the lambs at weaning. Phillips and Dawson (1937, 1940) found that in selection, singles were preferred to twins, early lambs to late lambs, and heavy lambs at birth to light lambs at birth. It was felt that this practice was not desirable since genetic possibilities were being omitted and environmental factors were not considered.

The effect of the age on the weaning weight of the lambs has been discussed previously. Since this study is concerned primarily with the production of two-year-old ewes, the factor of age of dam will not be discussed. The effect of type of birth of the lambs is probably the most important as far as body weights are concerned.

The average weaning weights of the Rambouillet type 1, type 2 and type 9 lambs were 84.5 pounds, 68.5 pounds, and 80.4 pounds respectively.

Table XXIV. Average weaning weight of lambs by breed, line and type of birth

Rambouillet	2000	3000	5000	6000	7000	8000	All
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Type 1	86.6	84.8	82.7	82.8	86.4	90.5	84.5
Type 2	--	71.0	67.2	--	--	--	68.5
Type 9	81.0	78.0	--	77.0	88.0	--	80.4
All	86.2	80.2	81.0	82.3	86.6	90.5	
Targhee	0	2	4	6	8		All
Type 1	86.1	83.9	86.3	89.0	86.2		86.0
Type 2	--	70.2	85.5	74.5	81.8		79.0
Type 9	87.0	76.0	77.1	--	89.5		83.8
All	86.2	80.6	85.5	86.8	85.6		
Columbia	0	2	4	4K			All
Type 1	88.2	89.2	94.7	88.4			89.0
Type 2	79.0	--	--	73.5			76.2
Type 9	--	102.0	95.0	87.0			92.8
All	85.2	91.0	94.8	87.4			

The difference in the weaning weights of the three types was significant (1% level).

The differences in the weaning weights of the lambs of the six Rambouillet lines were not significant. Of the type 1 lambs, the 5000 line lambs were the lightest, 82.7 pounds, and the 8000 line lambs were the heaviest, 90.5 pounds, a difference of 7.8 pounds.

The differences in weaning weights of the lambs in the five Targhee lines were not significant. The average weaning weight of the type 1 lambs varied from 83.9 pounds in the 2 line to 89.0 pounds in the 6 line, a difference of 5.1 pounds.

The average weaning weight of the Targhee type 1 lambs was 86.0 pounds, the type 2 lambs, 79.0 pounds and the type 9 lambs 83.8 pounds, a difference of 7.0 pounds between the lightest and heaviest types. The difference was not significant.

Of the type 1 Columbia lambs, those in the 0 line had the lowest average weaning weight, 88.2 pounds, of the four Columbia lines. The type 1 Columbia lambs in the 4 line were the heaviest at weaning of the four lines, with an average weaning weight of 94.7 pounds, an advantage of 6.5 pounds over the lambs of the corresponding type in the 0 line. The differences in the average weaning weights of the four lines were not significant.

The type 1 Columbia lambs weighed 89.0 pounds at weaning, the type 2 lambs, 76.2 pounds and the type 9 lambs, 92.8 pounds, a difference of 16.6 pounds between the heaviest and lightest types. This difference was significant (5% level).

Table XXV. Standard deviation of weaning weights of type 1 lambs

Rambouillet	2000	3000	5000	6000	7000	8000	All
Avg. wt. lbs.	86.6	84.8	82.7	82.8	86.4	90.5	84.5
s =	10.76	2.95	12.89	9.78	7.03	7.09	10.79
No.	12	5	33	11	8	6	75
Targhee	0	2	4	6	8		All
Avg. wt. lbs.	86.1	83.9	86.3	89.0	86.2		86.0
s =	12.70	9.13	16.19	9.85	6.37		10.94
No.	21	21	11	11	14		78
Columbia	0	2	4	4K			All
Avg. wt. lbs.	88.2	89.2	94.7	88.4			89.0
s =	11.50	10.34	11.50	9.44			9.63
No.	4	6	3	28			41

The variability of weaning weights within lines differed considerably between lines. The standard deviation of weaning weights of the type 1 lambs are given in Table XXV by breed and line.

In the six Rambouillet lines, the standard deviation of the weaning weights appeared to increase with increased numbers of lambs within lines. In the Targhee lines, a greater variation in weaning weights existed in the 0 line than in the 2 line, although the number of lambs in the two

lines was the same. The same was true in the case of the 4 and 6 lines, with the lambs in the 4 line showing the greatest variation. The lambs in the 8 line showed the least variation in weaning weights of the five lines of Targhee lambs.

The standard deviation of weaning weights was not greatly different in the four Columbia lines. The type 1 Columbia lambs showed less variation in weaning weights than did the type 1 Rambouillet and Targhee lambs.

The average weaning weight of the lambs weaned from the purebred band from 1947 to 1951 inclusive are given in Table XXVI. The weaning weights given in this table include all lambs weaned from the band with no adjustment made for sex, type of birth, or age of dam. The difference in age at weaning during the five-year period was essentially unimportant.

The most evident factor to be observed in Table XXVI is the increase in average weight of the lambs weaned in 1950 and 1951 over preceding years. It is felt that this weight advantage was largely due to better management during lambing.

The weaning weights were not consistently high nor low in any line during the five-year period. The weaning weights of the ewes, as lambs, in 1949 were generally slightly lower than the average weights of their respective lines. This is probably largely due to sex differences, since the average weight for the line includes both ewe lambs and ram lambs.

The average weaning weight of all the lambs born in the purebred band in 1951 were not consistently heavier than the lambs weaned from the two-year-old ewes during the same year. In comparing the average weaning

Table XXVI. Average weaning weight of all lambs weaned from the purebred band from 1947-1951 ^{1/}

	1947	1948	1949	1950	1951
Rambouillet	lbs.	lbs.	lbs.	lbs.	lbs.
2000	73.2	71.7	70.3	81.2	87.5
3000	75.2	68.1	73.3	75.8	85.3
5000	78.2	72.9	71.6	79.9	80.8
6000	75.9	72.2	72.7	80.1	83.0
7000	78.1	75.9	69.5	79.4	81.0
8000	--	78.9	74.5	82.1	84.7
Targhee					
0	79.8	74.8	70.8	84.0	84.4
2	77.7	71.9	70.9	81.8	85.0
4	--	--	--	--	84.7
6	--	81.5	73.7	88.8	88.9
8	--	77.1	77.2	89.0	89.9
Columbia					
0	76.8	78.1	72.7	80.2	87.9
2	72.2	73.9	71.3	83.0	91.3
4	--	79.6	74.2	84.7	85.1

^{1/} The weights given for the first four years in this table were taken from a mimeograph circular prepared by J. L. Van Horn for a Sheep Breeding Field Day at the Montana Experiment Station.

weights of all lambs in 1951 shown in Table XXVI, to the average weaning weights of the lambs weaned from the two-year-old ewes, shown in Table XXIV, it may be observed that the lambs weaned from two-year-old dams in the Rambouillet 5000 line average 0.2 of a pound more than all lambs weaned in that line. In the Rambouillet 7000 and 8000 lines, the lambs weaned from two-year-old dams were 5.6 pounds and 5.8 pounds heavier than all the lambs weaned in the respective lines.

Two-year-old ewes in the Targhee 0 and 4 lines also weaned lambs heavier than the average of all lambs weaned from these lines in 1951. The same was true for the two-year-old ewes in the Columbia 4 line.

Since no correction was made for type of birth in the average weights shown in Table XXVI, it would logically be assumed that these weights are affected by the higher proportion of multiple births from the mature ewes. The average weights also include the weaning weights of the lambs weaned from the two-year-old ewes.

The pounds of lamb weaned per two-year-old ewe in the Rambouillet 6000 line was 68.1 pounds, the lowest of the six Rambouillet lines. The ewes in the 7000 line weaned the most pounds of lamb per ewe, 77.9 pounds. The difference between the lowest and highest producing Rambouillet lines was 9.8 pounds. The difference was not significant among the six lines.

The ewes in the Targhee 4 line weaned 90.0 pounds of lamb per ewe, while the ewes in the Targhee 8 line weaned 74.5 pounds of lamb per ewe, a difference of 15.5 pounds between the heaviest and lightest producing lines. The difference in pounds of lamb weaned per ewe in the five Targhee lines

Table XXVII. Pounds of lamb weaned per ewe by two-year-old dams

Line	No. of ewes	Pounds of lamb
Rambouillet		
2000	15	74.7
3000	10	72.2
5000	41	73.1
6000	16	68.1
7000	10	77.9
8000	7	77.6
All lines	99	72.2
Targhee		
0	25	75.8
2	28	80.6
4	19	90.0
6	13	86.8
8	23	74.5
All lines	108	80.6
Columbia		
0	6	85.2
2	9	70.8
4	4	94.8
4K	34	82.2
All lines	53	81.6

was not significant.

The ewes in the Columbia 2 line produced 70.8 pounds of lamb per ewe, while the ewes in the 4 line produced 94.8 pounds of lamb per ewe, a difference of 24.0 pounds. This difference was not significant among the four lines.

The Rambouillet two-year-old ewes weaned 72.2 pounds of lamb per ewe, the Targhee ewes, 80.6 pounds per ewe and the Columbia ewes, 81.6 pounds per ewe. The difference between breeds in pounds of lamb weaned per ewe was not significant.

The analysis of variance of the pounds of lamb weaned per ewe are given by breed, line and type of birth of the ewes in Appendix Table XXXI.

Table XXVIII. Pounds of lamb weaned per ewe by breed and type of birth of ewes as two-year-olds

	Rambouillet	Targhee	Columbia
Type 1	74.3	80.5	81.5
Type 2	68.8	87.5	89.8
Type 9	68.5	65.4	90.0

The pounds of lamb weaned per ewe by breed and type of birth are given in Table XXVIII.

The correlation coefficients of the weaning weights of the ewes and the pounds of lamb they weaned as two-year-old ewes are shown in Table XXIX. The correlation coefficients shown are generally positive, but none of

them are significant.

The standard deviation of the weaning weights of the ewes and the lambs are given by breed and type of birth in Appendix Table XXXIV. The variation about the mean weaning weight was 8.9 pounds for the Rambouillet ewes, 11.0 pounds for the Rambouillet lambs, 8.3 pounds for the Targhee ewes, 11.5 pounds for the Targhee lambs, 9.9 pounds for the Columbia ewes and 9.8 pounds for the Columbia lambs.

Table XXIX. Correlation coefficients of ewe weaning weight and pounds of lamb weaned per ewe by breed and type of birth of ewe

	Rambouillet		Targhee		Columbia	
	r	no.	r	no.	r	no.
Type 1	.09	62	.08	69	.04	41
Type 2	.45	16	-.12	21	-.80	4
Type 9	.20	21	-.05	8	.21	6
All types	.11	99	.05	98	.04	51

The weaning weights of the type 1 ewes and lambs tended to show more variation than the ewes and lambs of the other two types.

Yearling Body Weight of the Ewes and Two-year-old Lamb Production

The growth of the ewe between weaning and yearling age is dependent largely upon the genetic ability of the ewe to gain weight, providing environmental conditions are optimum for such growth. Two factors of importance in relation to the weaning weight of the ewe lambs, and hence,

selection of replacements based on the size of the ewe lambs at weaning are (1) age at weaning, and (2) the type of birth. The effects of these two factors on size are reduced as the ewe progresses toward maturity.

Terrill and Stoehr (1942) found that the fall body weight of yearling ewes, Rambouillets, Corriedales and Columbias, just prior to breeding, was closely associated with their lifetime production of lamb and wool.

Phillips and Dawson (1940) reported that the effect of type of birth was less at six months than at three months, and that the effect tended to disappear at twelve months of age.

Table XXX. Average body weights of ewes at weaning and fall yearling age by breed and type of birth

	Rambouillet		Targhee		Columbia	
	Wean. Wt.	Fall yrlyg. wt.	Wean. wt.	Fall yrlyg. wt.	Wean. wt.	Fall yrlyg. wt.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Type 1	74.3	122.5	74.2	126.7	75.8	127.2
Type 2	63.9	119.3	69.0	124.9	76.5	139.5
Type 9	68.0	119.2	69.4	120.3	69.8	125.8

The average body weight of the ewes at weanling and fall yearling age are given in Table XXX. The correlation coefficients of these weights are given in Table XXXI.

The correlation of the weaning weight and the fall yearling weight of the Rambouillet, Targhee and Columbia type 1 ewes is highly significant.

The same is true for the type 2 Rambouillet and Columbia ewes, also the type 9 Rambouillet ewes. The correlation of the weaning weight and fall yearling weight of the Targhee type 2 ewes was significant (5% level). The correlation of the weaning weight and fall yearling weight of the type 9 Targhee and Columbia ewes was not significant.

The difference in the weaning weight of the Rambouillet ewes by type of birth is significant (1% level). The difference in the weaning weight of the Targhee ewes by type of birth is significant (5% level). There was no significant difference in the weaning weight of the Columbia ewes by type of birth (Appendix Table XXXII).

Table XXXI. Correlation coefficients of ewe weaning weight and fall yearling weight by breed and type of birth

	Rambouillet		Targhee		Columbia	
	r	no.	r	No.	r	No.
Type 1	.71**	62	.72**	68	.66**	41
Type 2	.77**	16	.46*	21	.99**	4
Type 9	.71**	21	.36	8	.62	6

The effect of type of birth of the ewes on their body weight had practically disappeared when the ewes reached fall yearling age.

The body weight of the ewes as fall yearlings was more closely associated with the pounds of lamb weaned per ewe as two-year-olds than the weaning weight of the ewes. The correlation coefficient of the fall yearling weight of the Targhee ewes and pounds of lamb weaned per ewe is

significant (5% level). The correlation coefficient of the fall yearling weight and the pounds of lamb weaned per ewe of the type 1 Targhee ewes, the type 2 and the type 9 Columbia ewes are significant (5% level).

Table XXXII. Correlation coefficients of fall yearling weight of ewes and pounds of lamb weaned per ewe as two-year-olds by breed and type of birth

	Rambouillet		Targhee		Columbia	
	r	no.	r	no.	r	no.
Type 1	.09	62	.23*	75	.05	42
Type 2 -	.45	16	.19	23	.82*	4
Type 2	-.03	21	.29	10	.81*	6
All types	.14	99	.23*	108	.14	52

Wool Production

The body weight of the ewe and her wool production are highly correlated. The correlation of the ewe's weaning weight to her yearling grease fleece weight is highly significant for the three breeds, Rambouillet, Targhee and Columbia, as may be seen in Table XXXIII. The correlation of the weaning weight and yearling grease fleece weights of the three types of Rambouillet ewes are highly significant. The weaning weight of the type 2 and type 9 Targhee ewes were not significantly correlated to their yearling grease fleece weight. This is also true in the case of the type 2 Columbia ewes.

The correlation coefficients of the ewes' weaning weight and their

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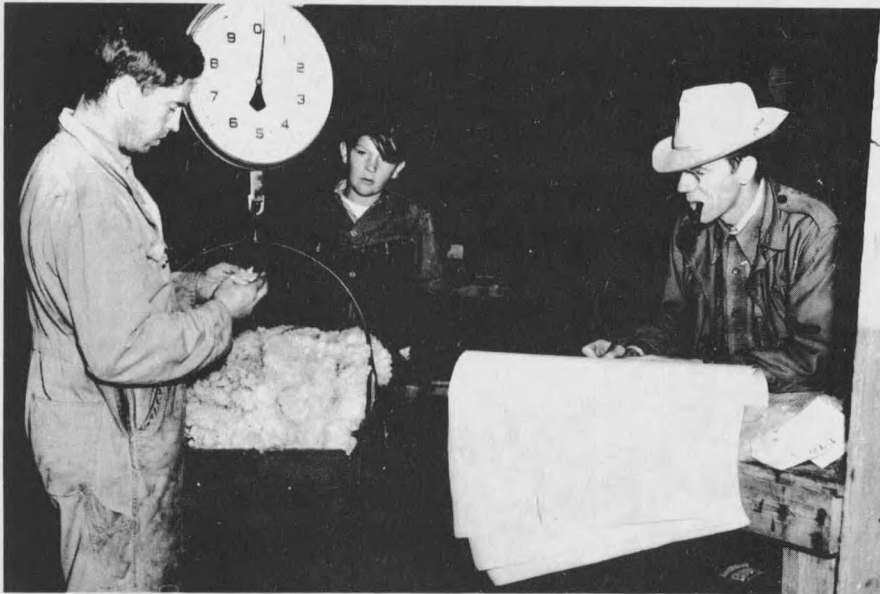


Figure 14. Weighing and grading individual fleeces at shearing time.

yearling grease fleece weights were highly significant for the three types of birth when breed differences are not considered.

The correlation of the ewes' weaning weight to their two-year-old grease fleece weights is highly significant for the type 1 ewes and is not significant for the type 2 and type 9 ewes. The similarity of the grease fleece weights of the ewes of the three types within breeds at the two-year-old shearing date indicated a greater similarity of body weights at that date than at weaning.

Table XXXIII. Correlation coefficients of ewe weaning weight and yearling grease fleece weights by breed and type of birth

	Rambouillet		Targhee		Columbia		All breeds	
	r	no.	r	no.	r	no.	r	no.
Type 1	.87**	62	.43**	60	.66**	41	.64**	163
Type 2	.64**	16	.39	15	.38	4	.59**	35
Type 9	.44*	21	.57**	21	.89**	5	.46**	47
All types	.76**	99	.40**	96	.62**	50		

The average yearling grease fleece weight of the Rambouillet ewes varied from 9.1 pounds in the 7000 line to 10.2 pounds in the 5000 line, a difference of 1.1 pounds. The difference was not significant. The difference of 1.0 pound between the yearling grease fleece weights of the Rambouillet type 1 ewes and the type 2 ewes was highly significant.

The average grease fleece weights of the six lines of Rambouillet ewes were more uniform at the second shearing than at the first shearing. With

the exception of the 8000 line, as shown in Table XXXV, the variation in average grease fleece weights between the lines was only 0.4 of a pound. The difference in the grease fleece weight of the Rambouillet ewes, by lines, as two-year-olds, was not significant. The difference of 0.4 of a pound in the two-year-old grease fleece weight of the type 1 and type 9 Rambouillet ewes was not significant.

The average grease fleece weights of the five lines of Targhee ewes were essentially the same at the first shearing and also the second shearing.

Table XXXIV. Correlation coefficients of ewe weaning weight and two-year-old grease fleece weights by breed and type of birth

	Rambouillet		Targhee		Columbia		All breeds	
	r	no.	r	no.	r	no.	r	no.
Type 1	.40**	60	.12	64	.39*	39	.29**	163
Type 2	.24	15	.08	21	-.28	3	.20	39
Type 9	.20	21	-.36	8	.55	6	.22	35
All types	.33**	96	.10	93	.38**	48		

There was no significant difference in the average grease fleece weights among the five lines of Targhee ewes, as yearlings nor as two-year-olds. The difference in the fleece weights of the three birth types of Targhee ewes as yearlings and as two-year-olds was not significant.

A difference of 1.9 pounds existed between the average yearling grease

Table XXXV. Yearling and two-year-old fleece weights of the ewes by breed and line

Line	Avg. yrlg. fleece wt.	No. ewes	Avg. 2-yr.-old fleece wt.	No. ewes
Rambouillet	lbs.		lbs.	
2000	10.1	15	9.0	14
3000	9.2	10	9.0	10
5000	10.2	41	9.1	40
6000	9.7	16	9.1	15
7000	9.1	10	8.7	10
8000	9.8	7	8.3	7
Targhee				
0	10.1	25	9.2	24
2	10.1	28	9.2	26
4	10.2	19	9.6	18
6	10.4	13	9.5	13
8	10.3	23	9.7	23
Columbia				
0	12.8	5	11.1	5
2	11.8	9	10.5	9
4	11.4	4	11.0	3
4K	10.9	33	10.2	32

fleece weights of the O line Columbia ewes and the 4K line Columbia ewes. The difference in the average yearling grease fleece weights of the four Columbia lines was significant (5% level). There was no significant difference in the average yearling grease fleece weights of the three types of Columbia ewes.

The difference in average grease fleece weights between the four Columbia lines was not as great at the second shearing as it was at the first shearing, and the difference was not significant. Type of birth of the Columbia ewes did not have a significant effect on their two-year-old grease fleece weights.

Table XXXVI. Average grease fleece weights of ewes by breed, age at shearing and type of birth

	Rambouillet		Targhee		Columbia	
	Yrlg. fl. wt.	2-yr.-old fl. wt.	Yrlg. fl. wt.	2-yr.-old fl. wt.	Yrlg. fl. wt.	2-yr.-old fl. wt.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Type 1	10.0	9.1	10.2	9.4	11.3	10.4
Type 2	9.0	8.9	9.9	9.2	12.6	10.1
Type 9	9.2	8.7	11.0	10.0	10.8	10.8
All types	9.8	9.0	10.2	9.4	11.3	10.5

A highly significant difference existed between the average yearling grease fleece weights of the three breeds of ewes, and also the two-year-old grease fleece weights of the three breeds. The average yearling grease

fleece weights of the Rambouillet ewes, the Targhee ewes, and the Columbia ewes were 9.8 pounds, 10.2 pounds, and 11.3 pounds respectively. The average two-year-old grease fleece weights were 9.0 pounds, 9.4 pounds, and 10.5 pounds respectively for the Rambouillet, Targhee and Columbia ewes.

The differences between the yearling and two-year-old grease fleece weights of the Rambouillet, Targhee and Columbia ewes were highly significant.

The analysis of the grease fleece weights are shown in Appendix Tables XXXV, XXXVI, XXXVII and XXXVIII.

The grade and length of the fleeces shorn from the ewes as yearlings and as two-year-olds are given in Table XXXVII.

Table XXXVII. Grades and lengths of fleeces shorn from the ewes as yearlings and as two-year-olds by breed ^{1/}

Breed	Age at shearing	Fine st.	Fine fr.	1/2 st.	1/2 fr.	3/8 st.	3/8 cl.	1/4 st.
		no.	no.	no.	no.	no.	no.	no.
Rambouillet	Yearling	82		14				
	2-yr.-old	63	4	28	1			
Targhee	Yearling	14		62	1	24		
	2-yr.-old	11		64	4	23		
Columbia	Yearling			8		27	1	12
	2-yr.-old			14		26		8

^{1/} Some fleece weights were not available for some ewes for both years, so these ewes were omitted in this table.

Table XXXVIII. Correlation coefficients of fall yearling weight and two-year-old grease fleece weights

	Rambouillet		Targhee		Columbia		All breeds	
	r	no.	r	no.	r	no.	r	no.
Type 1	.35**	60	.32**	71	.35**	40	.36**	171
Type 2	.46	15	.02	22	.28	3	.24	40
Type 9	.48*	21	.45	10	-.06	6	.43**	37
All types	.41**	96	.26**	103	.23	49		

The correlation of the fall yearling weight of the type 2 ewes, to their two-year-old fleece weights was not as high as the same correlation for the type 1 ewes, as may be seen in Table XXXVIII.

The yearling and two-year-old grease fleece weights of the type 1 ewes were highly correlated. A highly significant correlation existed between the yearling grease fleece weights and the two-year-old grease fleece weights of the type 2 Targhee ewes and the type 9 Rambouillets.

Table XXXIX. Correlation coefficients of yearling and two-year-old grease fleece weights

	Rambouillet		Targhee		Columbia	
	r	no.	r	no.	r	no.
Type 1	.65**	60	.56**	64	.77**	39
Type 2	.45	15	.71**	22	.77	3
Type 9	.54**	21	.18	8	.72	5

Effects of Feed Treatments During First Winter on Growth
of Ewes and Their Two-year-old Production

During the winter of 1949-1950, the purebred ewe lambs and the grade ewe lambs were used in an experiment conducted to determine whether the extraction process, the solvent method compared to the hydraulic method, altered the nutritive value of cottonseed meal. The main difference in the composition of the meal was the ether extractable (crude fat) material.

A total of 583 ewe lambs were divided as equally as possible into two groups by weight and breeding. The two groups were fed equal amounts of a mixed grass hay containing some clover, with a protein content of 5.2 percent. During the last thirty days of the trial, alfalfa hay containing 12.7 percent protein was fed. Sufficient hay was provided to allow the lambs all they would consume without undue waste. In addition to the hay, the lambs in one group were given 1/3 of a pound per head per day of the solvent extracted cottonseed meal pellets; while the lambs in the other group were given the same amount of hydraulic extracted cottonseed meal pellets.

Table XL. Chemical analyses of hydraulic extracted and solvent extracted cottonseed meal

	Dry matter	Protein	Ether extract
	%	%	%
Hydraulic extracted	94.9	43.1	6.6
Solvent extracted	93.4	42.0	1.7

Table XLI. Average body weights and body weight gains of ewes by breed, type of birth, and feed treatment

Type Process	1		2		9		All	
	Hyd.	Sol.	Hyd.	Sol.	Hyd.	Sol.	Hyd.	Sol.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Rambouillet								
Dec. 1	85.7	88.1	83.4	76.2	82.0	82.7	84.5	85.3
Apr. 5	101.5	104.8	100.8	92.5	97.5	100.3	100.6	102.2
Gain	15.8	16.7	17.4	16.3	15.5	17.6	16.1	16.9
Targhee								
Dec. 1	84.6	87.7	80.2	81.5	82.0 ₁ /	81.4	83.5	85.6
Apr. 5	97.8	100.5	96.8	94.7	88.0	99.2	97.3	99.2
Gain	13.2	12.8	16.6	13.2	6.0	17.8	13.8	13.6
Columbia								
Dec. 1	83.0	83.0	88.3	107.0 ₁ /	76.8	79.5	82.7	83.7
Apr. 5	100.4	99.8	105.7	137.0	99.2	96.5	100.8	101.2
Gain	17.4	16.8	17.4	30.0	22.4	17.0	18.1	17.5

The body weights of the ewes as lambs involved in this study of the production of two-year-old ewes are given in Table XL. The body weight gains of the lambs in the two feed groups were similar. The Rambouillet lambs in the group fed hydraulic extracted cottonseed mean gained 16.1

1/ Only one ewe in classification.

pounds during the 125 day period, compared to a 16.9 pound gain in the group receiving the solvent extracted meal.

The group of Targhee lambs receiving hydraulic extracted meal gained 13.8 pounds during the feed period, compared to 13.6 pounds gain in the group receiving the solvent extracted cottonseed meal.

The Columbia lambs in the group receiving hydraulic extracted cottonseed meal gained 18.1 pounds during the 125 day feed period compared to a 17.5 pound gain in the group receiving the solvent extracted cottonseed meal.

Table XLII. Average body weights and body weight gains of ewes by feed treatment and type of birth

Process Type (lamb)	Hydraulic			Solvent		
	1	2	9	1	2	9
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 1	84.6	82.4	80.6	85.8	81.1	81.9
Apr. 5	99.7	99.4	97.3	100.7	96.3	99.5
Gain	15.1	17.0	16.7	14.9	15.2	17.6

The body weight gain of the type 1 lambs in the two feed groups were similar as may be seen in Table XLII. The average weight of the lambs, at the beginning of the trial, did not have a constant effect on the amount of gain in weight during the experiment. The hydraulic extracted cottonseed meal and the solvent extracted meal produced comparable weight gains in ewe lambs when fed at the rate of 1/3 of a pound per head per day with hay.

The average gain of the lambs fed hydraulic extracted meal was 15.7 pounds for the 125 day period compared to 15.4 pounds for the lambs fed the solvent extracted meal.

The Columbia ewe lambs gained the most weight while on the experiment, followed by the Rambouillet ewe lambs, and the Targhee ewe lambs had the lowest weight gains for the feeding period.

The type 2 and type 9 lambs made somewhat better gains during the feeding period than the type 1 lambs. There was no apparent relationship between rate of gain of the types of birth and the methods of processing the cottonseed meal.

Table XLIII. Average body weights and body weight gains of ewes by feed treatment

	Hydraulic process	Solvent process
	lbs.	lbs.
Dec. 1	83.7	84.5
Apr. 5	99.4	99.9
Gain	15.7	15.4

The grease fleece weights of the ewes as yearlings were not materially affected by the feed treatments during the first winter. The Rambouillet ewes fed hydraulic extracted cottonseed meal had grease fleece weights averaging 9.8 pounds, as yearlings, compared to an average grease fleece weight of 9.9 pounds from the ewes that received the meal extracted by the solvent

Table XLIV. Production of the ewes by breed, type of birth and feed treatment

Process Type	Hydraulic			Solvent		
	1	2	9	1	2	9
Rambouillet	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Yrlg. fl. wt.	10.0	9.6	9.4	10.3	9.2	9.1
2-yr. fl. wt.	9.1	9.1	8.7	9.5	8.7	8.6
Lamb born per ewe	11.3	10.8	11.7	10.8	10.5	11.4
Lamb weaned per ewe	71.8	76.4	79.5	76.5	56.0	58.5
Targhee						
Yrlg. fl. wt.	10.2	10.0	10.9 ₁ /	10.2	9.9	10.9
2-yr. fl. wt.	9.4	9.3	11.1	9.4	9.1	9.8
Lamb born per ewe	11.5	11.6	11.0	10.2	11.7	11.0
Lamb weaned per ewe	86.8	84.0	77.0	74.4	91.3	64.1
Columbia						
Yrlg. fl. wt.	11.4	11.6	10.7	11.0	15.4 ₁ /	11.0
2-yr. fl. wt.	10.5	10.0	11.4	10.3	10.3	9.8
Lamb born per ewe	9.3	9.2	11.1	11.3	22.0	15.1
Lamb weaned per ewe	68.0	88.0	88.5	91.0	95.0	93.0

1/ One ewe in these groups.

by the solvent method. The average yearling grease fleece weight of the Targhee ewes fed hydraulic extracted meal during the first winter was 10.2 pounds compared to average grease fleece weights of 10.3 pounds for the group of Targhees fed the solvent extracted meal. The Columbia ewes fed hydraulic extracted meal had yearling grease fleece weights averaging 11.4 pounds and the Columbia ewes fed the solvent extracted meal had an average yearling grease fleece weight of 11.1 pounds.

The feed treatments given the ewes during the first winter did not affect their two-year-old fleece weights. The average two-year-old grease fleece weights of the ewes fed hydraulic extracted meal were: Rambouillet, 9.0 pounds; Targhees, 9.4 pounds; and Columbias, 10.6 pounds. The average grease fleece weights of the ewes, as two-year-olds, that had received the solvent extracted meal were: Rambouillet, 9.2 pounds; Targhee, 9.4 pounds; and Columbia, 10.2 pounds.

The average pounds of lamb born per ewe by breed in the group fed hydraulic extracted meal were: Rambouillet, 11.2 pounds; Targhee, 11.5 pounds; and Columbia, 9.5 pounds. The Rambouillet, Targhee and Columbia ewes fed the solvent extracted meal gave birth to 10.9 pounds, 10.6 pounds and 12.1 pounds of lamb per ewe, respectively.

The average pounds of lamb weaned per ewe in the group fed hydraulic extracted meal were: Rambouillet, 74.3 pounds; Targhee, 85.9 pounds; and Columbia, 72.9 pounds. In the group fed the solvent extracted meal, the Rambouillet ewes weaned 69.9 pounds of lamb per ewe; the Targhees, 76.0 pounds; and the Columbias, 91.4 pounds.

Effects of Feed Treatments During Second Winter
on the Production of the Ewes

The yearling ewes were randomized into four feed groups along with the mature ewes. The first group received alfalfa hay ad libitum with no concentrate supplement until 30 days before lambing. During the last 30 days before lambing, this group of ewes was given $1/2$ of a pound of a 20 percent protein pellet per head per day and hay

The second group of ewes was given alfalfa hay ad libitum supplemented with $1/3$ of a pound of a 20 percent protein pellet per head per day throughout the feeding period.

The third group of ewes was given $1/3$ of a pound of a concentrate pellet consisting of one-half 20 percent protein pellet (the same used in the first two groups) and one-half dehydrated alfalfa per head per day.

The fourth group of ewes was given alfalfa hay ad libitum and $1/3$ of a pound of dehydrated alfalfa pellets per head per day.

The different feed treatments did not have a significant effect on the wool production of the Rambouillet ewes. The fleece weights given in Table XLV shows the average grease fleece weights of the Rambouillet ewes by feed group and type of birth. The ewes in group 1 had average grease fleece weights of 8.6 pounds compared to 9.3 pounds from the ewes of the other three groups. The average grease fleece weights of the type 2 and type 9 ewes were not consistent within groups; however, in the over-all average, disregarding type of birth, the ewes in group 4 showed a slight advantage in average grease fleece weight.

A difference of 1.4 pounds existed between the average grease fleece

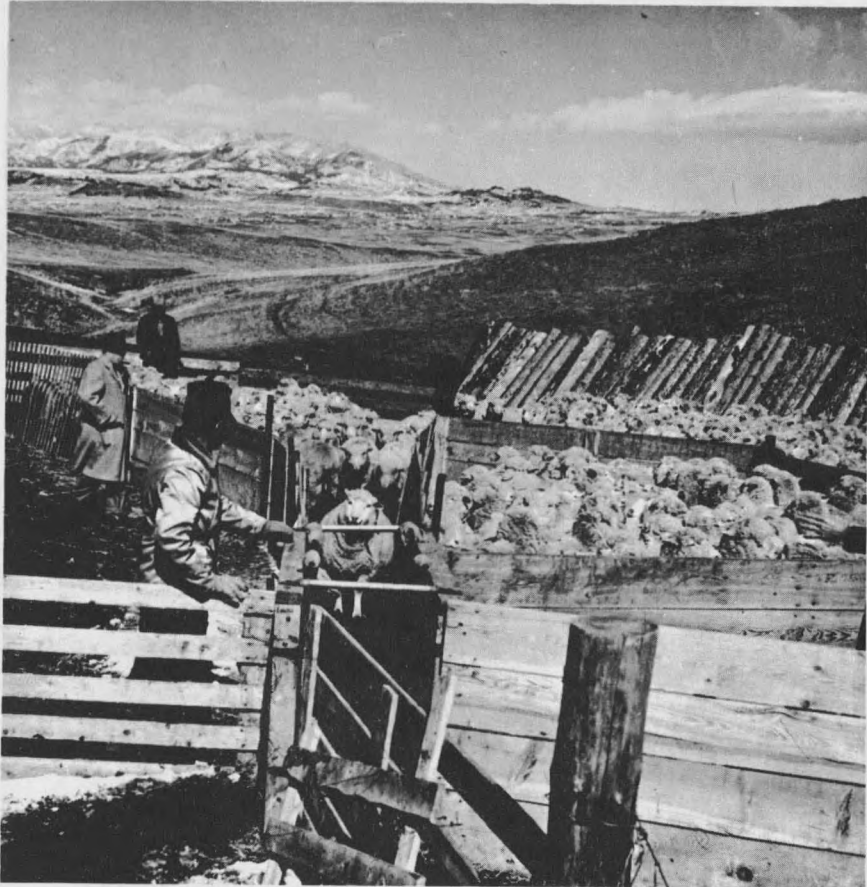


Figure 15. The ewes are separated into their respective feed groups each morning and fed a pelleted concentrate.

Table XLV. Effects of second-winter feed treatments on two-year-old fleece weights

Type	Feed treatments							
	1		2		3		4	
	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes
Rambouillet								
1	8.6	16	9.3	15	9.3	13	9.3	17
2	10.5	1	9.2	5	8.7	6	8.6	3
9	8.8	6	8.0	5	8.5	4	9.4	5
Avg.	8.7		9.0		9.0		9.2	
Targhee								
1	8.5	14	10.0	22	9.4	18	9.5	17
2	8.7	9	9.7	3	9.7	5	9.3	5
9	9.1	3	11.2	2	10.2	2	9.8	3
Avg.	8.6		10.0		9.5		9.5	
Columbia								
1	10.6	11	10.2	9	10.3	8	10.3	12
2	--	--	10.6	2	8.9	1	--	--
9	9.9	2	13.0	2	9.6	2	--	--
Avg.	10.5		10.7		10.1		10.3	

weights of the Targhee ewes in group 1, (8.6 pounds) and the Targhee ewes in group 2 (10.0 pounds). The average grease fleece weights of the Targhee ewes in groups 3 and 4 were the same (9.5 pounds). The difference in the average grease fleece weights of the Targhee ewes in the four groups was highly significant.

The difference in the average grease fleece weights of the Columbia ewes in the four groups was not significant.

The average grease fleece weights of all the ewes in groups 1, 2, 3, and 4 were 9.1 pounds, 9.8 pounds, 9.4 pounds and 9.6 pounds respectively.

The lamb production of the Rambouillet ewes was not significantly affected by the different feed treatments. Of the type 1 ewes in the four groups, the ewes in group 2 gave birth to the most pounds of lamb, 12.3 pounds per ewe. The type 1 ewes in group 3 gave birth to the least pounds of lamb 9.8 pounds per ewe.

The average pounds of lamb born per ewe by the Rambouillet ewes in the four groups were: group 1, 10.9 pounds; group 2, 11.5 pounds; group 3, 10.9 pounds; and group 4, 11.2 pounds. A difference of 0.6 of a pound of lamb per ewe existed between the highest producing and lowest producing groups.

The type 1 Targhee ewes had less variation in average pounds of lamb born per ewe between groups than the Rambouillet ewes. The type 1, 2 and 9 Targhee ewes in group 3 had consistently lower average pounds of lamb born per ewe than the comparable types in the other feed groups. The pounds of lamb born per ewe in group 3 was 9.7 pounds compared to 11.8 pounds born per ewe in group 4, the highest producing group of Targhee ewes. The

Table XLVI. Pounds of lamb born per ewe by breed, type of birth of ewe and second-winter feed treatment

Type	Feed treatments							
	1		2		3		4	
	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes
Rambouillet								
1	11.0	17	12.3	15	9.8	14	10.9	17
2	11.6	1	10.2	6	12.0	6	10.9	3
9	10.4	6	10.7	5	13.2	4	12.3	5
Avg.	10.9		11.5		10.9		11.2	
Targhee								
1	11.0	16	11.5	22	10.1	19	11.4	18
2	12.9	9	10.3	3	9.1	5	12.4	6
9	10.7	3	11.4	2	8.1	2	12.9	3
Avg.	11.6		11.3		9.7		11.8	
Columbia								
1	10.2	11	11.5	10	9.5	8	10.5	13
2	--	--	15.0	2	9.8	2	--	--
9	12.0	2	10.2	2	15.1	2	--	--
Avg.	10.5		11.8		10.5		10.5	

difference in average pounds of lamb born per ewe in the four groups was not significant.

The type 1 Columbia ewes had more variation in average pounds of lamb born per ewe between the groups than the type 1 Targhee ewes, but less than the type 1 Rambouillet ewes. The type 1 Columbia ewes in group 3 had the lowest pounds of lamb born per ewe of the four groups. The difference between groups in pounds of lamb born per ewe to the type 1 ewes was not significant. A significant difference existed in the average pounds of lamb born per ewe to the type 9 Columbia ewes between the three groups that have this type classification. The type 9 Columbia ewes in group 3 gave birth to an average of 15.1 pounds of lamb per ewe compared to 10.2 pounds of lamb born per ewe in group 2.

Although the difference in average pounds of lamb born per ewe between groups to the type 1 ewes of the three breeds was not significant, it may be noted that all type 1 ewes in group 3 consistently gave birth to less pounds of lamb per ewe than comparable ewes in the other feed treatments. The type 1 ewes in group 2 gave birth to more pounds of lamb per ewe than the ewes of the same type in the other three feed groups.

The average pounds of lamb born per ewe by the type 2 and type 9 ewes were not consistently high nor low in any of the four feed treatments.

The pounds of lamb weaned per ewe by the Rambouillet type 1 ewes varied from 69.8 pounds in group 1 to 78.4 pounds in group 4, a difference of 8.6 pounds. The difference between the four treatments was not significant, however. When the three types of birth were included, the pounds of

Table XLVII. Pounds of lamb weaned per ewe by type of birth
of ewe and second-winter feed treatment

Type	Feed treatments							
	1		2		3		4	
	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes
Rambouillet								
1	69.8	16	73.5	15	75.7	14	78.4	17
2	0.0	1	80.2	6	63.2	6	80.0	3
9	70.0	7	46.0	5	70.0	4	87.8	5
Avg.	66.9		69.7		71.6		80.5	
Targhee								
1	79.2	16	87.3	22	74.1	19	77.9	17
2	94.4	9	59.7	3	71.2	5	104.5	6
9	31.0	3	64.0	2	72.0	2	101.5	4
Avg.	79.0		82.5		73.4		87.3	
Columbia								
1	88.4	11	72.1	10	86.5	8	79.9	13
2	--	--	83.5	2	96.0	2	--	--
9	103.0	2	87.5	2	79.5	2	--	--
Avg.	90.6		75.9		86.9		79.9	

lamb weaned per ewe in group 1 remained the lowest, 66.9 pounds, and group 4 remained the highest, 80.5 pounds, weaned per ewe. The difference of 13.6 pounds weaned per ewe between the lowest producing group and the highest producing group was not significant. The difference in the average pounds of lamb weaned per ewe between the four feed treatments was not significant.

A difference of 13.2 pounds weaned per ewe existed between the lowest producing group of type 1 Targhee ewes (group 3) and the highest producing group of type 1 Targhee ewes (group 2). When the three types of ewes within a feed treatment were combined, the ewes in group 4 weaned the most pounds of lamb per ewe (87.3 pounds) and the ewes in group 3 produced the least pounds of lamb per ewe (73.4 pounds), a difference of 13.9 pounds. The difference in average pounds of lamb weaned per ewe between the four treatments was not significant. The difference between the highest producing group (4) and the lowest producing group (3) was not significant.

The type 1 Columbia ewes in group 1 produced 88.4 pounds of lamb per ewe, 16.3 pounds more per ewe than the type 1 ewes in group 2. When the three types of ewes within groups were combined, group 1 remained the highest in production and group 2 the lowest. The differences in the average pounds of lamb weaned per ewe by the type 1 ewes in the four groups was not significant. The same was true when the types within a group were combined. The difference of 14.7 pounds, between the lowest and the highest producing groups was not significant.

The ewes of the three breeds in group 1 weaned an average of 76.8 pounds of lamb per ewe; the ewes in group 2, 76.1 pounds per ewe; the

Table XLVIII. Average weaning weight of lambs by their type of birth and the second-winter feed treatment of the ewes

Type	Feed treatments							
	1		2		3		4	
	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes	lbs.	no. ewes
Rambouillet								
1	80.5	19	86.1	16	88.7	16	83.8	24
2	--	--	67.5	4	71.0	2	--	--
9	77.0	1	83.5	2	79.0	2	--	--
Avg.	80.3		82.4		86.0		83.8	
Targhee								
1	87.1	18	86.4	22	82.4	21	88.6	17
2	75.2	4	82.0	4	88.5	2	71.8	8
9	85.5	4	--	--	--	--	77.0	1
Avg.	85.0		85.7		83.0		83.0	
Columbia								
1	90.6	13	87.3	10	90.8	9	86.3	9
2	--	--	--	--	73.5	2	79.0	2
9	--	--	95.0	2	79.0	1	102.0	1
Avg.	90.6		88.6		86.9		86.6	

ewes in group 3, 75.3 pounds of lamb per ewe; and the ewes in group 4, 83.2 pounds of lamb per ewe. The difference in the average pounds of lamb weaned per ewe between the four groups was not significant. The difference of 7.9 pounds between groups 3 and 4, the lowest and highest producing groups, was not significant.

The average weaning weights of the lambs were not consistently high, nor consistently low in any of the four feed treatments. The heaviest Rambouillet lambs, at weaning, were in group 3, the lightest in group 1. The Targhee lambs in group 2 were heaviest at weaning of the four groups of Targhee lambs, and the lambs in group 3 and 4 had the lowest average weaning weights.

The heaviest Columbia lambs were in group 1 and the lightest in group 4.

There was no significant difference in the average weaning weights of the type 1 lambs within the three breeds, between the four feed treatments.

The average weaning weight of all type 1 lambs in group 1 was 85.5 pounds; group 2, 86.5 pounds; group 3, 86.2 pounds; and group 4, 85.9 pounds. There was no significant difference in average weaning weights of the type 1 lambs between groups.

The average weaning weight of all lambs in group 1 was 84.7 pounds; group 2, 85.1 pounds; group 3, 84.9 pounds; and group 4, 84.0 pounds.

Two-year-old Lamb Production of Ewes
Born in 1950

The weaning weights of the lambs born to the two-year-old ewes in 1952 are summarized in Tables IL, L and LI.

The type 1 lambs weaned from the ewes in the 6000 line were the heaviest of this type in the six Rambouillet lines. The type 1 lambs weaned from the ewes in the 8000 line were the lightest of this type in the Rambouillet lines. In 1951, the two-year-old ewes in the 8000 line weaned the heaviest type 1 lambs and the ewes in the 6000 line weaned almost the lightest type 1 lambs.

The two-year-old ewes in the 7000 line weaned the most pounds of lamb per ewe of the six Rambouillet lines in 1951 and 1952.

In 1951, the two-year-old Rambouillet ewes weaned 72.2 pounds of lamb per ewe, 3.3 pounds more per ewe than the two-year-old ewes in 1952. The average weight of lambs weaned from the two-year-old ewes in 1952 were lower than the average weight of the lambs weaned from the two-year-old ewes in 1951. The two-year-old ewes lambing in 1952 gave birth to more twin lambs than the two-year-old ewes lambing in 1951.

The heaviest type 1 Targhee lambs were weaned from the two-year-old ewes in the 6 line, both in 1951 and in 1952. In 1951 the two-year-old Targhee ewes in the 2 line weaned the lightest type 1 lambs and in 1952 the ewes in the 8 line weaned the lightest type 1 lambs.

In 1952, the two-year-old ewes in the 6 line weaned more pounds of lamb per ewe than the ewes in the other Targhee lines. This was partly due

Table II. Two-year-old lamb production of Rambouillet ewes born in 1950

	2000	3000	5000	6000	7000	8000
Average weaning weight, lbs.	74.4	78.1	82.1	80.8	73.9	77.0
Pounds weaned per ewe	55.8	69.4	76.2	64.6	83.1	66.0
Average weaning wt., type 1, lbs.	81.6	81.5	81.9	86.7	83.0	77.0
Average weaning wt., type 2, lbs.	65.5	68.0	--	63.0	65.5	--
Average weaning wt. type 9, lbs.	--	--	84.0	--	72.0	--
Number ewes	12	9	14	10	8	7
No. ewes with lambs born, not weaned	4	2	1	2	--	1
No. multiple births	3	2	1	1	5	1
No. single births	8	7	13	8	3	6
No. dry ewes	1	--	--	1	--	--

to the greater number of multiple births from the ewes in the 6 line, as may be seen in Table II.

The two-year-old Targhee ewes in the 0 line weaned 64.3 pounds of lamb per ewe in 1952, compared to 104.1 pounds of lamb weaned per ewe by the ewes in the 6 line, a difference of 39.8 pounds per ewe between the lightest producing line and the heaviest producing line.

The average pounds of lamb weaned per ewe by the Targhee two-year-old

Table L. Two-year-old lamb production of Targhee ewes born in 1950

	0	2	6	8 ¹ / ₂
Average weaning weight, lbs.	78.6	80.8	77.0	85.5
Pounds weaned per ewe	64.3	80.8	104.1	78.4
Average weaning wt., type 1, lbs.	80.9	87.2	91.2	87.9
Average weaning wt., type 2, lbs.	59.5	61.5	74.4	78.0
Average weaning wt., type 9, lbs.	82.0	--	65.0	85.0
Number ewes	22	16	17	12
No. ewes with lambs born, not weaned	4	--	3	2
No. multiple births	2	2	10	3
No. single births	19	12	7	9
No. dry ewes	1	2	--	--

ewes in 1951 were 80.6 pounds, and the average pounds of lamb weaned per ewe by the Targhee two-year-old ewes in 1952 were 80.9 pounds, a difference of 0.3 of a pound of lamb per ewe.

The type 1 lambs weaned from the two-year-old ewes in 1951 and the type 1 lambs weaned from the two-year-old ewes in 1952 in the Columbia 4 line were the heaviest type 1 lambs in their respective years. The

¹/₂ The 4 and 8 lines were combined in 1950.

Table LI. Two-year-old lamb production of Columbia ewes born in 1950

	0	2	4	4L ₁ /
Average weaning weight, lbs.	74.3	80.6	79.2	74.7
Pounds weaned per ewe	74.3	92.1	79.2	61.6
Average weaning wt., type 1, lbs.	79.4	86.8	90.5	75.9
Average weaning wt., type 2, lbs.	61.8	62.0	68.0	65.8
Average weaning wt., type 9, lbs.	73.0	--	--	73.4
Number ewes	15	7	4	57
No. ewes with lambs born, not weaned	2	--	--	10
No. multiple births	3	1	1	10
No. single births	12	6	2	45
No. dry ewes	--	--	1	2

two-year-old Columbia ewes in the 0 line weaned the lightest type 1 lambs in 1951, and the two-year-old ewes in the 4L line weaned the lightest type 1 lambs in 1952. The two-year-old ewes in the 4L line gave birth to a greater percentage of twin lambs in 1952, than did the two-year-old ewes in the same line in 1951. The average weaning weights of the three types of lambs within the line were approximately ten pounds lighter in 1952 than in 1951.

1/ The 4L line is the same as the 4K line (letter designates age).

SUMMARY

The purpose of the investigation of these data was to explore possibilities of relationships existing between the body weights of the ewes during their early life and their subsequent lamb and wool production as two-year-olds to enhance selection techniques. The effects of environmental influences, such as type of birth and age at weaning, on the growth of ewe lambs and their production as two-year-olds were studied.

The growth of two hundred and fifty-nine ewes was measured from birth to twenty three months of age by body weights taken at irregular intervals during the period. Records of the individual lamb and wool production of these ewes were tabulated with the body weights.

In this selected group of ewes, relatively little difference was found in the body weights of the Rambouillet and Targhee ewes from birth to twenty-three months of age. The Columbia ewes were somewhat heavier during the period than the Rambouillet and Targhee ewes. The greatest difference in weights of the three breeds occurred at fall yearling age, about sixteen and one-half months. The Rambouillet ewes weighed 121.3 pounds; the Targhee ewes, 125.7 pounds; and the Columbia ewes, 128.0 pounds.

The environmental effect of type of birth on body weights was more pronounced at weaning time than at fall yearling age. The twin-born lambs were somewhat lighter at fall yearling age than the single-born lambs. The lambs born twin and raised single were lighter at fall yearling age than the lambs raised as twins.

A highly significant difference existed between the birth weights of

the single and the twin-born lambs produced by the two-year-old ewes in each of the three breeds. There was no significant difference in the birth weights of the Rambouillet, Targhee and Columbia lambs. There was a highly significant difference in birth weights among lines of Rambouillet lambs born to the two-year-old ewes. The difference in birth weights of lambs born among the Targhee lines and among the Columbia lines was not significant.

The type of birth of the ewes did not significantly affect the pounds of lamb born per ewe as two-year-olds. A significant correlation existed between the birth weights of the Rambouillet ewes and the pounds of lamb born per ewe as two-year-olds ($r=.24^*$). It appeared that as the breeding of the ewes tends toward the dual purpose type, Targhees and Columbias, this relationship was lost.

The birth weights and the weaning weights of the single-born lambs were significantly correlated (Rambouillets, $r=.30^{**}$; Targhees, $r=.46^{**}$; Columbias, $r=.48^{**}$). The lambs which were heavier at birth were also heavier at weaning. This was true with both the ewes, as lambs, and the lambs they produced as two-year-olds. It was also found that a highly significant correlation existed between the birth weight of the single-born ewes and their weight at fall yearling age (Rambouillet, $r=.36^{**}$; Targhee, $r=.57^{**}$; Columbia, $r=.47^{**}$).

The single-born ram lambs were heavier at birth and weaning than the ewe lambs. The ram lambs born and raised as twins, and the ram lambs born twin and raised as singles were not consistently heavier at birth and

weaning than the ewe lambs of the same types.

The late single-born lambs were consistently heavier at birth than the early single-born lambs. This difference was highly significant for the Targhee lambs but was not significant for Rambouillet and Columbia lambs. At weaning time, the early single-born lambs were consistently heavier than the late single-born lambs. The early single-born Rambouillet lambs were significantly heavier at weaning than the late single-born lambs. The difference in weaning weight of the early single-born and the late single-born Targhee and Columbia lambs was not significant. The average daily gain of the early and late born lambs within breeds was similar from birth to weaning.

When the two-year-old dams were divided into early single-born and late single-born groups, the relationship of the groups was much the same as the lambs, as far as birth weights and weaning weights were concerned.

The lambs born to the two-year-old ewes made greater average daily gains from birth to weaning than did their dams. No correction was made for sex of the lambs, however. It is felt that most of this difference in average daily gain was due to better feeding and management at lambing time.

In purebred lines where two sires were used, the birth weights and weaning weights of the lambs expressed differences as a result of sire influence. These varied from minor differences to differences of 11.6 pounds at weaning time. Greater differences existed in lines having four lambs or less of the same type of birth from each ram. The number of lines in which two sires were used was limited, however.

Type of birth had a significant effect on the weaning weights of the Rambouillet and Columbia lambs born to the two-year-old ewes. The Rambouillet single-born, the twin-born and the twin-born, single-raised lambs weighed 86.0 pounds, 79.0 pounds and 83.8 pounds respectively. The Columbia single-born, the twin-born and the twin-born, single raised lambs weighed 89.0 pounds, 76.2 pounds, and 92.8 pounds respectively. The type of birth did not significantly affect the weaning weights of the Targhee lambs. The type of birth of the Rambouillet and Targhee ewes had a significant effect on their weaning weights. Highly significant correlations existed between the weaning weight and the fall yearling weights of the ewes. The pounds of lamb weaned per ewe were not significantly affected by the type of birth of the ewe or by the breed line of the ewe.

The correlation of the weaning weights of the ewes and the pounds of lamb weaned per ewe as two-year-olds was not significant; however, the correlation coefficients were positive and in some cases approaching significance (Rambouillet, $r=.11$; Targhee, $r=.05$; Columbia, $r=.24$).

The body weights of the ewes as fall yearlings was more closely related to the pounds of lamb weaned per ewe than was their weaning weight (Rambouillet, $r=.14$; Targhee, $r=.23^*$; Columbia, $r=.14$).

The weaning weights of the ewes and their yearling fleece weights were significantly correlated (Rambouillet, $r=.76^{**}$; Targhee, $r=.40^{**}$; Columbia, $r=.66^{**}$) and the fall yearling weights of the single-born ewes were significantly correlated to their two-year-old fleece weights (Rambouillet, $r=.40^{**}$; Targhee, $r=.12^*$; Columbia, $r=.39^{**}$).

The difference between the yearling and two-year-old fleece weights of the ewes were significant, the yearling fleece weights being the heaviest.

The ewes were divided into two groups during their first winter and fed cottonseed meal extracted by solvent or hydraulic processes. The feed treatments did not materially affect the growth, lamb production, yearling fleece weights or two-year-old fleece weights of the ewes when one group was compared to the other.

During the second winter the ewes were divided into four groups. Group 1 received no concentrate until 30 days before lambing. The ewes in this group were given 1/2 of a pound of 20% protein pellet per head per day during the 30 days prior to lambing. Group 2 received 1/3 of a pound of 20% protein pellet per head per day throughout the experiment. Group 3 was fed 1/3 of a pound of a pellet consisting of one-half dehydrated alfalfa and one-half 20% protein concentrate per head per day throughout the experiment. Group 4 was fed 1/3 of a pound of pelleted dehydrated alfalfa per head per day throughout the experiment. All four groups were fed good quality alfalfa hay ad libitum.

The feed treatments did not significantly affect the pounds of lamb born per ewe or the pounds of lamb weaned per ewe. The treatments did not affect the grease wool production of the Rambouillet and Columbia ewes. There was a significant difference in the average grease fleece weights of the Targhee ewes between the four different groups.

CONCLUSIONS

It is evident from this study that genetically valuable breeding stock may be lost if precautions are not taken to adjust for environmental conditions affecting the size of ewe lambs when replacements are selected at weaning time. The selection of larger ewes at fall yearling age is a more reliable method of obtaining higher production than the selection of larger ewes at weaning time.

The effects of type of birth and age at weaning on the body weights of ewes was less pronounced at fall yearling age than at weaning age.

The correlation coefficients of the fall yearling weights of the ewes and the pounds of lamb weaned per ewe were generally positive and in some cases significant.

The type of birth of the ewe did not significantly affect the pounds of lamb born or weaned per ewe at first lambing.

A significant correlation existed between the birth weights of the Rambouillet ewes and the pounds of lamb born per ewe at first lambing. No significant correlation was found between the birth weights of the Targhee and Columbia ewes and the pounds of lamb born to them at first lambing.

The weaning weight of the ewes and their yearling grease fleece weights were significantly correlated. The weaning weights and the fall yearling weights of the single-born ewes were significantly correlated to their two-year-old grease fleece weights.

The correlation coefficients of the birth weight and weaning weights

and also the correlation coefficients of the birth weights and fall yearling weights of the single-born ewes were highly significant. The correlation coefficients of the birth weights and weaning weights of the single-born lambs the ewes produced as two-year-olds were also highly significant.

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APPENDIX

Appendix Table I. The effects of sires on the growth of Rambouillet ewes from birth to fall yearling age by type of birth of the ewes

Line	Sire code	Type	No. lambs	Birth wt.	Wt. at 4 1/2 months	Wt. at 16 1/2 months
				lbs.	lbs.	lbs.
2000	1	1	9	10.8	72.2	120.9
		2	5	8.0	59.8	115.8
		9	1	6.2	68.0	114.0
3000	2	1	1	10.4	83.0	123.0
		3	1	9.0	77.0	112.0
	3	2	1	9.8	67.0	131.0
		9	1	8.0	68.0	106.0
		4	1	2	10.3	64.5
	5	9	3	8.5	71.3	127.0
		1	1	13.0	75.0	135.0
5000	2	1	4	9.4	73.5	123.5
		7	1	10.3	75.0	126.8
	7	2	3	9.8	74.3	134.0
		9	3	8.6	71.3	125.0
		8	1	18	10.0	73.3
	8	2	4	8.1	58.5	112.8
		9	4	8.0	71.5	118.5
6000	9	1	8	11.1	75.9	125.1
		2	2	8.0	69.0	115.5
		9	6	9.2	68.5	120.0
7000	10	1	7	9.7	76.4	127.4
		2	1	9.2	62.0	115.0
		9	2	7.2	57.5	110.5
8000	11	1	3	12.3	74.3	128.0
		12	1	11.9	79.3	121.7
	9	1	11.2	52.0	112.0	

Appendix Table II. The effects of sires on the growth of Targhee ewes from birth to fall yearling age by type of birth of the ewes

Line	Sire code	Type	No. lambs	Birth wt.	Wt. at 4 1/2 months	Wt. at 16 1/2 months
				lbs.	lbs.	lbs.
0	20	2	2	8.9	70.0	125.5
		9	1	8.8	77.0	130.0
	21	1	11	8.5	68.9	119.2
		2	3	8.1	43.0	128.3
		9	2	7.4	69.0	116.0
	23	1	1	10.6	72.0	132.0
		2	3	7.6	69.0	120.0
	99	1	1	10.3	--	117.0
		9	1	9.4	--	117.0
2	24	1	7	9.5	73.9	125.0
		2	1	7.0	68.0	124.0
		9	2	8.6	69.5	124.0
	99	1	14	10.4	71.7	124.5
		2	3	8.4	65.5	118.0
		9	1	6.7	67.0	113.0
4	16	1	6	9.3	77.2	130.2
		2	1	8.5	67.0	131.0
	17	1	2	10.5	75.5	126.0
		2	1	7.6	64.0	111.0
		9	1	8.3	75.0	110.0
	18	1	3	8.3	74.7	121.3
		2	1	11.0	69.0	123.0
	19	1	2	8.9	68.5	129.0
	99	1	1	7.5	--	127.0
		9	1	9.5	--	144.0
6	22	1	7	10.2	75.9	134.6
		2	5	8.8	71.0	127.6
		9	1	6.6	59.0	109.0
8	25	1	20	10.6	76.5	130.0
		2	3	9.1	72.7	132.0

Appendix Table III. The effects of sires on the growth of Columbia ewes from birth to fall yearling age by type of birth of the ewes

Line	Sire code	Type	No. lambs	Birth	Wt. at 4 1/2	Wt. at 16 1/2
				wt.	months	months
				lbs.	lbs.	lbs.
0	13	1	4	10.8	81.2	136.2
		2	1	8.6	64.0	118.0
2	14	1	6	10.1	81.7	133.2
		9	1	5.6	67.0	130.0
	15	1	2	10.2	70.5	121.5
4	26	1	2	10.6	85.5	126.0
		2	1	9.5	79.0	147.0
	27	1	1	9.5	--	133.0
4K	99	1	27	9.3	73.3	124.9
		2	2	8.8	81.5	146.5
		9	5	8.4	70.6	125.0

Appendix Table IV. Analysis of variance--birth weight of Rambouillet Targhee and Columbia lambs by their line and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between lines	5	9.81	4.42**	2.30	3.20
Within lines	98	2.22			
Total	103				
Between types	1	87.99	49.99**	3.94	6.90
Within types	102	1.76			
Total	103				
<u>Targhee</u>					
Between lines	4	1.80	.53	2.46	3.51
Within lines	111	3.37			
Total	115				
Between types	1	114.59	48.97**	3.92	6.84
Within types	114	2.34			
Total	115				
<u>Columbia</u>					
Between lines	3	4.13	1.64	2.79	4.20
Within lines	52	2.51			
Total	55				
Between types	1	19.20	8.38**	4.02	7.12
Within types	54	2.29			
Total	55				
<u>All breeds</u>					
Between breeds	2	7.40	2.53	3.04	4.71
Within breeds	271	2.92			
Total	273				

Appendix Table V. Analysis of variance--birth weight of Rambouillet, Targhee and Columbia lambs by line and type of birth of ewe

Source of variation	Degrees of freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between lines	5	22.20	2.15	2.30	3.20
Within lines	94	10.33			
Total	99				
Between types	2	5.36	.49	3.09	4.82
Within types	97	11.04			
Total	99				
<u>Targhee</u>					
Between lines	4	15.28	.87	2.46	3.51
Within lines	104	17.62			
Total	108				
Between types	2	4.38	.25	3.09	4.82
Within types	106	17.78			
Total	108				
<u>Columbia</u>					
Between lines	3	3.77	.23	2.79	4.20
Within lines	49	16.70			
Total	52				
Between types	2	14.76	.92	3.18	5.06
Within types	50	16.00			
Total	52				
<u>All breeds</u>					
Between breeds	2	.90	.06	3.04	4.71
Within breeds	257	14.81			
Total	259				

Appendix Table VI. Correlation coefficients--birth weight of
Rambouillet, Targhee and Columbia ewes and pounds of
lamb born per ewe by type of birth of ewe 1/

Rambouillet	2000	3000	5000	6000	7000	8000	All lines
	r	r	r	r	r	r	r
Type 1	.696*	-.431	.142	.405	.190	.097	.246
Type 2	.331	--	.958**	--	--	--	.636**
Type 9	--	.716	.400	.630	--	--	.357*
All Rambouillets							r=.239*
Targhee	0	2	4	6	8		All lines
Type 1	-.291	-.029	.603*	.693*	-.161		.026
Type 2	.110	-.644	--	.183	--		.091
Type 9	.640	--	--	--	--		.497
All Targhees							r=.056
Columbia	0	2	4	4K			All lines
Type 1	--	-.025	--	-.226			-.051
Type 2	--	--	--	--			.465
Type 9	--	--	--	.587			.382
All Columbias							r=-.047

1/ Correlations were not made when there were three or less ewes in the group.

Appendix Table VII. Correlation coefficients -- birth weights and weaning weights of lambs (Rambouillet and Targhee) by time of birth and lines. 1/

Rambouillet	Early		Late		All	
	r	No. ewes	r	No. ewes	r	No. ewes
2000	.693	6	.320	6	.451	12
3000	.945**	4	--	1	.920**	5
5000	.411	16	.338	17	.181	33
6000	.310	7	.370	4	.335	11
7000	.999**	3	.340	5	.830**	8
8000	.503	3	-.224	3	-.063	6
All	.315*	39	.381*	36	.304**	75
Targhee						
0	.605*	12	.377	9	.382	21
2	.127	9	.652*	12	.475*	21
4	.681	5	.965**	6	.653*	11
6	--	2	.638	9	.593	11
8	.328	6	.583	8	.609	14
All	.512**	34	.541**	44	.455**	78

1/ Lambs born and raised as singles.

Appendix Table VIII. Correlation coefficients--birth weights and weaning weights of ewes (Rambouillet and Targhee) by time of birth and lines 1/

Rambouillet	Early		Late		All	
	r	No. ewes	r	No. ewes	r	No. ewes
2000	.646	4	.590	5	.392	9
3000	--	2	.833	3	.106	5
5000	.578**	18	.171	9	.517**	27
6000	.149	6	--	2	.652*	8
7000	.268	3	.850*	4	.549	7
8000	--	2	.719	4	.782*	6
				All lines	.453**	62
Targhee						
0	.616	5	.742*	7	.629*	12
2	.460	5	.493	13	.438	18
4	-.722	5	.895**	7	.006	12
6	.991**	3	.927**	4	.926**	7
8	.797**	8	.804**	11	.728**	19
				All lines	.600**	68

1/ Ewes born and raised as singles only.

Appendix Table IX. Correlation coefficients--birth weights and fall yearling weights of ewes (Rambouillet and Targhee) by time of birth and lines 1/

Rambouillet	Early		Late		All	
	r	No. ewes	r	No. ewes	r	No. ewes
2000	.815*	4	.050	5	.128	9
3000	--	2	.676	3	.640	5
5000	.379	18	-.202	9	.225	27
6000	.238	6	--	2	.622	8
7000	.807	3	.681	4	.568	7
8000	--	2	.651	4	.638	6
				All lines	.360**	62
Targhee						
0	.047	5	.349	8	.119	13
2	.228	5	.724**	16	.645**	21
4	.180	6	.739*	8	.438	14
6	.963**	3	.819*	4	.868**	7
8	.762*	8	.585*	12	.634**	20
				All lines	.573**	75

1/ Ewes born and raised as singles only.

Appendix Table X. The effect of birth dates on birth weight and weaning weight of Rambouillet lambs 1/

Line	Time of birth	Birth weight	Weaning weight	No. ewes
		lbs.	lbs.	
2000	Early	11.6	91.8	6
	Late	11.4	81.3	6
3000	Early	10.6	84.0	4
	Late	13.0	88.0	1
5000	Early	10.0	87.3	16
	Late	11.0	78.4	17
6000	Early	11.5	82.6	7
	Late	11.9	83.2	4
7000	Early	11.7	90.3	3
	Late	10.5	84.0	5
8000	Early	10.7	92.3	3
	Late	13.7	88.7	3
All	Early	10.8	86.9	39
	Late	11.4	81.3	36

1/ Lambs born and raised as singles.

Appendix Table XI. The effect of birth dates on birth weight and weaning weight of Targhee lambs 1/

Line	Time of birth	Birth weight	Weaning weight	No. ewes
		lbs.	lbs.	
0	Early	10.3	87.9	12
	Late	11.2	83.8	9
2	Early	10.4	83.9	9
	Late	11.4	83.8	12
4	Early	11.6	93.8	5
	Late	12.1	80.0	6
6	Early	11.6	97.5	2
	Late	11.5	87.1	9
8	Early	10.4	82.7	6
	Late	11.8	88.9	8
All	Early	10.6	87.4	34
	Late	11.5	84.9	44

1/ Lambs born and raised as singles.

Appendix Table XII. The effect of birth dates on birth weight, weaning weight and fall yearling weight of Rambouillet ewes 1/

Line	Time of birth	Birth weight	Weaning weight	Fall yearling	No. ewes
		lbs.	lbs.	lbs.	
2000	Early	10.5	77.5	124.5	6
	Late	11.0	68.0	118.0	6
3000	Early	9.7	80.0	117.5	2
	Late	11.2	68.0	117.7	3
5000	Early	10.1	74.1	121.8	18
	Late	9.8	72.8	120.7	9
6000	Early	12.0	78.7	129.8	6
	Late	8.2	67.5	111.0	2
7000	Early	9.5	78.7	126.7	3
	Late	9.8	74.8	128.0	4
8000	Early	13.0	80.5	128.5	2
	Late	11.7	75.0	123.0	4
All	Early	10.5	76.4	124.1	35
	Late	10.3	71.6	120.6	27

1/ Ewes born and raised as singles.

Appendix Table XIII. The effect of birth dates on birth weight, weaning weight and fall yearling weight of Targhee ewes 1/

Line	Time of birth	Birth weight	Weaning weight	Fall yearling	No. ewes
		lbs.	lbs.	lbs.	
0	Early	8.5	69.8	123.6	5
	Late	9.3	68.7	117.8	7
2	Early	8.8	73.8	121.8	5
	Late	10.5	74.4	127.1	13
4	Early	8.4	79.6	127.5	5
	Late	9.6	71.4	127.1	7
6	Early	10.1	72.7	132.7	3
	Late	10.3	78.2	136.0	4
8	Early	10.3	80.2	131.0	8
	Late	10.8	73.7	129.4	11
All	Early	9.2	76.0	127.3	26
	Late	10.2	73.1	126.4	42

1/ Ewes born and raised as singles.

Appendix Table XIV. Analysis of variance--birth weight of early and late single born Rambouillet and Targhee lambs

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between ages	1	6.95	2.76	3.98	7.01
Within ages	74	2.52			
Total	75				
<u>Targhee</u>					
Between ages	1	16.58	7.97**	3.96	6.96
Within ages	77	2.08			
Total	78				

Analysis of variance--weaning weight of early and late single born Rambouillet and Targhee lambs

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between ages	1	703.52	6.58*	3.98	7.01
Within ages	74	106.85			
Total	75				
<u>Targhee</u>					
Between ages	1	116.72	.10	3.96	6.96
Within ages	77	118.11			
Total	78				

Appendix Table XV. Analysis of variance--birth weight, weaning weight and fall yearling weight of early and late single born Rambouillet ewes

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Birth weight</u>					
Between ages	1	.54	.18	4.00	7.08
Within ages	61	2.93			
Total	62				
<u>Weaning weight</u>					
Between ages	1	348.08	5.56*	4.00	7.08
Within ages	61	62.60			
Total	62				
<u>Fall yearling weight</u>					
Between ages	1	186.88	1.97	4.00	7.08
Within ages	61	94.83			
Total	62				

Appendix Table XVI. Analysis of variance--birth weight, weaning weight and fall yearling weight of early and late single born Targhee ewes

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Birth weight</u>					
Between ages	1	16.10	4.55*	3.98	7.01
Within ages	74	3.54			
Total	75				
<u>Weaning weight</u>					
Between ages	1	131.10	1.78	3.98	7.01
Within ages	67	73.60			
Total	68				
<u>Fall yearling weight</u>					
Between ages	1	16.57	.12	3.98	7.01
Within ages	74	134.12			
Total	75				

Appendix Table XVII. Analysis of variance--birth weight and weaning weight of early and late single born Columbia lambs

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Birth weight</u>					
Between ages	1	.73	.26	4.10	7.35
Within ages	39	2.79			
Total	40				
<u>Weaning weight</u>					
Between ages	1	229.57	2.57	4.10	7.35
Within ages	39	89.22			
Total	40				

Appendix Table XVIII. Analysis of Variance--birth weight, weaning weight and fall yearling weight of early and late single born Columbia ewes

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Birth weight</u>					
Between ages	1	1.17	.38	4.08	7.31
Within ages	41	3.07			
Total	42				
<u>Weaning weight</u>					
Between ages	1	152.00	1.49	4.08	7.31
Within ages	40	102.09			
Total	41				
<u>Fall yearling weight</u>					
Between ages	1	53.68	.43	4.08	7.31
Within ages	41	124.96			
Total	42				

Appendix Table XIX. Number of Rambouillet lambs
with weights by line and type of birth

Line	Age months	Type 1 No.	Type 2 No.	Type 9 No.	Total No.
2000	Birth	14	--	2	16
	2 1/2	13	--	1	14
	4 1/2	12	--	1	13
3000	Birth	7	2	4	13
	2 1/2	5	2	2	9
	4 1/2	5	2	2	9
5000	Birth	36	4	--	40
	2 1/2	33	4	--	37
	4 1/2	33	4	--	37
6000	Birth	14	--	2	16
	2 1/2	11	--	1	12
	4 1/2	11	--	1	12
7000	Birth	9	--	2	11
	2 1/2	8	--	1	9
	4 1/2	8	--	1	9
8000	Birth	7	--	--	7
	2 1/2	6	--	--	6
	4 1/2	6	--	--	6
Total	Birth	87	6	10	103
	2 1/2	76	6	5	87
	4 1/2	75	6	5	86

Appendix Table XX. Number of Targhee lambs with weights
by line and type of birth

Line	Age months	Type 1 No.	Type 2 No.	Type 9 No.	Total No.
0	Birth	22	--	2	24
	2 1/2	21	--	1	22
	4 1/2	21	--	1	22
2	Birth	22	6	2	30
	2 1/2	22	6	1	29
	4 1/2	21	6	1	28
4	Birth	13	8	2	23
	2 1/2	12	8	1	21
	4 1/2	11	8	1	20
6	Birth	11	2	--	13
	2 1/2	11	2	--	13
	4 1/2	11	2	--	13
8	Birth	17	4	4	25
	2 1/2	15	4	2	21
	4 1/2	14	4	2	20
Total	Birth	85	20	10	115
	2 1/2	81	20	5	106
	4 1/2	78	20	5	103

Appendix Table XXI. Number of Columbia lambs with weights
by line and type of birth

Line	Age months	Type 1 No.	Type 2 No.	Type 9 No.	Total No.
0	Birth	3	2	--	5
	2 1/2	4	2	--	6
	4 1/2	4	2	--	6
2	Birth	7	--	2	9
	2 1/2	7	--	1	8
	4 1/2	6	--	1	7
4	Birth	3	--	--	3
	2 1/2	3	--	--	3
	4 1/2	3	--	--	3
4K	Birth	30	2	4	36
	2 1/2	28	2	2	32
	4 1/2	28	2	2	32
Total	Birth	43	4	6	53
	2 1/2	42	4	3	49
	4 1/2	41	4	3	48

Appendix Table XXII. Regression coefficients--weaning weight
by age at weaning of lambs by breed and type of birth

Breed	Number of lambs	$Y = a + bX$ regression estimate
Rambouillet		
Type 1	74	$38.89 + .3490X \pm .1534$
Type 2	3	$354.20 + -1.6371X \pm .6477$
Type 9	5	$40.90 + .3050X \pm .3540$
Targhee		
Type 1	78	$51.58 + .2649X \pm .1385$
Type 2	10	$36.00 + .9679X \pm .6273$
Type 9	5	$-78.97 + 1.1933X \pm .3243$
Columbia		
Type 1	41	$37.19 + .3881X \pm .2215$
Type 2	2	$274.60 + -.9000X \pm .0000$
Type 9	4	$-97.80 + 1.3967X \pm .4500$

Appendix Table XXIII. Analysis of variance--regression coefficients of weaning weight by age at weaning of Rambouillet lambs by type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Type 1</u>					
Regression	1	577.2	5.17*	3.98	7.01
Deviation about regression	72	111.6			
Total	73				
<u>Type 2</u>					
Regression	1	303.0	6.45	161.0	4052.0
Deviation about regression	1	47.0			
Total	2				
<u>Type 9</u>					
Regression	1	16.5	.743	10.13	34.12
Deviation about regression	3	22.2			
Total	4				

Appendix Table XXIV. Analysis of variance--regression coefficients of weaning weight by age at weaning of Targhee lambs by type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Type 1</u>					
Regression	1	422.9	3.66	3.96	6.96
Deviation about regression	76	115.6			
Total	77				
<u>Type 2</u>					
Regression	1	1110.0	2.38	5.32	11.26
Deviation about regression	8	466.0			
Total	9				
<u>Type 9</u>					
Regression	1	169.4	13.53*	10.13	34.12
Deviation about regression	3	12.5			
Total	4				

Appendix Table XXV. Analysis of variance--regression coefficients of weaning weight by age at weaning of Columbia lambs by type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Type 1</u>					
Regression	1	269.0	3.07	4.10	7.35
Deviation about regression	39	87.7			
Total	40				
<u>Type 2 1/</u>					
<u>Type 9</u>					
Regression	1	236.0	9.63	18.51	98.49
Deviation about regression	2	24.5			
Total	3				

1/ Only two lambs in this classification.

Appendix Table XXVI. The effects of sires on the growth of Rambouillet lambs from birth to weaning by their type of birth

Line	Sire code	Type	No. lambs	Birth wt.	Wt. at 2 1/2 months	Wt. at 4 1/2 months
				lbs.	lbs.	lbs.
2000	1	1	7	11.7	63.8	92.8
	2	1	4	10.9	55.2	81.2
		9	1	8.0	49.0	81.0
	99	1	3	12.2	56.3	83.3
3000	12	1	5	10.8	59.8	84.0
		2	2	7.6	41.5	71.0
		9	2	8.3	50.0	78.0
	99	1	2	12.0	50.0	88.0
5000	6	1	9	10.0	60.4	90.7
		2	2	9.3	43.5	73.5
	7	1	18	10.4	55.1	80.1
		2	2	9.5	36.0	61.0
	99	1	9	11.0	48.1	78.5
6000	8	1	8	11.6	57.0	82.3
	9	1	4	11.4	56.8	83.2
	99	1	2	12.7	60.0	84.0
		9	1	9.6	52.0	77.0
7000	10	1	9	10.9	58.4	86.4
		9	1	7.6	56.0	88.0
8000	11	1	4	11.6	63.2	92.5
	99	1	3	13.3	56.0	86.5

Appendix Table XXVII. The effects of sires on the growth of Targhee lambs from birth to weaning by their type of birth

Line	Sire code	Type	No. lambs	Birth wt.	Wt. at 2 1/2 months	Wt. at 4 1/2 months
				lbs.	lbs.	lbs.
0	13	1	19	10.8	59.1	87.7
		9	1	8.2	61.0	87.0
	99	1	3	10.8	47.3	77.0
2	13	1	1	10.0	62.0	92.0
		9	1	9.0	47.0	76.0
	15	1	15	10.9	57.5	79.0
		2	4	8.6	46.8	76.0
	16	1	2	11.0	58.0	86.0
	99	1	4	10.7	43.0	78.0
2		2	8.2	28.0	58.5	
4	18	1	4	11.9	62.7	92.3
		9	1	6.5	51.0	77.0
	19	1	4	12.2	66.0	95.8
		2	4	8.9	63.2	95.8
	99	1	5	11.1	44.0	72.2
		2	4	9.8	42.2	75.2
6	17	1	7	11.8	60.9	92.7
		2	2	8.8	49.0	74.5
	99	1	4	11.0	46.2	82.5
8	19	1	8	10.8	56.3	83.6
		2	2	10.2	58.5	88.5
	18	1	1	11.0	62.0	86.0
		2	2	8.5	45.0	75.0
		9	1	8.6	63.0	93.0
	20	1	2	11.5	59.0	90.0
		9	1	9.5	62.0	86.0
		99	1	6	11.1	52.2

Appendix Table XXVIII. The effects of sires on the growth of Columbia lambs from birth to weaning by their type of birth

Line	Sire code	Type	No. lambs	Birth wt.	Wt. at 2 1/2 months	Wt. at 4 1/2 months
0	22	1	4	10.4	60.5	88.2
		2	2	8.6	47.5	79.0
2	21	1	7	11.5	61.3	89.2
		9	1	10.0	72.0	102.0
4	23	1	3	10.2	59.7	94.7
		9	1	8.2	65.0	95.0
4K	25	1	27	10.4	60.5	89.0
		2	2	8.2	49.0	73.5
		9	2	10.0	56.5	87.0
		99	1	3	10.8	51.3

Appendix Table XXIX. Analysis of variance--weaning weight of single born lambs by breed and line

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Rambouillet</u>					
Between lines	5	87.01	.73	2.35	3.29
Within lines	69	118.49			
Total	74				
<u>Targhee</u>					
Between lines	4	49.30	.40	2.50	3.60
Within lines	73	123.48			
Total	77				
<u>Columbia</u>					
Between lines	3	36.32	.37	2.86	4.38
Within lines	37	97.32			
Total	40				

Appendix Table XXX. Analysis of variance--weaning weight of lambs by breed and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between types	2	630.44	5.76**	3.11	4.88
Within types	84	109.52			
Total	86				
<u>Targhee</u>					
Between types	2	381.55	2.98	3.09	4.82
Within types	101	128.06			
Total	103				
<u>Columbia</u>					
Between types	2	338.56	3.91*	3.20	5.10
Within types	47	86.54			
Total	49				

Appendix Table XXXI. Analysis of variance--pounds of lamb weaned per ewe by breed, line and type of birth of the ewes

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between lines	5	480.04	.39	2.30	3.20
Within lines	94	1216.14			
Total	99				
Between types	2	382.20	.32	3.09	4.82
Within types	97	1195.37			
Total	99				
<u>Targhee</u>					
Between lines	4	900.51	.55	2.46	3.51
Within lines	104	1638.98			
Total	108				
Between types	2	1699.51	1.06	3.09	4.82
Within types	106	1609.97			
Total	108				
<u>Columbia</u>					
Between lines	3	1252.94	1.33	2.79	4.20
Within lines	49	943.54			
Total	52				
Between types	2	283.42	.29	3.18	5.06
Within types	50	948.54			
Total	52				
<u>All Breeds</u>					
Between breeds	2	2706.36	2.04	3.04	4.71
Within breeds	257	1325.93			
Total	259				

Appendix Table XXXII. Analysis of variance--weaning weight of the ewes by breed and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Rambouillet</u>					
Between types	2	825.04	13.11**	3.09	4.82
Within types	97	62.95			
Total	99				
<u>Targhee</u>					
Between types	2	272.00	4.26*	3.09	4.82
Within types	95	63.86			
Total	97				
<u>Columbia</u>					
Between types	2	126.00	1.31	3.19	5.08
Within types	48	96.48			
Total	50				

Appendix Table XXXIII. Analysis of variance--fall yearling weight of the ewes by breed and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between types	2	125.40	1.25	3.09	4.82
Within types	97	100.64			
Total	99				
<u>Targhée</u>					
Between types	2	185.86	1.48	3.09	4.82
Within types	106	125.92			
Total	108				
<u>Columbia</u>					
Between types	2	291.55	2.36	3.18	5.06
Within types	50	123.42			
Total	52				

Appendix Table XXXIV. Weaning weights of ewes and lambs by breed and type of birth with standard deviation and coefficients of variation

Type	Wean. wt.	Ewes Std. dev.	Coef. var.	Wean. wt.	Lambs Std. dev.	Coef. var.
	lbs.	lbs.	%	lbs.	lbs.	%
Rambouillet						
1	74.3	8.2	11.04	84.4	10.8	12.80
2	64.0	8.4	13.12	76.7	7.1	9.26
9	68.0	6.2	9.12	72.3	7.5	10.37
All	71.3	8.9	12.48	72.2	11.0	15.24
Targhee						
1	73.6	8.6	11.67	86.0	10.9	12.67
2	65.8	5.9	8.97	79.0	13.3	16.84
9	69.4	5.6	8.07	83.8	6.4	7.64
All	71.6	8.3	11.59	80.6	11.5	14.27
Columbia						
1	75.8	10.1	13.32	89.0	9.6	10.79
2	76.5	8.6	11.24	76.2	4.3	5.64
9	69.8	5.8	8.31	92.8	8.4	9.05
All	75.1	9.9	13.18	81.6	9.8	12.01

Appendix Table XXXV. Analysis of variance--yearling fleece weights of ewes by breed, line and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Rambouillet</u>					
Between lines	5	3.53	2.29	2.30	3.20
Within lines	93	1.54			
Total	98				
Between types	2	8.90	5.97**	3.09	4.82
Within types	96	1.49			
Total	98				
<u>Targhee</u>					
Between lines	4	.44	.32	2.46	3.51
Within lines	103	1.39			
Total	107				
Between types	2	2.93	2.22	3.09	4.82
Within types	105	1.32			
Total	107				
<u>Columbia</u>					
Between lines	3	6.15	2.85*	2.80	4.22
Within lines	47	2.16			
Total	50				
Between types	2	3.86	1.65	3.19	5.08
Within types	48	2.34			
Total	50				
<u>All breeds</u>					
Between breeds	2	34.80	20.84**	3.04	4.71
Within breeds	255	1.67			
Total	257				

Appendix Table XXXVI. Analysis of variance--two-year-old fleece weights of ewes by breed, line and type of birth

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between lines	5	1.03	.78	2.30	3.20
Within lines	90	1.32			
Total	95				
Between types	2	1.54	1.18	3.09	4.82
Within types	93	1.30			
Total	95				
<u>Targhee</u>					
Between lines	4	1.34	.94	2.46	3.51
Within lines	98	1.42			
Total	102				
Between types	2	1.90	1.35	3.09	4.82
Within types	100	1.41			
Total	102				
<u>Columbia</u>					
Between lines	3	1.36	.84	2.81	4.24
Within lines	45	1.62			
Total	48				
Between types	2	.70	.43	3.20	5.10
Within types	46	1.64			
Total	48				
<u>All breeds</u>					
Between breeds	2	34.26	24.30**	3.04	4.71
Within breeds	245	1.41			
Total	247				

Appendix Table XXXVII. Analysis of variance--yearling and two-year-old fleece weights of ewes by breeds

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between years	1	37.34	25.40**	3.89	6.76
Within years	193	1.47			
Total	194				
<u>Targhee</u>					
Between years	1	33.75	24.28**	3.89	6.76
Within years	209	1.39			
Total	210				
<u>Columbia</u>					
Between years	1	18.12	9.01**	3.94	6.90
Within years	98	2.01			
Total	99				

Appendix Table XXXVIII. Analysis of variance--effect of second-winter feed treatment on two-year-old fleece weights

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Rambouillet</u>					
Between treat.	3	1.01	.77	2.70	3.98
Within treat.	92	1.32			
Total	95				
<u>Targhee</u>					
Between treat.	3	8.68	7.23**	2.70	3.98
Within treat.	99	1.20			
Total	102				
<u>Columbia</u>					
Between treat.	3	.56	2.81	2.82	4.26
Within treat.	45	1.65			
Total	48				

Appendix Table XXXIX. Analysis of variance--pounds of lamb born per ewe by breed, type of birth of ewe and second-winter feed treatment

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet - type 1</u>					
Between treat.	3	15.60	2.11	2.76	4.13
Within treat.	59	7.40			
Total	62				
<u>Rambouillet - type 2</u>					
Between treat.	3	3.20	.17	3.49	5.95
Within treat.	12	19.32			
Total	15				
<u>Rambouillet - type 9</u>					
Between treat.	3	8.24	.64	3.24	5.29
Within treat.	16	12.88			
Total	19				
<u>Rambouillet - all types</u>					
Between treat.	3	2.43	.24	2.70	3.98
Within treat.	95	10.02			
Total	98				
<u>Targhee - type 1</u>					
Between treat.	3	8.17	.40	2.74	4.08
Within treat.	71	20.68			
Total	74				
<u>Targhee - type 2</u>					
Between treat.	3	18.35	1.16	3.13	5.01
Within treat.	19	15.77			
Total	22				

Appendix Table XXXIX. (cont'd)

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level .1%
<u>Targhee - type 9</u>					
Between treat.	3	9.53	4.54	4.76	9.78
Within treat.	6	2.10			
Total	9				
<u>Targhee - all types</u>					
Between treat.	3	23.06	1.31	2.70	3.98
Within treat.	104	17.56			
Total	107				
<u>Columbia - type 1</u>					
Between treat.	3	23.06	1.31	2.85	4.34
Within treat.	38	15.52			
Total	41				

Appendix Table XL.- Analysis of variance--pounds of lamb weaned per ewe by breed, type of birth of ewe and second-winter feed treatment

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet - type 1</u>					
Between treat.	3	218.9	.24	2.76	4.13
Within treat.	58	858.1			
Total	61				
<u>Rambouillet - all types</u>					
Between treat.	3	850.1	.71	2.70	3.98
Within treat.	95	1201.8			
Total	98				
<u>Targhee - type 1</u>					
Between treat.	3	639.8	.37	2.74	4.08
Within treat.	70	1727.6			
Total	73				
<u>Targhee - all types</u>					
Between treat.	3	917.3	.56	2.70	3.98
Within treat.	104	1647.2			
Total	107				
<u>Columbia - type 1</u>					
Between treat.	3	544.7	.45	2.85	4.34
Within treat.	38	1222.4			
Total	41				
<u>Columbia - all types</u>					
Between treat.	3	601.3	.60	2.80	4.22
Within treat.	48	1008.4			
Total	51				
<u>All breeds - all types</u>					
Between treat.	3	839.6	.62	2.65	3.88
Within treat.	255	1361.1			
Total	258				

Appendix Table XLI. Analysis of variance--pounds of lamb weaned per ewe by breed, between highest and lowest producing feed treatment groups

Source of variation	Degrees freedom	Mean squares	F ratio	Level	
				5%	1%
<u>Rambouillet</u>					
Between treat.	1	2252.1	3.28	4.05	7.21
Within treat.	47	687.5			
Total	48				
<u>Targhee</u>					
Between treat.	1	2577.0	1.37	4.03	7.17
Within treat.	51	1883.8			
Total	52				
<u>Columbia</u>					
Between treat.	1	1496.7	2.38	4.24	7.77
Within treat.	25	629.4			
Total	26				
<u>All breeds</u>					
Between treat.	1	1976.3	1.40	3.92	6.84
Within treat.	125	1412.4			
Total	126				

Appendix Table XLIII. Analysis of variance--weaning weights of single born lambs by breed and second-winter feed treatment of the ewes

Source of variation	Degrees freedom	Mean squares	F ratio	Level 5%	Level 1%
<u>Rambouillet</u>					
Between treat.	3	212.77	1.89	2.74	4.08
Within treat.	71	112.29			
Total	74				
<u>Targhee</u>					
Between treat.	3	135.58	1.14	2.74	4.08
Within treat.	74	118.97			
Total	77				
<u>Columbia</u>					
Between treat.	3	48.31	.57	2.86	4.38
Within treat.	37	84.86			
Total	40				
<u>All breeds</u>					
Between treat.	3	8.42	.07	2.65	3.88
Within treat.	190	113.73			
Total	193				



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Colman, K. L.
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