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Effects of Type of Birth, Breed of Sire, Postweaning Nutrition and Age at First Breeding on Lamb and Wool Productivity of Range Ewes

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EFFECTS OF TYPE OF BIRTH, BREED OF SIRE, POSTWEANING NUTRITION AND AGE AT FIRST BREEDING ON LAMB AND WOOL PRODUCTIVITY OF RANGE EWES

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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INTRODUCTION

In an effort to improve range sheep production in the United States, several of the traditional practices employed in this industry have been questioned. The use of whiteface ewes, breeding ewes to first lamb as 2-year-olds, selection for or against twin ewes and postweaning nutrition of replacement ewes are all areas in which some research has indicated that a change from the traditional practices may result in greater production.

Validity of research findings is often questioned because the research may have been conducted under conditions very different from the normal commercial operation. By conducting a study on various ranches, the results would then be more comparable to real life situations.

It was the objective of this study to determine which combination of factors (traditional vs innovative) would result in the greatest lamb and wool production from ewes on a typical range operation. This study was conducted over a 7-year period, with five groups of ewes being maintained on several different range operations in an effort to minimize differences due to management practices.

REVIEW OF LITERATURE

Prebreeding Growth

Hazel and Terrill (1946a), Slen and Banky (1959), Bennett et al. (1963), Vesely et al. (1966) and Sidwell and Miller (1971b) all found that male lambs, whether intact or castrated, wean at heavier weights than females. Average differences reported ranged from 4.9 kg (Hazel and Terrill, 1946a) to .8 kg (Vesely et al., 1966).

The weight advantage of single lambs over twins is evident at birth (Lambe et al., 1964; Vesely and Peters, 1964) and is still present at weaning. deBaca et al. (1956), Bailey et al. (1960), Lambe et al. (1964), Sidwell and Miller (1971b) and Vesely and Peters (1972) found single lambs to have heavier weaning weights than twins. This difference was found to be as great as 7.7 kg (deBaca et al., 1956).

Twins and singles exhibit the same potential for growth, although twin growth is retarded intrauterine and during the first few weeks of life when milk is the primary nutrient source (Guyer and Dyer, 1954).

Burris and Baugus (1955) found a high correlation (r = .90) between early lamb growth and a ewe's milk production; but, as lambs grew older, this correlation decreased.

The rate of gain for singles and twins after 2 months of age was found to be the same by Slen and Banky (1959). Cassard and Weir (1956) found similar results, reporting that from 0 to 70 days of age single lambs grew faster than twins and from 70 to 120 days of age twins grew faster. All weight differences for single and twin ewe lambs

were lost by 240 days of age. Dun and Grewal (1963) found that it wasn't until 18 months of age that twins weighed nearly as much as singles. When comparing yearling weights of 932 Rambouillet ewes, Hazel and Terrill (1946a) found that singles averaged 2.7 kg heavier than twins.

Gould and Whiteman (1975) found that the average weights of lambs from 111 Dorset x western twin dams were .9 kg heavier than lambs produced by 129 single ewes of the same breeding when the ewes were 15 months old. After that, the difference became smaller and there was no difference in 70-day lamb weights by the time the ewes were 4 years old.

Terrill and Stoehr (1942), in an experiment involving 758 Columbia, Corriedale and Rambouillet range ewes, found no consistent difference in lamb production of single and twin ewes remaining in the flock 5 years or longer.

Estrus in Lambs

It is generally agreed that some ewe lambs will show estrus during their first winter. The reported percentages of estrus occurrence in ewe lambs vary widely, however.

Burfening et al. (1971), in a study involving 1431 range ewe lambs, found among nutrition treatment groups that an average of 19% of ewe lambs showed estrus as detected by vasectomized rams with ochred briskets. Wiggins (1955) reported similar results, with 14.5 to 15.9% of range ewe lambs reaching puberty during their first winter.

In an experiment involving 399 crossbred ewe lambs from two birth years, Cedillo et al. (1977) found that 90% of the ewe lambs exhibited estrus during their first winter. The mean age of first estrus was 205 days, with a range of 157 to 243 days. These lambs had a mean body weight of 38.1 kg (range of 24 to 53 kg). All the ewes in the study were either from Columbia or Suffolk dams with four different breeds of sire. Of the half-Columbia ewes, 18% failed to show estrus during their first winter as compared to only 2% of the half-Suffolk ewes. The half-Suffolk ewes first cycled an average of 10 days earlier ($P<.01$) than the Columbia crosses. In an experiment by Southam et al. (1971), 96% of 130 ewe lambs reached puberty at an average age of 214.7 days and at an average weight of 43.1 kilograms.

In a study involving purebred and crossbred ewes, 50% of the ewe lambs that were exposed conceived (Vesely and Peters, 1974). The conception rate in crossbreds was higher than in purebred ewes mated to rams of another breed. Prolificacy, however, was not significantly altered by crossbreeding.

Dickerson and Laster (1975) reported that of 825 ewe lambs of various breeds 52.6% were in estrus during the fall breeding season. The adjusted mean age at puberty was 232 days, and the adjusted weight at puberty was 42.8 kilograms. Puberty was delayed 1 week in twins and their average weight was 3 kg less.

Ch'ang and Rae (1969) found in an analysis of data collected on a flock of Romney ewes over a period of 11 years that the number of times a ewe cycles during her first autumn (2.4 times, average) was

unaffected by type of birth and rearing and was moderately affected by age of individual. Bowstead (1929) found that ewe lambs from ewes bred as lambs did not conceive as readily as their dams, but subsequent production was little affected.

Breeding as Lambs

In a study involving 98 ewes, Bowstead (1929) found that ewes bred to lamb as yearlings produced more and heavier lambs as 2- and 3-year-olds than did ewes first bred as yearlings. Results also indicated that breeding ewe lambs did not cause a decrease in their mature weight.

In studying a flock of 139 Columbia and Targhee ewes, Levine et al. (1978) found that, per ewe entering the experiment, ewes lambing as yearlings weaned a higher number of lambs and more kilograms of lamb as compared to ewes first lambing as 2-year-olds, even when not considering the first lamb crop of the early-bred ewes. It was noted, however, these results could be due in part to heavier culling of ewes which failed to lamb as yearlings. The ewes may have had unsoundnesses which prevented breeding as lambs and resulted in culling from the herd.

Briggs (1936) reported that, in a study involving 244 Hampshire x Rambouillet cross ewes, the early-bred ewes (bred as lambs vs yearlings) produced more lambs and more kilograms of lamb in their lifetimes. The early-bred ewes took 10 months longer to reach mature weight, but by 31 months of age both groups weighed the same. The most noticeable difference in the groups was that the mouths of early-bred ewes did not hold up as well as those of the later-bred ewes. This was possibly

because the early breeding did not allow the teeth to develop as well. Spencer et al. (1942), Longrigg (1961), Hulet et al. (1969), Burfening et al. (1972) and Tyrell (1976) all found results similar to those of Briggs when comparing productivity of ewes bred first as lambs to ewes first bred as yearlings.

Postweaning Nutrition

Burfening et al. (1971) studied the effects of postweaning and wintering nutrition on 684 Rambouillet, 391 Targhee and 356 Columbia range ewes lambs in a 3-year study. The ewes were fed either a ration consisting of range and/or grass hay and 454 g of a 30% protein supplement per day (H) or a ration consisting only of range and/or grass hay (L). The ewes were maintained on these rations from early fall weaning until the next spring. Mid-winter, half of each treatment group's ration was changed, resulting in four groups, HH, HL, LH and LL. Estrus detection in the ewes was accomplished using vasectomized rams with painted briskets. Results of this experiment showed that 26.6% of the HH and 26.15 of the HL ewes came into estrus their first winter, while only 13.6% of the LH and LL ewes showed estrus. These results indicated that a higher plane of postweaning nutrition was advantageous in achieving puberty in ewe lambs.

In a 1-year study of 158 ewe lambs of various breeds, Southam et al. (1971) found that range supplemented with .8 kg alfalfa pellets daily was adequate to provide the necessary growth to induce puberty in ewe lambs. The drylot lambs in the study, which were fed alfalfa pellets ad libitum, had higher but nonsignificant rates of pregnancy

(82 vs 73% of total) and percent lambing (74 vs 64%) when compared to the range lambs.

Jordan et al. (1970) found, when comparing two rations fed to 177 crossbred ewe lambs, the percentage of ewes conceiving and subsequently lambing was not affected by nutrition treatment from 10 to 24 weeks of age. Of the two rations compared, one permitted normal growth but restricted fattening (gain of .32 kg per day) and the other had enough corn added to produce maximum gains (.67 kg per day). The groups on the higher ration had a greater percentage of ewes showing estrus, more than two times during their first winter. This group also produced heavier lambs at birth. However, by 30 days of age there was no difference in lamb weights due to the nutrition of the dam.

Ewe Weight

Ch'ang and Rae (1972), in an 11-year study of a flock of Romney ewes, found yearling weight and subsequent fertility were positively correlated ($r = .23$). Subsequent fertility in this case was defined as the number of lambs born per ewe in her first three matings.

In a study involving 758 Columbia, Corriedale and Rambouillet range ewes, it was found that ewes heavier as yearlings weaned more kilograms of lamb during their lifetimes (Terrill and Stoehr, 1942). They found an inverse relationship between average lifetime body weight and kilograms of lamb produced per year when considered independently of yearling weight. These researchers suggested that ewes should be selected on the basis of prebreeding weight.

Nichols and Whiteman (1966) found that yearling weight and average lifetime weight were positively correlated to lifetime production of lamb when analyzing the lifetime records of 164 Rambouillet and 3/4 Rambouillet-1/4 Panama ewes. Average lifetime weight, when adjusted to a common condition score, was correlated with total number of lambs born, total number of lambs raised, average lamb birth weight, average 70-day lamb weight ($P<.01$) and average lamb gain from 70 to 140 days of age ($P<.01$) with correlation coefficients (r) of .14, .09, .09, .24 and .28, respectively. Average lifetime condition score was negatively and nonsignificantly correlated with lifetime production, indicating that fatter ewes tend to be poorer producers.

Foote et al. (1959) found that yearling ewes having higher body weights shed a greater number of ova. The 449 ewes in this study were purchased as feeder lambs and allotted into two treatment groups. One group received a ration of hay only for 6 months, and the other received a ration of hay and grain (20% more TDN). The ewes on the higher plane of nutrition had a higher percentage of multiple ovulations than the ewes receiving only hay.

Lax and Brown (1967) found in over 400 Merino ewes 15 to 16 months of age that each 4.5-kg increase in body weight represented eight more lambs produced per 100 ewes bred. It was also reported that lamb survival increased with ewe body weight. For each 4.5-kg increase in ewe body weight, the ram and ewe lamb survival rates increased by 5 and 2%, respectively.

When observing 2,364 Rambouillet, 1,956 Targhee and 1,350 Columbia ewes, Hulet et al. (1969) found that ewes which showed estrus during their first winter had heavier weaning weights and fall body weights. Similarly, Levine et al. (1978) found when comparing 7-month (prebreeding) weights for 139 Columbia and Targhee ewe lambs over 5-year groups that the average weight of ewes which did lamb was greater than (up to 4.7 kg) or equal to that of ewes which did not lamb.

It was reported by Fletcher (1970) that for 189 mature Merino ewes with body weights from 42 to 57 kg there was a 1.3% increase in the number of twin ovulations per kilogram of weight. This increase was found to be due to inherent body weight differences regardless of feeding regime.

Evidence was found by Barlow and Hodges (1976) of a positive genetic correlation between weaning weight and reproductive performance of 190 Merino ewe lambs. Selection for weaning weight had an effect ($P<.05$) on the number of ewes lambing. Of the heavier ewes (average weight, 31.4 kg), 55% lambed compared with 20% of the lighter ewes (24.6 kg).

Another study (Curll et al., 1975) involving 360 mature Border Leicester x Merino ewes showed that heavier ewes tended to produce more lambs per ewe bred. However, by the time the lambs were 10 weeks of age, there was little or no difference in numbers, partly due to dystocia problems in heavier ewes. These researchers reported that ewes weighing 44 kg at mating produced 107 lambs per 100 ewes bred and ewes weighing an average of 58 kg produced 152 lambs per 100 ewes.

Crossbreeding

Sidwell et al. (1964) in a study involving 4,331 lambs found crossbreeding to be a positive factor in improving weaning weights of lambs. Four-way cross lambs had average weaning weights 4.7 kg higher than purebred lambs. Three-way and two-way cross lambs had 4.3 and 2.4 kg higher weaning weights when compared to purebred lambs. The advantages of all crossbred lambs over purebred lambs involving the same breeds were 3.2 kg for weaning weight and .28 kg for birth weight.

Similar results were found by Sidwell and Miller (1971b) when comparing 299 Targhee and 63 Suffolk x Targhee lambs. Weights taken at weaning averaged 2.2 kg higher for the crossbreds as compared to the straightbred lambs.

Several researchers have found crossbred ewes to be superior to purebreds in nearly all lamb production traits. Vesely and Peters (1974) found fertility to be increased by crossbreeding, although prolificacy did not show improvement. In this study involving 18,181 lambs, survival ability of lambs was found to be increased by crossbreeding as was total weight of lambs marketed per ewe. Botkin and Paules (1965) and Southam et al. (1971) also found lamb production to be greater for crossbred ewes than for purebreds.

When studying livability of 3,621 purebred and crossbred lambs, Sidwell et al. (1962) found livability highest for lambs from crossbred ewes mated to purebred rams. The crossbred lambs from purebred ewes mated to a purebred ram of another breed had better survival rates than purebred lambs.

Wool Production

It has been shown in several studies that a ewe's wool production is dependent on several factors, including type of birth, age at first breeding, postweaning nutrition, breed and lamb production. In comparing clean fleece weights to grease weights, although shrinkage varies widely, on the average shorn grease wool shrinks about 55.5% (Ensminger, 1970).

Single ewes tend to shear heavier fleeces throughout their lifetimes. This difference is usually small and is often not statistically significant. Hazel and Terrill (1946b), Price et al. (1953), Slen and Bandy (1958, 1959), Lambe et al. (1964), Dun and Grewal (1963), Brown et al. (1966) and Sidwell and Miller (1971a) all found the fleece weights of single-born ewes to be heavier than those of twin ewes. For yearling fleeces, the differences for singles ranged from .05 kg (Lambe et al. 1964) to .15 kg (Dun and Grewal, 1963) more wool produced.

When analyzing 1,457 clean fleece weights of Canadian Corriedale, Rambouillet and Romnelet ewes, Slen and Banky (1958) found that the maximum clean fleece weight of twin ewes occurred at a slightly earlier age and began decreasing sooner than that of single ewes.

A ewe's wool production varies with her age as reported by Lush and Jones (1923), Slen and Banky (1958), Campbell (1962), Vesely et al. (1965), Brown et al. (1966), Nichols and Whiteman (1966) and Sidwell and Miller (1971a). It is generally observed that a ewe's wool production declines as age increases, although reports of the age of maximum production vary.

Lush and Jones (1923) and Slen and Banky (1958) indicated that maximum wool production may occur as early as 2 years of age. Work by Spencer (1927) and Campbell (1962) showed a production peak at 3 years of age, which was similar to findings by Brown et al. (1966) of 3.5 years of age. Sidwell and Miller (1971a) found maximum production to occur later, from 4 to 7 years of age, with slightly lower wool weights reported for 3-year-olds and wool weights of 2-year-olds even lower than those of aged ewes 8 years and older.

Brown et al. (1966) found that the increase in wool weight from 1.5 to 3.5 years of age was due to an increase in the number of fibers, and the yearly decline thereafter of grease fleece weight of .09 to .14 kg per year was due to a decrease in volume. Work by Campbell (1962) showed that a ewe's fleece weight decreased 25% from 3 to 10 years of age.

Lush and Jones (1923) demonstrated that shearings 4 to 5 years apart showed a positive correlation ($r = .52$). Similarly, Hill (1921) found a high degree of correlation ($r = .70$) between the weight of wool produced in the first year and the average weights of fleeces produced in the two subsequent years when comparing clean fleece weights of 29 Rambouillet wethers in a drylot situation.

Sidwell et al. (1971) reported that for yearling ewes the average grease fleece weight of 25 Suffolk x Targhee crossbred ewes (3.70 kg) was less than that of 61 purebred Targhee ewes (4.82 kg). Of the nine crosses studied, the Suffolk x Targhee cross was the only one that showed a depression in fleece weight due to crossbreeding.

Southam et al. (1971) found that the average yearling grease fleece weight was higher for 71 ewes fed a high postweaning plane of nutrition as compared to that of 59 ewes fed a lower nutritional plane. The rations compared in the study were alfalfa pellets fed ad libitum in a drylot situation vs fall range plus .8 kg alfalfa pellets per day. These rations were fed during a 60-day prebreeding period.

When comparing 177 crossbred ewe lambs fed two different rations, Jordan et al. (1970) found that yearling fleece weights were significantly higher for the ewes on the fattening rations as compared to those of the ewes on the growing ration.

Vesely et al. (1965) reported that barren ewes had higher fleece weights than ewes which lambed. Seebeck and Tribe (1952) also found this to be true and found that ewes bearing single lambs had higher fleece weights than those bearing twins. Slen and Whiting (1956) found similar results when comparing single- and twin-bearing ewes. They also determined that both early and advanced pregnancy and lactation affect wool growth. However, the difference was averaged out for all ewes by the end of lactation.

When analyzing 2,424 grease fleece weights, Ray and Sidwell (1964) found that ewes lambing and lactating produced significantly less wool than open ewes. They found the effects of pregnancy to be less pronounced than those of parturition and lactation.

Studies indicate that breeding ewes to lamb as yearlings seems to have little or no effect on lifetime wool production. Briggs (1936) found that early breeding had no effect on wool production when studying

244 Hampshire-Rambouillet ewes. Hulet et al. (1969), in an experiment involving 2,634 Rambouillet, 1,956 Targhee and 1,350 Columbia ewes, found that there was no significant association of the incidence of early estrus and wool production. However, in the Targhee and Rambouillet ewes, lifetime grease fleece weights were slightly lower for those showing estrus in their first winter.

It was found by Tyrell (1976) that ewes bred at 8 months of age had 7% lower yearling fleece weights than those bred as yearlings, but there was no difference in succeeding years. Spencer et al. (1942) and Levine et al. (1978) found that breeding ewe lambs did cause a slight decrease in lifetime wool production.

Ewe Losses

Due to differences in management and environment, ewe losses from the herd, either due to death or culling or both, vary widely among flocks.

For 2,255 range ewes, Matthews et al. (1977) found that the average age of removal of ewes from the herd was similar for Targhee ewes bred to either Targhee or Suffolk rams and for Suffolk x Targhee ewes bred to Suffolk rams. The ages were 6.09, 6.29 and 6.10 years, respectively.

Campbell (1962) found ewe losses to average 4.6% per year over a 20-year period in a flock of Rambouillets in which the average flock size was 173 ewes. A lower average death rate of 2.2% per year for ewes 1.5 to 7.5 years of age was found by Turner et al. (1959) when studying a flock of 1,000 Merino ewes. During drought years this was

found to increase to 3.8% for ewes 1.5 to 6.5 years of age, with the increase for older ewes being much greater.

In a study involving 501 ewes, the percentage of 1- to 6-year-old ewes leaving the flock due to death was 3.2% of the original number of ewes (Slyter, 1968).

MATERIALS AND METHODS

Objectives

The objectives of this experiment were set in an effort to evaluate the wool and lamb productivity of range ewes while comparing different management practices. The objectives were:

1. To determine whether single- or multiple-born (twin or triplet) ewes are more productive.
2. To determine whether the common type of whiteface range ewe or whiteface-blackface crossbreds are more productive.
3. To determine whether ewe lambs fed a high-energy ration or those fed a moderate ration postweaning are more productive.
4. To determine whether ewe lambs bred at 7 months of age, ewes not exposed until 19 months of age or ewes exposed but not bred at 7 months of age are more productive.

Management

The female progeny of 250 straightbred Targhee ewes were utilized in this study. These ewes were maintained at the South Dakota State University Antelope Range Field Station near Buffalo, South Dakota. In the autumn of 1970, these ewes were randomly assigned to two breeding groups. One group was exposed to Targhee rams and the other group was exposed to Suffolk rams. In subsequent years (1971

through 1974), the two groups of ewes had the breed of sire rotated between Targhee and Suffolk rams. These ewes were exposed each autumn for approximately 35 days, with the lambs born in late February and March.

After weaning at an average age of 70 to 80 days, the ewe lambs were trucked to the U.S. Irrigation and Dryland Field Station, Newell, South Dakota, in 1971 and the South Dakota State University Sheep Unit in the years 1972 through 1975 for their postweaning treatment. At this time, the ewe lambs were randomly assigned within type of birth groups, single or multiple (hereafter referred to as "twin"), and within breed groups to a high or moderate energy ration. These two rations were designed to supply approximately the NRC (1964) requirements for replacement ewe lambs (moderate energy) vs fattening lambs (high energy). All ewe lambs were fed in drylot for approximately 100 days on a 60% cracked corn (IFN 4-02-854), 40% alfalfa (IFN 1-00-111) ration. The moderate energy level group was hand fed what they would consume, up to 1.14 kg per head per day during the first 70 days of the trial, and 1.36 kg per head per day during the last 30 days. The high energy group was self-fed. The ration was fed in ground form in all years except 1972, when it was fed as a pellet.

After the postweaning feeding period, the lambs were randomly allotted within previous treatment groups to be exposed to rams at either 7 or 19 months of age. Two-thirds of the lambs were exposed for 34 days at 7 months of age and one-third were exposed for the first time when they were approximately 19 months of age. Finnsheep crossbred ram lambs

were used during all breeding seasons except 1972, when Columbia ram lambs were used. The rams' briskets were painted daily with dye-colored grease to determine which ewes had been bred.

Following the breeding season of the group exposed at 7 months of age, all groups were combined and managed as a single flock with the following exception: All ewes lambing at 12 months of age received supplemental grain prior to and following lambing and they nursed their lambs for approximately 60 days before the lambs were weaned in late May.

Each year during the first week in June, all yearling ewes were sold as a group under a research contract to producers in northwestern South Dakota who agreed to provide the university with subsequent lifetime production data. The ewes were then maintained on range sheep operations typical of that area.

No lambs in the study were culled, and mature ewes were culled only if they had unhealthy udders or had not lambed for 2 years in succession. Ram lambs were generally castrated within 10 days of birth. If rams were left intact, it was random across all treatments within location. All lambs within a production unit were weaned as a group. Ewes were shorn prior to lambing and their fleeces were tied and weighed on a hanging dial scale. Their lambing date was recorded and their lambs were ear tagged and weighed within 24 hours after birth.

Data Collected

The data presented are for ewes born in the years 1971 through 1975 and their production data collected through and including 1977.

In this study, 1,458 ewes lambed as a result of 1,749 matings. Ages given (i.e, 12 months) for annual production data are approximate.

Preweaning data for the ewes include year of birth, birth weight, type of birth, breed of sire and weaning weight. Information collected on all ewes at or after the end of the postweaning period included total feed consumption, body weight, wither height and age at first breeding. Subsequent yearly data collected included date of lambing, number of lambs born, sex of lambs, number of lambs weaned, weaning date of lamb crop, lamb weaning weight, fleece weight and ewe weight and wither height at weaning of the lamb crop. Deaths of ewes and lambs were noted and categorized as to cause whenever possible. Producers were often assisted by university personnel at times of data collection.

Data reported for ewes in this study were year of birth, type of birth, breed of sire and age at first breeding. Yearly production data reported included fleece weight, number of lambs born, sex of lambs, number of lambs weaned and lamb weaning weight.

Statistical Analysis of Data

Statistical procedures in all analyses were performed according to Steel and Torrie (1960). In this manuscript, the levels of probability considered were .05, .01 and .005 for all F-tests. The Tukey and Chi-square tests were performed at the 5% level.

Comparisons of treatments (breed of sire, age at first breeding, postweaning nutrition, type of birth and year) were performed using a least squares analysis of variance with one- or two-way classifications. When there were significant differences between treatments as determined

by the F-test, Tukey's ω procedure was employed for mean comparisons. One-way Chi-square analyses were used in comparing lambing percentages of different groups of ewes.

Because of the large amount of data in this study, discussion of individual significant two-way interactions will be deleted. These data are presented in tabular form in the appendix. Nearly all the interaction differences that were significant ($P<.05$) were magnitude differences rather than rank differences. Analysis of variance and Chi-square analysis of variance are shown in the appendix tables.

RESULTS AND DISCUSSION

Prebreeding Growth

In order to determine if differences existed between treatment groups prior to administration of any treatment, ewe date of birth, birth weight and weaning weight were analyzed. Weight and wither height measurements were taken at 7 months of age and a ratio was computed to aid in determining if size at this age affected productivity. Factors considered in the analysis were year, type of birth, breed of sire, postweaning nutrition and age at first breeding. These results are presented in table 1.

Birth date differed ($P<.005$) by year, due in part to different breeding dates imposed by management.

Birth weights were different ($P<.005$) within all factors except age at first breeding. Single ewes were .80 kg heavier than twins. This agreed with results of studies reported by Lambe et al. (1964) and Vesely and Peters (1964). Suffolk x Targhee ewes were .42 kg heavier at birth than Targhees, which was similar to results obtained by Sidwell et al. (1964). By chance those ewes on the higher plane of nutrition were .16 kg heavier at birth than the ewes on the moderate ration. Birth weights for ewes born in different years ranged from a high of 5.01 kg in 1974 to a low of 4.60 kg in 1971.

Weaning weights differed ($P<.005$) within breed of sire, type of birth and year groups. The Suffolk x Targhees weaned 2.37 kg heavier than the Targhees, which agreed with research reported by Sidwell et al. (1964) and Sidwell and Miller (1971b), with weaning weights 2.2 kg to

TABLE 1. LEAST SQUARES MEANS AND STANDARD ERRORS FOR EWE BIRTH DATE, BIRTH WEIGHT AND WEANING WEIGHT AND 7-MONTH WITHER HEIGHT, 7-MONTH WEIGHT AND WEIGHT:HEIGHT RATIO

Parameter	Birth date[a]	Birth weight (kg)	Weaning weight (kg)	Weight at 7 months (kg)	Height at 7 months (cm)	Weight:height ratio (kg/cm)
Overall mean	63.8 ± .34	4.89 ± .031	27.5 ± .19	47.6 ± .27	61.34 ± .146	.775 ± .0040
Ewe type of birth		***	***	***	***	***
Single	63.8 ± .53	5.29 ± .049	30.0 ± .29	50.0 ± .42	62.10 ± .229	.805 ± .0062
Multiple	63.8 ± .39	4.49 ± .037	24.9 ± .22	45.2 ± .32	60.58 ± .172	.744 ± .0047
Ewe breed[b]		***	***	***		***
T	64.2 ± .44	4.68 ± .040	26.3 ± .24	45.3 ± .35	61.57 ± .189	.735 ± .0052
S x T	63.4 ± .49	5.10 ± .046	28.7 ± .27	49.9 ± .39	61.11 ± .214	.815 ± .0058
Postweaning nutrition		***		***	***	***
High	63.8 ± .45	4.81 ± .042	27.4 ± .25	50.3 ± .36	62.08 ± .198	.809 ± .0050
Moderate	63.8 ± .46	4.97 ± .043	27.7 ± .26	44.9 ± .37	60.60 ± .200	.740 ± .0055
Age at first breeding					*	
7 months	63.6 ± .54	4.92 ± .050	27.5 ± .30	48.2 ± .43	61.82 ± .231[b]	.778 ± .0063
19 months	63.3 ± .53	4.81 ± .049	27.9 ± .29	47.9 ± .42	61.16 ± .229[b,c]	.782 ± .0063
7 months, open	64.5 ± .64	4.93 ± .059	27.0 ± .35	46.7 ± .51	61.04 ± .278[c]	.764 ± .0076
Year of birth	***	***	***	***	***	***
1971	60.0 ± .69[c]	4.61 ± .064[c]	22.5 ± .38[c]	41.5 ± .56[c]	58.22 ± .305[c]	.712 ± .0083[c]
1972	63.7 ± .63[d]	4.96 ± .058[d]	31.5 ± 34[d]	49.1 ± .50[d]	63.16 ± .272[d]	.777 ± .0075[d]
1973	68.7 ± .75[e]	4.94 ± .070[d]	25.4 ± .42[e]	52.6 ± .61[e]	60.61 ± .331[e]	.868 ± .0090[e]
1974	61.2 ± .79[d]	5.01 ± .073[d]	31.6 ± .44[d]	47.6 ± .63[d]	63.30 ± .343[d]	.751 ± .0094[d]
1975	65.3 ± .79[d]	4.92 ± .072[d]	26.4 ± .43[e]	47.1 ± .62[d]	61.42 ± .338[e]	.766 ± .0092[d]

[a] Days after January 1.

[b] T = Targhee, S x T = Suffolk x Targhee.

[c,d,e] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

3.2 kg heavier. The single ewes were 5.09 kg heavier than the twins. This was supported by several studies including those by deBaca et al. (1956), Bailey et al. (1961), Lambe et al. (1964), Sidwell and Miller (1971b) and Vesely and Peters (1972). The ewes weaned in 1971 were lightest at 22.50 kg and the ewes weaned in 1974 were heaviest at 31.61 kilograms.

Significant effects were observed in prebreeding weight (at 7 months of age) for all factors reported except age at first breeding. The single ewes were 4.8 kg heavier than the twins. The Suffolk x Targhees were 4.6 kg heavier than the Targhees. The ewes which had been on the higher plane of nutrition were 5.4 kg heavier than those on the moderate ration. Overall, the 1971 group was lightest at 41.5 kg and the 1973 group was heaviest at 52.6 kilograms.

Wither height differed ($P<.005$) within type of birth, post-weaning nutrition and year groups. There was also a difference ($P<.05$) between age at first breeding groups. Single ewes were 1.52 cm taller than twins. Those ewes on the higher plane of nutrition were 1.48 cm taller than the ewes on the moderate ration. The ewes that were bred at 7 months of age were .78 cm taller than the ewes which were exposed but not bred at 7 months. The 1974 ewes were tallest at 63.30 cm and the 1971 ewes were shortest at 58.22 centimeters.

The weight:height ratio (calculated from data taken at 7 months of age) differed ($P<.005$) for all factors except age at first breeding. A higher ratio indicated more weight per centimeter of height or a fatter animal. Single ewes had higher ratios than twins, Suffolk x

Targhees had higher ratios than Targhees and ewes on the higher nutritional plane had higher ratios than ewes fed less. Ewes born in 1973 had the highest ratio and the 1971 ewes had the lowest ratio.

Annual Weight

The results of the analysis done on annual ewe weights are found in tables 2 and 3. The significance of the factors decreased with age. The weight of single ewes was consistently heavier than that of twins. The Suffolk x Targhee tended to be heavier than the Targhees. Postweaning nutrition was significant ($P<.005$) only at 12 months of age, indicating that the extra nutrients accelerated the growth process but did not alter mature weight. Age at first breeding was significant at 12 months ($P<.005$) and at 72 months ($P<.01$). At 12 months, the ewes which were bred at 7 months were lighter than ewes from the other two groups, indicating that by allowing ewe lambs to remain open one can expect more weight gain. At 72 months, the ewes first bred at 7 months were lighter than those first exposed at 19 months. The weight of ewes exposed but not bred at 7 months did not differ significantly from either of the other two groups. The significance at this age may have been due in part to low numbers and/or culling practices.

Briggs (1936) reported similar results, indicating that early-bred ewes took 10 months longer to reach mature weight, but by 31 months of age there was no difference between groups.

When comparing average weights for the entire flock (table 2) vs those of ewes weaning a lamb[s] (table 3), the same general pattern of significance was seen with the exception of one factor. Postweaning

TABLE 2. LEAST SQUARES MEANS AND STANDARD ERRORS FOR ANNUAL EWE WEIGHT (KG)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	51.3 ± .29	66.7 ± .35	71.2 ± .41	73.5 ± .51	72.5 ± .76	70.0 ± 1.17
Ewe type of birth	***	***	***			*
Single	53.0 ± .45	68.0 ± .53	72.6 ± .64	74.2 ± .78	73.7 ± 1.09	72.4 ± 1.47
Multiple	49.5 ± .35	65.4 ± .41	69.9 ± .48	72.9 ± .63	71.4 ± .99	67.4 ± 1.82
Ewe breed[a]	***	***	***	***		
T	48.8 ± .37	65.4 ± .45	69.2 ± .53	71.8 ± .66	71.5 ± 1.00	67.7 ± 1.81
S x T	53.8 ± .43	68.0 ± .50	73.2 ± .60	75.3 ± .78	73.6 ± 1.11	72.2 ± 1.51
Postweaning nutrition	***					
High	52.3 ± .39	67.0 ± .45	71.4 ± .54	73.5 ± .66	72.8 ± .95	69.9 ± 1.48
Moderate	50.2 ± .41	66.5 ± .49	71.1 ± .57	73.6 ± .73	72.3 ± 1.11	70.0 ± 1.77
Age at first breeding	***					**
7 months	49.1 ± .46[b]	66.8 ± .56	70.8 ± .58	73.8 ± .76	70.7 ± 1.18	65.2 ± 1.99[b]
19 months	51.8 ± .45[c]	66.6 ± .54	71.5 ± .64	73.0 ± .72	73.7 ± 1.10	74.2 ± 1.73[c]
7 months, open	52.9 ± .56[c]	66.7 ± .65	71.3 ± .82	73.7 ± 1.10	73.3 ± 1.54	70.4 ± 2.26[b,c]
Year of production	***	***	***	***	***	
1972	42.4 ± .60[b]					
1973	55.1 ± .54[c]	61.0 ± .70[b]				
1974	50.8 ± .65[d]	68.8 ± .63[c]	64.9 ± .76[b]			
1975	51.6 ± .68[d]	66.9 ± .78[c]	74.1 ± .68[c]	67.0 ± .84[b]		
1976	56.5 ± .66[c]	66.9 ± .82[c]	74.2 ± .83[c]	77.6 ± .77[c]	69.5 ± 1.03	
1977		70.0 ± .81[c]	71.7 ± .90[c]	76.0 ± .90[c]	75.6 ± 1.04	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

** P<.01.

*** P<.005.

TABLE 3. LEAST SQUARES MEANS AND STANDARD ERRORS FOR ANNUAL WEIGHT (KG) OF THOSE EWES WEANING A LAMB(S)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	48.0 ± .51	65.6 ± .41	70.7 ± .47	72.7 ± .55	71.8 ± .74	68.1 ± 1.49
Ewe type of birth	***	***	**			
Single	49.7 ± .71	67.1 ± .64	71.9 ± .73	73.0 ± .82	72.6 ± 1.07	70.5 ± 1.64
Multiple	46.3 ± .70	64.2 ± .48	69.5 ± .56	72.4 ± .66	71.0 ± .99	65.7 ± 2.81
Ewe breed[a]	***	***	***	***		
T	46.0 ± .77	64.5 ± .56	69.1 ± .64	70.6 ± .70	70.5 ± 1.02	66.5 ± 2.63
S x T	50.0 ± .60	66.8 ± .56	72.3 ± .66	74.8 ± .85	73.2 ± 1.04	69.7 ± 1.71
Postweaning nutrition						
High	48.7 ± .57	66.2 ± .53	70.9 ± .75	72.7 ± .72	72.2 ± .89	68.7 ± 1.50
Moderate	47.3 ± .83	65.1 ± .58	70.4 ± .68	72.7 ± .77	71.4 ± 1.11	67.5 ± 2.50
Age at first breeding						**
7 months		65.3 ± .66	70.9 ± .75	73.1 ± .85	70.1 ± 1.30	63.4 ± 2.17[b]
19 months		65.7 ± .61	70.4 ± .76	72.3 ± .82	73.1 ± 1.06	73.4 ± 2.07[c]
7 months, open		65.9 ± .77	70.7 ± .86	72.7 ± 1.00	72.2 ± 1.43	67.5 ± 2.64[b,c]
Year of production	***	***	***	***	***	
1972	38.8 ± 1.12[b]					
1973	56.5 ± .88[c]	59.1 ± .96[b]				
1974	49.2 ± .88[d]	67.6 ± .67[c,d]	64.5 ± .92[b]			
1975	45.9 ± .99[e]	65.8 ± 1.17[c]	73.6 ± .76[c]	65.2 ± 1.00[b]		
1976	49.5 ± 1.55[d,e]	65.8 ± .82[c]	73.1 ± .88[c]	77.7 ± .82[c]	69.2 ± .92	
1977		69.8 ± .81[d]	71.6 ± 1.03[c]	75.2 ± .85[d]	74.4 ± 1.08	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d,e] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

** P<.01.

*** P<.005.

nutrition caused no difference at 12 months of age in the group of ewes weaning a lamb(s).

Those ewes weaning a lamb(s) tended to be lighter than the overall group. Suggestions are numerous as to why this was observed. One possibility was that open ewes, not enduring the stress of pregnancy and lactation, weighed more. Some studies indicate that heavier ewes are poorer producers. Terrill and Stoehr (1942) found an inverse relationship between body weight and kilograms of lambs produced per year when considered independently of yearling weight. Nichols and Whiteman (1966) found average lifetime condition score to be negatively correlated with lifetime production, indicating that fatter ewes tend to be poorer producers. Curll et al. (1975) found that heavier ewes at breeding tended to produce more lambs, but by the time the lambs were 10 weeks of age there was little or no difference in numbers.

Annual Wither Height

The results of the analysis of height data are found in table 4. Age at first breeding was not a significant factor in wither height of the ewes. When type of birth was significant, the single ewes were taller. The Targhees were taller than the Suffolk x Targhees. Post-weaning nutrition was significant only at 12 months when those ewes on the higher ration were taller.

For those ewes weaning a lamb(s), less significant differences were found (table 5), but the same trend was seen. Where significance was noted, it was shown that single ewes were taller, Targhees were

TABLE 4. LEAST SQUARES MEANS AND STANDARD ERRORS FOR ANNUAL EWE WITHER HEIGHT (CM)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	66.0 ± .12	66.4 ± .14	67.1 ± .19	66.8 ± .20	66.6 ± .24	66.4 ± .42
Ewe type of birth	***	*			*	**
Single	66.4 ± .19	66.7 ± .22	67.2 ± .30	67.0 ± .31	67.1 ± .35	67.6 ± .53
Multiple	65.6 ± .14	66.0 ± .16	67.0 ± .23	66.5 ± .25	66.1 ± .32	65.1 ± .66
Ewe breed[a]	***	***	*	*	***	
T	66.3 ± .16	67.0 ± .18	67.5 ± .25	67.4 ± .26	67.4 ± .32	66.7 ± .65
S x T	65.6 ± .18	65.7 ± .20	66.7 ± .28	66.1 ± .31	65.9 ± .35	66.0 ± .54
Postweaning nutrition	*					
High	66.2 ± .16	66.4 ± .18	67.2 ± .25	66.8 ± .26	66.8 ± .30	66.1 ± .53
Moderate	65.7 ± .17	66.4 ± .20	67.0 ± .27	66.7 ± .29	66.4 ± .36	66.6 ± .64
Age at first breeding						
7 months	66.6 ± .19	66.4 ± .23	67.0 ± .27	66.8 ± .30	66.1 ± .38	65.2 ± .72
19 months	66.4 ± .23	66.4 ± .22	67.0 ± .30	66.2 ± .28	66.4 ± .35	67.2 ± .62
7 months, open	65.9 ± .19	66.4 ± .28	67.3 ± .38	67.3 ± .43	67.4 ± .49	66.6 ± .81
Year of production	***	***	***	***		
1972	62.3 ± .25[b]					
1973	68.3 ± .22[c]	68.3 ± .28[b]				
1974	65.9 ± .28[d]	67.7 ± .26[b]	68.3 ± .36[b]			
1975	65.9 ± .27[d]	65.0 ± .32[c]	67.8 ± .32[b]	65.9 ± .33[b]		
1976	67.5 ± .28[c]	65.1 ± .33[c]	66.4 ± .39[c]	68.8 ± .32[c]	66.2 ± .33	
1977		66.6 ± .33[d]	66.1 ± .42[c]	65.6 ± .35[b]	67.0 ± .33	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

** P<.01.

*** P<.005.

TABLE 5. LEAST SQUARES MEANS AND STANDARD ERRORS FOR ANNUAL WITHER HEIGHT (CM) OF THOSE EWES WEANING A LAMB(S)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	65.3 ± .24	66.3 ± .17	67.0 ± .22	66.6 ± .24	66.6 ± .27	66.2 ± .49
Ewe type of birth						*
Single	65.8 ± .34	66.5 ± .27	67.0 ± .35	66.8 ± .37	67.0 ± .39	67.6 ± .54
Multiple	65.0 ± .33	66.0 ± .20	66.9 ± .27	66.4 ± .29	66.2 ± .36	65.0 ± .92
Ewe breed[a]		***		**	***	
T	65.6 ± .37	66.9 ± .24	67.3 ± .31	67.2 ± .31	67.4 ± .37	66.8 ± .86
S x T	65.2 ± .29	65.6 ± .24	66.6 ± .32	65.9 ± .38	65.7 ± .38	65.7 ± .56
Postweaning nutrition						
High	65.5 ± .26	66.4 ± .22	67.0 ± .28	66.6 ± .32	66.9 ± .32	66.2 ± .49
Moderate	65.3 ± .40	66.1 ± .24	67.0 ± .32	66.6 ± .34	66.4 ± .41	66.3 ± .82
Age at first breeding						*
7 months		66.0 ± .28	66.7 ± .36	66.8 ± .32	66.3 ± .48	65.1 ± .71[b]
19 months		66.5 ± .26	67.0 ± .36	65.9 ± .34	66.4 ± .39	67.5 ± .68[c]
7 months, open		66.3 ± .33	67.2 ± .41	67.0 ± .54	67.2 ± .52	66.2 ± .86[b,c]
Year of production	***	***	***	***		
1972	61.3 ± .54[b]					
1973	68.8 ± .42[c]	68.3 ± .41[b]				
1974	65.4 ± .42[d]	67.3 ± .28[b]	66.1 ± .44[b]			
1975	65.0 ± .48[d]	65.2 ± .49[c]	67.7 ± .36[c]	65.5 ± .45[b]		
1976	66.6 ± .74[d]	65.0 ± .35[c]	66.0 ± .42[b]	68.8 ± .37[c]	66.2 ± .34	
1977		65.5 ± .34[c]	66.0 ± .50[b]	65.4 ± .38[b]	67.1 ± .39	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

** P<.01.

*** P<.005.

taller and ewes first exposed at 19 months were taller than ewes bred at 7 months.

When the two groups were compared, it was seen that those ewes weaning a lamb(s) were shorter than the overall group. When weight was also considered, it appears that smaller mature ewes (shorter and lighter) wean a lamb(s) more often.

Date of Lambing

The results of this portion of the study are presented in table 6. Type of birth was a significant factor but was not consistent. At 12 and 24 months, the single ewes lambed earlier and at 48 months the twin ewes lambed earlier. At 12 and 24 months, the single ewes may have been cycling earlier in the fall as a result of the extra nutrition received as single lambs.

Breed was significant at 12, 36 and 48 months but was not consistent. The Suffolk x Targhees lambed earlier at the two younger ages, and the Targhees lambed earlier at 48 months. Postweaning nutrition was not a significant factor, and age at first breeding was significant only at 48 months, with those ewes exposed but not bred at 7 months lambing later than the other two groups. Year was highly significant at all ages.

Percentage of Ewes Lambing of Those Exposed

The results of this Chi-square analysis are presented in table 7 and figure 1. As a result of 1,749 matings, 1,458 ewes lambed. This resulted in an 83.4% overall percentage, which was used as the basis for comparison.

TABLE 6. LEAST SQUARES MEANS AND STANDARD ERRORS FOR LAMBING DATE (DAYS AFTER JANUARY 1)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	72.2 ± .73	100.4 ± .51	97.2 ± .68	80.2 ± 1.90	67.8 ± .83	56.5 ± 2.70
Ewe type of birth	*	*		***		
Single	70.6 ± 1.11	99.4 ± .77	97.5 ± 1.06	86.0 ± 2.82	66.4 ± 1.21	56.5 ± 3.56
Multiple	73.8 ± .92	101.3 ± .61	96.8 ± .78	74.4 ± 2.42	69.1 ± 1.12	56.4 ± 4.05
Ewe breed[a]	*		***	*		
T	73.8 ± 1.09	101.1 ± .68	100.0 ± .88	76.2 ± 2.47	68.1 ± 1.13	54.9 ± 4.04
S x T	70.6 ± .92	99.6 ± .72	94.3 ± .99	84.2 ± 2.86	67.4 ± 1.20	58.1 ± 3.67
Postweaning nutrition						
High	71.0 ± .91	100.7 ± .67	96.5 ± .86	80.7 ± 2.52	68.8 ± 1.02	59.7 ± 3.52
Moderate	73.5 ± 1.12	100.1 ± .70	97.8 ± .96	79.6 ± 2.64	66.7 ± 1.26	53.3 ± 4.03
Age at first breeding				*		
7 months		99.9 ± .83	97.6 ± 1.01	75.2 ± 2.76[b]	67.5 ± 1.37	56.0 ± 4.72
19 months		99.4 ± .77	96.9 ± 1.05	77.1 ± 2.60	68.6 ± 1.15	56.5 ± 4.20
7 months, open		101.9 ± .95	97.1 ± 1.32	88.2 ± 4.06	67.2 ± 1.72	56.9 ± 5.10
Year of production	***	***	***	***	***	
1972	84.2 ± 1.52[b]					
1973	69.4 ± 1.30[c]	112.1 ± 1.24[b]				
1974	73.7 ± 1.34[c]	67.2 ± .88[c]	99.1 ± 1.33[b]			
1975	72.4 ± 1.53[c]	124.3 ± 1.14[d]	77.5 ± 1.08[c]	124.5 ± 3.26[b]		
1976	61.4 ± 2.23[d]	124.8 ± 1.13[d]	84.8 ± 1.35[d]	54.2 ± 2.86[c]	83.4 ± 1.07	
1977		73.6 ± 1.09[e]	127.3 ± 1.42[e]	61.8 ± 3.38[c]	52.1 ± 1.22	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d,e] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

TABLE 7. PERCENTAGE OF EWES LAMBING OF THOSE EXPOSED

Parameter	Age (month) 12	24	36	48	60	72	Total lambing/ total exposed	Overall
Breed[a]	**							**
T	48.9	87.1	87.2	91.3	88.1	95.5	682/857	79.6
S x T	71.7	91.0	90.8	92.9	91.5	84.8	776/892	87.0
Type of birth		**	**					*
Single	56.4	84.6	82.4	92.7	91.7	89.7	560/694	80.7
Twin	62.4	91.8	92.9	91.7	88.3	88.5	898/1055	85.1
Postweaning nutrition								
High	64.6	87.6	91.7	90.2	93.3	96.6	750/885	84.7
Moderate	55.9	90.5	86.2	94.1	86.5	80.7	708/864	81.9
Age at first breeding								
7 months	60.2	87.8	86.5	89.9	85.9	90.0	478/545	87.7[b]
19 months	--	93.3	88.0	97.0	94.8	81.8	457/495	92.3
7 months, open	0.0	85.3	95.3	87.7	88.2	100.0	296/332	89.2
Overall	60.2	89.0	89.0	92.1	89.9	89.1	1458/1749	83.4

[a] T = Targhee, S x T = Suffolk x Targhee.

[b] Does not include 7-month breeding. Including 7-month breeding, percentage was 76.5 (705 lambing/922 exposed).

* P<.05.

** P<.01.

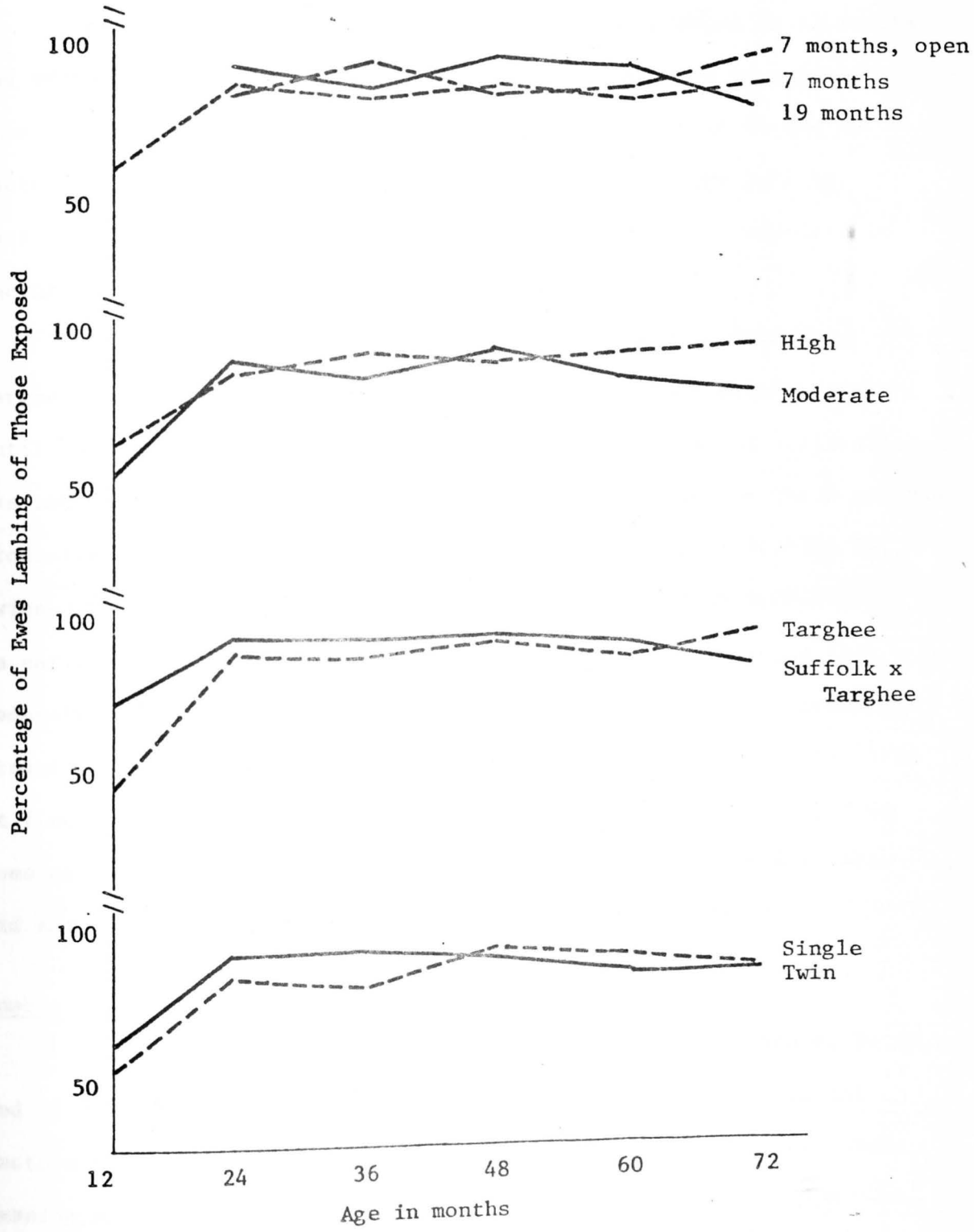

Figure 1. Percentage of ewes lambing of those exposed.

Significant differences between breeds were found at 12 months and overall. An average of 7.4% more Suffolk x Targhee ewes lambed than did Targhee ewes. Type of birth was significant at 24 and 36 months and overall with a higher percentage of the twins lambing. Postweaning nutrition and age at first breeding were not significant factors.

In looking at figure 1, it can be seen that the Suffolk x Targhees had a higher lambing percentage than straight Targhee ewes until 72 months of age. At this age, numbers were low and reliability was somewhat decreased. Singles, it seems, took longer to reach maximum productivity, but, once it was attained, they were as productive as twins. The two nutrition groups showed no difference in productivity in early years, although by 72 months it appeared that ewes on the moderate ration may have been less productive. Age at first breeding seemed to have no consistent effect, except that those ewes first bred at 7 months averaged slightly lower than the other two groups. This does not take into account the 12-month lamb crop, because some ewes did not have the opportunity to lamb at 12 months of age.

Number of Lambs Born and Weaned Per Ewe Exposed and Bred

The results of these analyses are presented in tables 8, 9, 10 and 11. Ewe breed and year were the only consistently significant factors in this portion of the study. The only exceptions were post-weaning nutrition at 12 months and age at first breeding at 24 months, both for number of lambs weaned per ewe lambing.

TABLE 8. LEAST SQUARES MEANS AND STANDARD ERRORS FOR NUMBER OF LAMBS BORN PER EWE EXPOSED

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	.74 ± .038	1.24 ± .031	1.27 ± .039	1.49 ± .048	1.56 ± .076	1.52 ± .100
Ewe type of birth						
Single	.71 ± .061	1.22 ± .047	1.24 ± .062	1.51 ± .071	1.55 ± .108	1.40 ± .130
Multiple	.77 ± .047	1.26 ± .036	1.31 ± .045	1.47 ± .061	1.58 ± .101	1.65 ± .151
Ewe breed[a]	***	***	***			
T	.54 ± .052	1.15 ± .040	1.16 ± .049	1.43 ± .062	1.49 ± .100	1.73 ± .152
S x T	.94 ± .055	1.33 ± .044	1.39 ± .058	1.56 ± .071	1.64 ± .113	1.32 ± .133
Postweaning nutrition						
High	.81 ± .053	1.20 ± .040	1.32 ± .051	1.50 ± .064	1.66 ± .096	1.70 ± .132
Moderate	.67 ± .053	1.28 ± .043	1.25 ± .055	1.49 ± .066	1.46 ± .110	1.35 ± .147
Age at first breeding						
7 months		1.38 ± .094	1.25 ± .054	1.44 ± .069	1.54 ± .116	1.57 ± .172
19 months		1.30 ± .048	1.24 ± .059	1.60 ± .068	1.64 ± .109	1.34 ± .154
7 months, open		1.14 ± .057	1.33 ± .080	1.44 ± .100	1.50 ± .158	1.66 ± .195
Year of production	***	***	***	***	*	
1972	.72 ± .084[b,c]					
1973	.84 ± .075[b]	.71 ± .062[b]				
1974	.93 ± .089[b]	1.42 ± .056[c]	.98 ± .072[b]			
1975	.76 ± .089[b,c]	1.15 ± .071[d]	1.49 ± .065[c]	1.22 ± .081[b]		
1976	.45 ± .089[c]	1.51 ± .073[c]	1.52 ± .080[c]	1.61 ± .072[c]	1.71 ± .102	
1977		1.41 ± .068[c]	1.10 ± .085[b]	1.66 ± .087[c]	1.41 ± .107	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

TABLE 9. LEAST SQUARES MEANS AND STANDARD ERRORS FOR NUMBER OF LAMBS WEANED PER EWE EXPOSED

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	.52 ± .034	.83 ± .030	.94 ± .039	1.09 ± .051	1.20 ± .073	1.06 ± .118
Ewe type of birth						
Single	.51 ± .054	.82 ± .046	.95 ± .061	1.09 ± .076	1.14 ± .104	1.07 ± .153
Muliplte	.53 ± .041	.83 ± .035	.94 ± .045	1.10 ± .065	1.26 ± .098	1.04 ± .179
Ewe breed[a]	***	*	***		*	
T	.37 ± .046	.76 ± .038	.84 ± .049	1.05 ± .067	1.05 ± .097	1.17 ± .181
S x T	.67 ± .049	.89 ± .043	1.05 ± .058	1.14 ± .076	1.35 ± .109	.94 ± .158
Postweaning nutrition	***					
High	.62 ± .047	.82 ± .039	.98 ± .051	1.14 ± .068	1.29 ± .093	1.24 ± .157
Moderate	.42 ± .047	.84 ± .041	.90 ± .054	1.05 ± .071	1.11 ± .107	.87 ± .174
Age at first breeding						
7 months		.88 ± .048	.86 ± .054	1.16 ± .074	1.15 ± .112	1.00 ± .204
19 months		.89 ± .046	.89 ± .059	1.11 ± .073	1.18 ± .105	.99 ± .182
7 months, open		.71 ± .055	1.07 ± .079	1.01 ± .107	1.26 ± .152	1.18 ± .230
Year of production		***	***	***		
1972	.43 ± .074					
1973	.60 ± .066	.53 ± .060[b]				
1974	.64 ± .079	.87 ± .054[c]	.76 ± .071[b]			
1975	.55 ± .079	.46 ± .069[b]	.94 ± .064[b]	.69 ± .087[b]		
1976	.39 ± .079	1.10 ± .070[d]	1.25 ± .079[c]	1.22 ± .077[c]	1.29 ± .099	
1977		1.17 ± .066[d]	.81 ± .084[b]	1.37 ± .094[c]	1.11 ± .103	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

TABLE 10. LEAST SQUARES MEANS AND STANDARD ERRORS FOR NUMBER OF LAMBS BORN PER EWE LAMBING

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	1.22 ± .036	1.37 ± .028	1.44 ± .033	1.65 ± .039	1.72 ± .063	1.64 ± .069
Ewe type of birth						
Single	1.19 ± .055	1.36 ± .043	1.44 ± .052	1.68 ± .057	1.70 ± .091	1.54 ± .091
Multiple	1.25 ± .046	1.37 ± .034	1.44 ± .038	1.62 ± .049	1.74 ± .085	1.74 ± .103
Ewe breed[a]	***	*	***			
T	1.08 ± .054	1.31 ± .038	1.34 ± .043	1.57 ± .050	1.68 ± .085	1.78 ± .103
S x T	1.36 ± .046	1.43 ± .040	1.54 ± .048	1.72 ± .058	1.76 ± .091	1.50 ± .094
Postweaning nutrition						
High	1.26 ± .045	1.35 ± .038	1.43 ± .041	1.68 ± .051	1.75 ± .077	1.75 ± .090
Moderate	1.18 ± .056	1.39 ± .039	1.45 ± .047	1.62 ± .054	1.69 ± .095	1.53 ± .103
Age at first breeding						
7 months		1.44 ± .047	1.51 ± .049	1.60 ± .056	1.80 ± .103	1.71 ± .121
19 months		1.37 ± .043	1.43 ± .051	1.65 ± .053	1.71 ± .087	1.53 ± .108
7 months, open		1.30 ± .053	1.38 ± .064	1.69 ± .083	1.65 ± .130	1.68 ± .130
Year of production		***	***	***		
1972	1.16 ± .075					
1973	1.36 ± .064	1.12 ± .070[b]				
1974	1.21 ± .066	1.48 ± .050[c]	1.31 ± .064[b]			
1975	1.16 ± .076	1.23 ± .065[b]	1.61 ± .052[c]	1.36 ± .066[b]		
1976	1.20 ± .111	1.53 ± .063[c]	1.64 ± .065[c]	1.75 ± .058[c]	1.76 ± .081	
1977		1.47 ± .061[c]	1.19 ± .069[b]	1.84 ± .069[c]	1.67 ± .092	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

TABLE 11. LEAST SQUARES MEANS AND STANDARD ERRORS FOR NUMBER OF LAMBS WEANED PER EWE LAMBING

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	.86 ± .046	.91 ± .031	1.06 ± .040	1.20 ± .050	1.32 ± .069	1.16 ± .105
Ewe type of birth						
Single	.87 ± .070	.91 ± .047	1.08 ± .061	1.20 ± .074	1.25 ± .100	1.20 ± .139
Multiple	.85 ± .057	.91 ± .037	1.04 ± .045	1.21 ± .063	1.38 ± .093	1.12 ± .158
Ewe breed[a]	**		*			
T	.74 ± .069	.86 ± .041	.96 ± .051	1.16 ± .065	1.19 ± .093	1.22 ± .158
S x T	.99 ± .058	.96 ± .043	1.16 ± .057	1.24 ± .075	1.44 ± .100	1.09 ± .143
Postweaning nutrition	*					
High	.97 ± .057	.91 ± .041	1.07 ± .049	1.26 ± .066	1.36 ± .084	1.29 ± .137
Moderate	.76 ± .071	.91 ± .043	1.05 ± .055	1.14 ± .069	1.27 ± .104	1.03 ± .158
Age at first breeding		*				
7 months		1.00 ± .051[b]	1.03 ± .058	1.29 ± .072	1.34 ± .113	1.29 ± .137
19 months		.94 ± .047[b,c]	1.03 ± .060	1.15 ± .068	1.23 ± .095	1.15 ± .164
7 months, open		.80 ± .058[c]	1.12 ± .076	1.17 ± .106	1.38 ± .142	1.19 ± .199
Year of production		***	***	***		
1972	.68 ± .095					
1973	.94 ± .081	.83 ± .076[b]				
1974	.84 ± .084	.90 ± .053[b]	.88 ± .082[b]			
1975	.83 ± .096	.48 ± .070[c]	1.00 ± .076[b]	.77 ± .085[b]		
1976	1.03 ± .140	1.12 ± .069[d]	1.01 ± .062[b]	1.32 ± .075[c]	1.33 ± .089	
1977		1.22 ± .066[d]	1.34 ± .077[c]	1.52 ± .089[c]	1.31 ± .101	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

When breed was significant, Suffolk x Targhees were superior in all cases. Botkin and Paules (1965) and Southam et al. (1971) also found lamb production to be greater for crossbreds than for purebreds.

Kilograms of Lamb Weaned Per Ewe Weaning a Lamb

These data are presented in table 12. Ewe type of birth was significant at 36 and 48 months. The twin ewes produced more kilograms of lamb. Breed was significant at all ages except 72 months. With the exception of the 24-month production, the Suffolk x Targhees produced more lamb than the Targhees. Postweaning nutrition was significant only at 36 months, with the ewes on the moderate ration being more productive. Age at first breeding was a significant factor at 24, 36 and 48 months. The results were not entirely consistent, although at 36 and 48 months those ewes first exposed at 19 months were the most productive and the ewes first bred at 7 months were least productive. Year was significant at 12 and 36 months. Lamb type of birth was significant at 24, 36, 48 and 60 months. In all cases, the more lambs born, the more kilograms of lamb were weaned.

In this portion of the study, it was shown that postweaning nutrition does not affect lifetime lamb productivity, that twin ewes are generally more productive and that Suffolk x Targhees generally produce more kilograms of lamb than Targhees. The results of crossbreeding are similar to those found by Botkin and Paules (1965), Southam et al. (1971) and Vesley and Peters (1974).

TABLE 12. LEAST SQUARES MEANS AND STANDARD ERRORS FOR TOTAL KILOGRAMS OF LAMB WEANED PER EWE WEANING A LAMB(S)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	19.7 ± .66	48.6 ± 1.65	47.2 ± 2.19	63.0 ± 3.58	57.6 ± 2.65	44.3 ± 4.95
Ewe type of birth			*	***		
Single	19.7 ± .92	50.0 ± 2.66	42.7 ± 2.75	52.4 ± 3.03	58.4 ± 3.85	47.7 ± 4.19
Multiple	19.6 ± .83	47.2 ± 1.85	51.6 ± 2.99	73.5 ± 6.63	56.8 ± 3.35	40.9 ± 8.49
Ewe breed[a]	***	***	***	*	***	
T	16.3 ± 1.10	55.4 ± 2.68	43.6 ± 2.43	60.2 ± 3.93	49.4 ± 3.77	43.3 ± 8.78
S x T	23.1 ± .63	41.9 ± 2.06	50.8 ± 2.27	65.8 ± 3.76	65.9 ± 3.43	45.3 ± 4.01
Postweaning nutrition			***			
High	19.7 ± .66	47.4 ± 2.33	39.2 ± 2.34	63.1 ± 3.60	58.1 ± 3.00	44.8 ± 7.71
Moderate	19.6 ± 1.04	49.9 ± 2.32	56.1 ± 3.99	62.8 ± 3.98	57.2 ± 3.98	43.8 ± 5.02
Age at first breeding		***	***	*		
7 months		54.7 ± 2.47[b]	37.4 ± 2.70[b]	34.4 ± 11.66[b]	57.6 ± 3.06	42.0 ± 8.39
19 months		49.8 ± 1.87[c]	55.4 ± 4.11[c]	90.6 ± 14.35[c]	53.9 ± 4.59	48.2 ± 4.93
7 months, open		41.4 ± 2.44[d]	48.7 ± 2.63[d]	64.0 ± 6.68[d]	61.3 ± 7.03	42.0 ± 8.39
Year of production	***		***			
1972	15.3 ± 1.45[b]					
1973	20.1 ± .90[c,e]	44.6 ± 2.84				
1974	17.3 ± 1.03[b,e]	49.4 ± 1.91	45.8 ± 2.76[b]			
1975	21.3 ± 1.28[c,f]	49.2 ± 2.50	42.8 ± 2.50[b]	60.2 ± 4.07		
1976	24.4 ± 1.80[d,f]	49.6 ± 2.28	54.8 ± 2.37[c]	85.6 ± 14.00	54.6 ± 3.87	
1977		50.4 ± 2.88	45.3 ± 3.08[b]	43.1 ± 8.52	60.7 ± 3.94	
Lamb type of birth		***	***	***	***	
Single	18.7 ± .53	37.0 ± .85[b]	35.6 ± 1.11[b]	41.0 ± 2.26[b]	42.9 ± 2.63[b]	37.0 ± 9.43
Twin	20.6 ± 1.16	43.7 ± 1.27[c]	49.5 ± 1.45[c]	56.4 ± 1.79[c]	64.8 ± 2.09[c]	51.6 ± 3.63
Triplet		65.2 ± 4.56[d]	56.4 ± 6.25[c]	91.6 ± 10.57[d]	65.2 ± 7.21[c]	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d,e,f] Means with different superscript in the same column and within main effect differ (P<.05).

* P<.05.

*** P<.005.

Lamb Weaning Weight

The results of this portion of the study are found in table 13. Ewe type of birth had little effect on lamb weaning weight. There was a significant difference at 36 months, with lambs from twin dams being heavier. This tends to agree with the findings of Terrill and Stoehr (1942). Ewe breed was significant at 12, 36 and 48 months. The lambs from Suffolk x Targhee dams were heavier. This agreed with results reported by Sidwell et al. (1964), which showed that three-way cross lambs were heavier than two-way crosses which were heavier than purebreds at weaning. Postweaning nutrition was significant only at 36 months. Age at first breeding was significant at 36 and 60 months but with no consistency in the results. Year was significant at 12, 24 and 36 months. Lamb type of birth was significant at all ages, with singles always weighing more than twins. This agreed with data from the parent ewes. Because of the low numbers, the weight differences of triplets were inconsistent. deBaca et al. (1956), Bailey et al. (1961), Lambe et al. (1964), Sidwell and Miller (1971b) and Vesely and Peters (1972) all found singles to have heavier weaning weights than twins. Sex of lamb was significant only at 36 months, with the male lambs being heavier. These results were inconsistent with most of the literature. Hazel and Terrill (1946a), Slen and Banky (1959), Bennett et al. (1963), Vesely et al. (1966) and Sidwell and Miller (1971b) all found that male lambs, whether rams or wethers, weaned heavier than ewe lambs.

TABLE 13. LEAST SQUARES MEANS AND STANDARD ERRORS FOR LAMB WEANING WEIGHT (KG)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	16.7 ± .54	31.4 ± 1.19	34.4 ± 1.23	36.1 ± 1.00	40.3 ± .83	36.4 ± 1.69
Ewe type of birth			***			
Single	17.4 ± .85	32.2 ± 1.98	31.2 ± 1.38	37.7 ± 1.07	40.1 ± 1.24	36.1 ± 1.22
Multiple	16.0 ± .57	30.5 ± 1.23	37.7 ± 1.51	34.5 ± 2.04	40.4 ± 1.09	36.8 ± 3.31
Ewe breed[a]	***		***	***		
T	14.5 ± .90	29.2 ± 1.74	32.5 ± 1.32	34.4 ± 1.17	39.8 ± 1.26	37.2 ± 3.20
S x T	18.9 ± .55	33.5 ± 1.77	36.4 ± 1.27	37.8 ± 1.07	40.8 ± 1.07	35.6 ± 1.27
Postweaning nutrition			***			
High	16.7 ± .69	31.2 ± 1.78	29.9 ± 1.14	36.1 ± 1.03	39.9 ± .98	37.5 ± 2.77
Moderate	16.7 ± .74	31.6 ± 2.12	38.9 ± 2.24	36.1 ± 1.16	40.6 ± 1.22	35.4 ± 1.50
Age at first breeding			***		*	
7 months		31.3 ± 1.81	27.9 ± 1.14[b]	40.7 ± 3.96	40.4 ± .98[b]	35.5 ± 2.99
19 months		32.5 ± 1.38	38.9 ± 2.24[c]	31.9 ± 4.61	36.4 ± 1.53[c]	37.3 ± 1.78
7 months, open		30.3 ± 1.85	35.7 ± 1.41[d]	35.7 ± 2.07	44.0 ± 2.09[d]	36.5 ± 3.23
Year of production	***	***	***			
1972	13.8 ± 1.17[b]					
1973	15.7 ± .78[b,c]	23.1 ± 1.95[b]				
1974	16.2 ± .75[c]	27.4 ± 1.42[c]	29.3 ± 1.45[d]			
1975	18.7 ± 1.01[d]	39.5 ± 2.08[d]	33.7 ± 1.38[c]	37.3 ± 1.21		
1976	19.3 ± 1.13[d]	37.4 ± 1.80[d]	39.4 ± 1.27[c]	33.3 ± 4.30	41.3 ± 1.22	
1977		29.4 ± 2.28[c]	35.4 ± 1.60[c]	37.6 ± 2.70	39.2 ± 1.29	
Lamb type of birth	***	***	***	***	***	*
Single	18.9 ± .53	36.6 ± .76[b]	35.4 ± .57[b]	41.6 ± .85[b]	42.6 ± .96[b]	40.4 ± 3.32
Twin	14.5 ± .92	26.7 ± .93[c]	31.3 ± .62[c]	36.0 ± .59[c]	37.9 ± .65[c]	32.4 ± 1.01
Triplet		30.7 ± 3.21[c]	36.5 ± 3.59[c]	30.7 ± 2.92[d]	40.3 ± 2.29[b,c]	
Sex of lamb			**			
Ewe	15.9 ± .64	31.6 ± 1.60	31.4 ± .93	36.1 ± 1.19	40.3 ± 1.22	35.8 ± 1.66
Wether	17.5 ± .67	31.1 ± 1.82	37.5 ± 2.17	36.1 ± 1.30	40.2 ± .92	37.1 ± 2.56
Ram	16.7 ± 1.33					

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.
** P<.01.
*** P<.005.

Wool Production

The results of the wool production analyses can be found in table 14. Wool production is shown only for ewes weaning a lamb(s). Type of birth was significant only at 12 months, with singles shearing heavier ($P<.01$) fleeces. Singles continued to shear heavier fleeces, although not significantly as age progressed. This corresponded well with the literature. The literature revealed that single ewes tended to shear heavier fleeces in their lifetimes, although the difference was usually small and not significant. This was reported by Hazel and Terrill (1946b), Price et al. (1953), Slen and Banky (1958, 1959), Dun and Grewal (1963), Brown et al. (1966) and Sidwell and Miller (1971a). The difference of .15 kg in yearling fleece weight reported by Dun and Grewal(1966) was similar to the .19 kg reported in this study.

At all ages, Targhees sheared heavier ($P<.005$) fleeces by as much as .74 kilogram. The difference at 12 months, .48 kg (3.30 vs 2.82 kg), was less than that reported by Sidwell et al. (1971) of 1.12 kg (4.82 vs 3.70 kg) in a study involving Targhee and Suffolk x Targhee ewes.

Postweaning nutrition was significant only at 12 months, with ewes on a higher plane of nutrition having fleeces .17 kg heavier ($P<.05$) than the ewes fed a moderate ration. This advantage, although not significant, continued until the ewes were 60 months of age. Both Jordan et al. (1970) and Southam et al. (1971) found yearling fleece weights to be higher for ewes fed on a higher postweaning plane of nutrition.

TABLE 14. LEAST SQUARES MEANS AND STANDARD ERRORS FOR FLEECE WEIGHT (KG) FOR EWES WEANING A LAMB(S)

Parameter	Age (month) 12	24	36	48	60	72
Overall mean	3.02 ± .030	4.60 ± .029	4.17 ± .036	4.39 ± .051	4.47 ± .063	4.54 ± .115
Ewe type of birth	**					
Single	3.16 ± .055	4.65 ± .053	4.18 ± .073	4.37 ± .092	4.62 ± .106	4.51 ± .165
Multiple	2.97 ± .047	4.53 ± .043	4.07 ± .062	4.40 ± .079	4.54 ± .102	4.55 ± .190
Ewe breed[a]	***	***	***	***	***	
T	3.30 ± .055	4.91 ± .074	4.49 ± .071	4.73 ± .082	4.84 ± .103	4.87 ± .188
S x T	2.82 ± .046	4.26 ± .049	3.75 ± .068	4.05 ± .093	4.32 ± .108	4.20 ± .170
Postweaning nutrition	*					
High	3.15 ± .045	4.64 ± .047	4.20 ± .063	4.44 ± .083	4.50 ± .093	4.54 ± .163
Moderate	2.98 ± .057	4.54 ± .048	4.05 ± .071	4.33 ± .086	4.66 ± .115	4.53 ± .187
Age at first breeding		***				
7 months	3.06 ± .037	4.45 ± .057^{b}	4.10 ± .080	4.39 ± .090	4.51 ± .122	4.62 ± .219
19 months		4.54 ± .053^{b}	4.10 ± .076	4.48 ± .085	4.53 ± .102	4.79 ± .195
7 months, open		4.77 ± .065^{c}	4.16 ± .091	4.29 ± .132	4.69 ± .156	4.19 ± .236
Year of production	***	***	***		***	
1972	3.55 ± .080^{b}					
1973	2.44 ± .065^{c}	4.40 ± .088^{b}				
1974	3.33 ± .067^{b}	4.89 ± .061^{c}	3.92 ± .127^{b}			
1975	3.05 ± .076^{d}	4.48 ± .078^{d,e}	4.63 ± .067^{c}	4.25 ± .107		
1976	2.94 ± .111^{d}	4.71 ± .078^{d,e}	3.96 ± .086^{b}	4.38 ± .094	3.98 ± .097	
1977		4.82 ± .074^{c}	3.98 ± .090^{b}	4.53 ± .109	5.18 ± .111	

[a] T = Targhee, S x T = Suffolk x Targhee.

[b,c,d,e] Means with different superscripts in the same column and within main effect differ (P<.05).

* P<.05.

** P<.01.

*** P<.005.

Age at first breeding was a significant factor only at 24 months, with the ewes exposed but not bred at 7 months of age having heavier ($P<.005$) fleeces than ewes from both remaining groups. This difference may be due in part to the fact that this group had a lower lambing percentage than the other two groups the preceding year, thus increasing wool production. The results of a study by Ray and Sidwell (1964) showed that ewes lambing and lactating produced significantly less wool than open ewes.

Results of analyses of data from succeeding shearings showed no consistent difference in wool production for ewes bred first as lambs vs those bred as yearlings, which was somewhat different from the results found in the literature. Spencer et al. (1942) and Levine et al. (1978) found that breeding ewe lambs did cause a decrease in lifetime wool production. Tyrell (1976) found that after a 7% difference at 12 months of age there was no difference in succeeding years. Hulet et al. (1969) found that there was no significant association of the incidence of early estrus and wool production on an overall comparison in a study involving Targhee, Rambouillet and Columbia ewes; but within the Targhee group, the lifetime fleece weights were lower for those showing estrus in their first winter.

Year effects on wool production were highly significant at 12, 24, 36 and 60 months.

Ewe Losses

Table 15 lists the causes of ewe losses from the flock from the beginning of the study through and including 1977. The "unknown" category includes all ewes missing with no date of death or those having a reported date of death but with no recorded reason. Also included in this group were any ewes whose identity was lost. Those ewes listed as having been culled were culled either for having bad udders, a bad mouth or failure to lamb for two consecutive years. Suspected predator losses were recorded as unknown unless the kill was verified by actual sight or examination of the carcass.

Table 16 shows the percentages of ewes remaining in the flock each year. Out of 607 ewes, 203 or 33.4% were lost from the flock over the 6-year period.

TABLE 15. CAUSES OF EWE LOSSES FROM THE STUDY (1971-1977)

Cause of loss	No. (607)	Percentage of total loss
Unknown	130 (21.4)[a]	64.0
Culled	23 (3.8)	11.3
Vaginal prolapse	14 (2.3)	6.9
Rectal prolapse	12 (2.0)	5.9
Lambing problems	6 (1.0)	3.0
Other	18 (3.0)	8.9
Total	203 (33.4)	100.0

[a] Numbers in parentheses are percentage values.

TABLE 16. PERCENTAGES OF EWES REMAINING IN THE STUDY

Year of birth	Original no.	Age of ewe in years					
		1	2	3	4	5	6
1971	114	93.9	90.4	83.3	67.5	61.4	47.4
1972	139	97.8	89.9	82.0	71.2	56.1	
1973	142	94.4	83.1	73.9	66.2		
1974	118	94.1	83.9	74.6			
1975	94	95.7	94.7				

SUMMARY

The objectives of this study were to determine which combinations of factors (traditional vs innovative) would result in the greatest lamb and wool production from ewes on a typical range operation. The factors studied were type of birth, breed, postweaning nutrition and age at first breeding.

Breed was the only factor studied which affected wool production. Targhee ewes were clearly superior to Suffolk x Targhee ewes in this trait. Single ewes and ewes on the higher plane of nutrition tended to shear heavier fleeces, although not significantly so. Age at first breeding did not affect wool production consistently.

Lamb production was affected most by ewe breed, with the crossbred ewes being superior over the straightbred ewes. The higher energy ration postweaning had a positive effect, although not significantly so. Type of birth results were in favor of twin ewes when there was a difference. Age at first breeding did not consistently affect lamb production.

In conclusion, it may be determined from this study that age at first breeding and postweaning nutrition do not affect annual lamb and wool production of mature ewes, that twin ewes tend to produce more lamb and that straightbred Targhees produce more wool while Suffolk x Targhees produce more lamb.

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APPENDIX

TABLE 1. LEAST SQUARES ANALYSIS OF VARIANCE FOR EWE DATE OF BIRTH, BIRTH WEIGHT, 7-MONTH WEIGHT, 7-MONTH HEIGHT, WEANING WEIGHT AND WEIGHT:HEIGHT RATIO

Source	Birth date[a]		Birth weight (kg)		7-month weight (kg)		7-month height (cm)		Weaning weight (kg)		Weight:height ratio (kg/cm)	
	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (TB)	1	.168	1	74.9101***	1	2657.437***	1	266.2763***	1	3028.335***	1	.42634***
Ewe breed	1	68.786	1	21.6401***	1	2511.666***	1	23.146	1	659.057***	1	.76196***
Postweaning nutrition (Nutr.)	1	.021	1	3.3089***	1	3586.945***	1	270.7716***	1	.849	1	.58310***
Age at first breeding (Age)	2	54.304	2	.6064	2	75.673	2	28.9554*	2	33.333	2	.01343
Year of Birth (Year)	4	1046.566***	4	2.4004***	4	1515.373***	4	432.8304***	4	1576.800***	2	.28708***
TB x Breed	1	23.587	1	.5422	1	.131	1	.6882	1	7.966	1	.00000
TB x Nutr.	1	2.610	1	.1279	1	95.747	1	17.4775	1	8.101	1	.01607
TB x Age	2	15.267	2	.2331	2	25.753	2	21.6815	2	.510	2	.01118
TB x Year	4	68.933	4	.2738	4	59.331	4	12.3281	4	106.486***	4	.01215
Breed x Nutr.	1	1.767	1	.3526	1	7.728	1	.9583	1	.409	1	.00070
Breed x Age	2	94.057	2	1.0508	2	56.990	2	4.3465	2	12.071	2	.01156
Breed x Year	4	117.180*	4	.2709	4	168.180***	4	52.5042***	4	58.014***	4	.01569
Nutr. x Age	2	28.764	2	.0304	2	23.960	2	7.3071	2	6.143	2	.00337
Nutr. x Year	4	14.800	4	.2340	4	232.508***	4	30.1114*	4	23.802	4	.08078***
Age x Year	8	25.495	8	.3440	8	49.466	8	5.1947	8	11.531	8	.01104
Error	543	47.798	545	.4135	540	30.617	540	9.0254	544	14.766	540	.00674

[a] Days after January 1.
* P<.05.
** P<.01.
*** P<.005.

TABLE 2. LEAST SQUARES ANALYSIS OF VARIANCE FOR ANNUAL EWE WEIGHT (KG)

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	1380.475***	1	623.020***	1	469.603***	1	77.570	1	131.478	1	235.221*
Ewe breed	1	2756.406***	1	609.243***	1	1041.991***	1	540.972***	1	105.501	1	185.816
Postweaning nutrition (Nutr.)	1	502.291***	1	24.574	1	4.212	1	1.396	1	7.729	1	.032
Age at first breeding (Age)	2	535.294***	2	1.929	1	14.057	2	15.205	2	104.140	2	310.664**
Year of production (Year)	4	2824.050***	4	981.098***	3	1365.340***	2	2020.623***	1	959.515***		
TB x Breed	1	.073	1	1.164	1	97.241	1	108.391	1	69.920	1	1.363
TB x Nutr.	1	40.880	1	146.546	1	31.443	1	184.636*	1	43.045	1	4.701
TB x Age	2	10.818	2	4.480	2	4.431	2	29.477	2	5.514	2	4.806
TB x Year	4	55.950	4	16.271	3	34.715	2	41.827	1	.470		
Breed x Nutr.	1	2.356	1	17.679	1	15.348	1	3.421	1	10.454	1	206.323
Breed x Age	2	150.845*	2	8.027	2	25.480	2	41.592	2	67.096	2	11.301
Breed x Year	4	84.158*	4	52.592	3	17.231	2	56.594	1	5.050		
Nutr. x Age	2	30.836	2	4.960	2	9.803	2	7.688	2	85.380	2	248.795*
Nutr. x Year	4	15.905	4	9.437	3	28.511	2	65.560	1	.032		
Age x Year	8	253.469***	8	90.485*	6	42.047	4	156.248**	2	172.874*		
Error	514	33.347	430	40.788	315	40.061	214	43.799	102	51.683	35	42.799

* P<.05.
** P<.01.
*** P<.005.

TABLE 3. LEAST SQUARES ANALYSIS OF VARIANCE FOR ANNUAL WEIGHT (KG) OF THOSE EWES WEANING A LAMB(S)

	Age (month)											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (TB)	1	340.489***	1	494.698***	1	277.285**	1	12.850	1	48.872	1	89.849
Ewe breed	1	498.788***	1	321.113***	1	484.065***	1	497.764***	1	140.547	1	43.947
Postweaning nutrition (Nutr.)	1	54.625	1	79.193	1	14.701	1	.061	1	13.726	1	9.316
Age at first breeding (Age)			2	8.674	2	3.946	2	8.908	2	65.730	2	302.191**
Year of production (Year)	4	1101.510***	4	717.017***	3	916.175***	2	1828.562***	1	584.339***		
TB x Breed	1	3.033	1	27.084	1	102.434	1	8.160	1	33.184	1	57.279
TB x Nutr.	1	52.345	1	129.847	1	2.136	1	216.763*	1	38.999	1	24.508
TB x Age			2	3.482	2	4.713	2	7.570	2	.592	2	18.642
TB x Year	4	19.014	4	12.271	3	27.340	2	24.753	1	.224		
Breed x Nutr.	1	69.816	1	.002	1	19.141	1	25.049	1	1.301	1	139.400
Breed x Age			2	3.163	2	16.797	2	4.220	2	78.012	2	15.472
Breed x Year	4	49.073	4	30.786	3	10.077	2	1.349	1	27.445		
Nutr. x Age			2	.007	2	3.442	2	46.409	2	57.904	2	274.370**
Nutr. x Year	4	6.854	4	8.581	3	72.684	2	132.944*	1	.498		
Age x Year			8	77.579*	6	30.060	4	146.329***	2	125.552*		
Error	152	26.175	286	35.273	233	39.265	161	34.410	81	39.142	24	47.047

* P<.05.
** P<.01.
*** P<.005.

TABLE 4. LEAST SQUARES ANALYSIS OF VARIANCE FOR ANNUAL EWE WITHER HEIGHT (CM)

	Age (month)											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (TB)	1	76.2579***	1	35.3274*	1	2.5664	1	13.7449	1	25.8576*	1	56.3926**
Ewe breed	1	48.6649***	1	156.4030***	1	39.3211*	1	63.0821***	1	52.4278***	1	4.7949
Postweaning nutrition (Nutr.)	1	32.6618*	1	.0304	1	3.1898	1	.8989	1	2.9892	1	2.6981
Age at first breeding (Age)	2	17.1714	2	.0042	2	1.8437	2	17.3875	2	11.3885	2	15.2473
Year of production (Year)	4	527.1594***	4	192.8040***	3	73.2279***	2	207.5483***	1	16.1732		
TB x Breed	1	2.9849	1	13.2398	1	.0003	1	22.2784	1	.4837	1	3.6694
TB x Nutr.	1	.0258	1	1.1120	1	74.9629***	1	13.9748	1	3.1661	1	.3599
TB x Age	2	4.2485	2	6.3149	2	9.3744	2	14.9441	2	5.5275	2	6.8486
TB x Year	4	13.7613	4	4.4666	3	3.1249	2	.8892	1	24.6510*		
Breed x Nutr.	1	.3555	1	1.8887	1	.1702	1	5.3556	1	.0731	1	.2711
Breed x Age	2	.1002	2	1.2718	2	25.1897	2	4.7133	2	1.6330	2	3.6747
Breed x Year	4	10.1296	4	58.1511***	3	21.5943	2	10.4928	1	.1570		
Nutr. x Age	2	11.4417	2	4.3811	2	.5703	2	2.6636	2	4.4327	2	16.9464
Nutr. x Year	4	5.9950	4	4.1357	3	9.2067	2	1.5929	1	.0480		
Age x Year	8	15.5948**	8	9.7660	6	15.5851	4	14.7790	2	26.3355**		
Error	513	5.8411	430	6.6806	315	8.7723	214	6.7563	102	5.2780	35	6.8152

* P<.05.
** P<.01.
*** P<.005.

TABLE 5. LEAST SQUARES ANALYSIS OF VARIANCE FOR ANNUAL WITHER HEIGHT (CM) OF THOSE EWES WEANING A LAMB(S)

	Age (month)											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (TB)	1	20.5412	1	10.6324	1	.2041	1	5.0624	1	11.8509	1	25.8711*
Ewe breed	1	4.1978	1	113.8397***	1	23.7968	1	45.6023**	1	44.5996***	1	5.5564
Postweaning nutrition (Nutr.)	1	.4498	1	3.8274	1	.0009	1	.0164	1	5.1399	1	.0064
Age at first breeding (Age)			2	4.1560	2	2.8108	2	18.1237	2	5.5790	2	17.1888*
Year of production (Year)	4	188.5881***	4	102.4235***	3	60.4940***	2	196.4119***	1	16.0757		
TB x Breed	1	2.9833	1	33.2330*	1	3.6073	1	9.4539	1	6.9290	1	1.0815
TB x Nutr.	1	6.5998	1	5.4343	1	57.7844*	1	14.5939	1	.6251	1	.8935
TB x Age			2	4.4257	2	3.0050	2	6.8196	2	9.6273	2	1.8126
TB x Year	4	23.8421***	4	2.8500	3	5.3190	2	.0345	1	20.9044*		
Breed x Nutr.	1	.2086	1	2.0022	1	1.3460	1	19.6586	1	.9005	1	.3641
Breed x Age			2	1.1410	2	8.5426	2	2.6691	2	4.9611	2	.2274
Breed x Year	4	4.7270	4	33.7395***	3	18.5209	2	16.8547	1	.0808		
Nutr. x Age			2	7.1631	2	1.4756	2	1.5953	2	2.9086	2	26.5746*
Nutr. x Year	4	5.8968	4	4.2576	3	3.0627	2	.7413	1	.3546		
Age x Year			8	9.9613	6	14.7353	4	10.7030	2	27.9530**		
Error	152	6.0427	286	6.3117	233	9.0010	161	6.8559	81	5.2236	24	5.0376

* P<.05.
** P<.01.
*** P<.005.

TABLE 6. LEAST SQUARES ANALYSIS OF VARIANCE FOR LAMBING DATE (DAYS AFTER JANUARY 1)

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	405.328*	1	319.948*	1	29.654	1	6087.283***	1	170.109	1	.038
Ewe breed	1	416.928*	1	193.743	1	1967.482***	1	2707.498*	1	12.932	1	97.981
Postweaning nutrition (Nutr.)	1	251.903	1	30.843	1	119.650	1	57.400	1	124.160	1	431.413
Age at first breeding (Age)			2	187.448	2	12.382	2	2268.888*	2	20.173	2	2.682
Year of production (Year)	4	1817.519***	4	62224.084***	3	29783.709***	2	90871.476***	1	25334 536***		
TB x Breed	1	61.295	1	.155	1	2.723	1	4314.263**	1	6.433	1	264.868
TB x Nutr.	1	81.151	1	336.990*	1	14.674	1	873.170	1	28.189	1	286.475
TB x Age			2	.976	2	24.355	2	3544.785***	2	81.397	2	122.353
TB x Year	4	26.112	4	76.776	3	21.700	2	2445.251*	1	.112		
Breed x Nutr.	1	15.772	1	4.947	1	419.605*	1	38.540	1	1.231	1	290.002
Breed x Age			2	125.174	2	143.847	2	2511.341*	2	207.823*	2	270.097
Breed x Year	4	136.009	4	214.642*	3	131.985	2	2769.747**	1	182.358		
Nutr. x Age			2	79.064	2	116.691	2	294.868	2	95.482	2	21.097
Nutr. x Year	4	83.855	4	256.529*	3	276.996	2	575.497	1	54.073		
Age x Year			8	71.402	6	108.426	4	1889.141*	2	36.708		
Error	204	80.560	423	83.329	307	101.771	219	595.960	113	65.205	34	296.675

* P<.05.
** P<.01.
*** P<.005.

TABLE 7. CHI-SQUARE ANALYSIS FOR PERCENTAGE OF EWES LAMBING OF THOSE EXPOSED

Age of ewe	χ^2 value			
	Breed	Nutrition	Age at first breeding	Type of birth
12 months	17.29**	2.80		1.33
24 months	1.97	1.05	5.76	13.19**
36 months	1.27	2.90	4.58	10.12**
48 months	.21	1.38	5.51	.09
60 months	.48	2.55	2.65	.47
72 months	1.53	3.41	2.79	.02
Overall	17.35**	2.48	6.16[a]	5.92*

[a] Does not include 7-month breeding.

* $P<.05$, χ^2 value = 3.84 and 5.99 for one and two degrees of freedom, respectively.

** $P<.01$, χ^2 value = 6.63 and 9.21 for one and two degrees of freedom, respectively.

TABLE 8. LEAST SQUARES ANALYSIS OF VARIANCE FOR NUMBER OF LAMBS BORN PER EWE EXPOSED

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	.313	1	.128	1	.311	1	.085	1	.027	1	.726
Ewe breed	1	13.651***	1	3.628***	1	3.925***	1	.859	1	.605	1	1.694
Postweaning nutrition (Nutr.)	1	1.541	1	.796	1	.687	1	.016	1	1.289	1	1.419
Age at first breeding (Age)			2	.885	2	.178	2	.663	2	.199	2	.407
Year of production (Year)	4	1.904***	4	9.520***	3	5.529***	2	3.856***	1	2.591*		
TB x Breed	1	.379	1	.062	1	.000	1	.043	1	1.274	1	.001
TB x Nutr.	1	.031	1	.192	1	.641	1	.006	1	.061	1	1.247
TB x Age			2	1.969***	2	.814	2	.552	2	2.493*	2	.022
TB x Year	4	.298	4	.270	3	.138	2	.039	1	.005		
Breed x Nutr.	1	1.396	1	.240	1	.986	1	.080	1	.131	1	.710
Breed x Age			2	.676	2	.081	2	.151	2	.484	2	.072
Breed x Year	4	.296	4	.734	3	.279	2	.434	1	.091		
Nutr. x Age			2	.058	2	.115	2	.546	2	.503	2	.182
Nutr. x Year	4	.686	4	.476	3	.006	2	.182	1	.317		
Age x Year			8	.472	6	.492	4	.459	2	.055		
Error	354	.457	480	.352	349	.394	240	.432	128	.613	40	.433

* P<.05.
*** P<.005.

TABLE 9. LEAST SQUARES ANALYSIS OF VARIANCE FOR NUMBER OF LAMBS WEANED PER EWE EXPOSED

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	.042	1	.009	1	.011	1	.008	1	.425	1	.014
Ewe breed	1	7.867***	1	1.768*	1	3.117***	1	.445	1	2.571*	1	.566
Postweaning nutrition (Nutr.)	1	3.253***	1	.040	1	.508	1	.455	1	1.023	1	1.555
Age at first breeding (Age)			2	1.320	2	1.002	2	.321	2	.111	2	.138
Year of production (Year)	4	.750	4	7.999***	3	3.154***	2	.413***	1	.960		
TB x Breed	1	.452	1	.518	1	.379	1	.001	1	1.349	1	.855
TB x Nutr.	1	.193	1	.202	1	1.426	1	.128	1	1.316	1	.451
TB x Age			2	.791	2	1.337*	2	.437	2	2.839**	2	.071
TB x Year	4	.096	4	.213	3	.531	2	.174	1	.238		
Breed x Nutr.	1	.377	1	.462	1	1.031	1	.193	1	.173	1	.507
Breed x Age			2	.305	2	.251	2	.170	2	1.122	2	.034
Breed x Year	4	.310	4	1.037*	3	.165	2	.077	1	1.387		
Nutr. x Age			2	.745	2	.698	2	.266	2	.270	2	.135
Nutr. x Year	4	.759	4	.252	3	.032	2	.189	1	.484		
Age x Year			8	.375	6	.396	4	.361	2	.379		
Error	354	.362	480	.329	349	.387	240	.497	128	.569	40	.609

* P<.05.
** P<.01.
*** P<.005.

TABLE 10. LEAST SQUARES ANALYSIS OF VARIANCE FOR NUMBER OF LAMBS BORN PER EWE LAMBING

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	.139	1	.011	1	.000	1	.141	1	.033	1	.428
Ewe breed	1	3.167***	1	1.420*	1	2.273***	1	.938	1	.130	1	.747
Postweaning nutrition (Nutr.)	1	.254	1	.174	1	.024	1	.151	1	.101	1	.494
Age at first breeding (Age)			2	.594	2	.361	2	.099	2	.177	2	.146
Year of production (Year)	4	.308	4	2.064***	3	2.998***	2	3.722***	1	.211.		
TB x Breed	1	.069	1	.052	1	.110	1	.044	1	.554*	1	.047
TB x Nutr.	1	.311	1	.299	1	.040	1	.000	1	.043	1	.791
TB x Age			2	.544	2	.207	2	.124	2	.453	2	.050
TB x Year	4	.295	4	.207	3	.151	2	.161	1	.048		
Breed x Nutr.	1	.030	1	.006	1	.692	1	.079	1	.195	1	.000
Breed x Age			2	.520	2	.778*	2	.252	2	.367	2	.316
Breed x Year	4	.187	4	1.038***	3	.869*	2	.434	1	.013		
Nutr. x Age			2	.122	2	.048	2	.676	2	.285	2	.613
Nutr. x Year	4	.168	4	.325	3	.033	2	.094	1	1.367		
Age x Year			8	.210	6	.199	4	.362	2	.517		
Error	204	.199	423	.263	307	.239	219	.247	113	.372	34	.194

* P<.05.
*** P<.005.

TABLE 11. LEAST SQUARES ANALYSIS OF VARIANCE FOR NUMBER OF LAMBS WEANED PER EWE LAMBING

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	.018	1	.000	1	.123	1	.006	1	.440	1	.067
Ewe breed	1	2.473**	1	.789	1	2.224*	1	.265	1	1.602	1	.152
Postweaning nutrition (Nutr.)	1	1.847*	1	.000	1	.010	1	.711	1	.218	1	.676
Age at first breeding (Age)			2	1.107*	2	.172	2	.452	2	.244	2	.007
Year of production (Year)	4	.508	4	5.565***	3	2.232***	2	8.468***	1	.009		
TB x Breed	1	.495	1	.503	1	.167	1	.072	1	1.639	1	1.204
TB x Nutr.	1	.099	1	.169	1	.315	1	.136	1	1.256	1	.208
TB x Age			2	.191	2	.637	2	.303	2	.853	2	.023
TB x Year	4	.233	4	.173	3	.554	2	.278	1	.069		
Breed x Nutr.	1	.005	1	.300	1	1.021	1	.223	1	.168	1	2.056*
Breed x Age			2	.357	2	.587	2	.162	2	.959	2	.144
Breed x Year	4	.237	4	1.224***	3	.463	2	.106	1	1.751		
Nutr. x Age			2	.894	2	.720	2	.194	2	.235	2	.619
Nutr. x Year	4	.686	4	.089	3	.058	2	.072	1	1.392		
Age x Year			8	.369	6	.341	4	.264	2	.549		
Error	204	.316	423	.310	307	.336	219	.409	113	.447	34	.452

* P<.05.
** P<.01.
*** P<.005.

TABLE 12. LEAST SQUARES ANALYSIS OF VARIANCE FOR TOTAL KILOGRAMS OF LAMB WEANED PER EWE WEANING A LAMB(S)

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS
Ewe type of birth (TB)	1	.275	1	81.129	1	791.213*
Ewe breed	1	725.235***	1	1573.752***	1	2487.412***
Postweaning nutrition (Nutr.)	1	.096	1	57.351	1	1488.771***
Age at first breeding (Age)			2	789.309***	2	855.823***
Year of production (Year)	4	148.020***	4	113.999	3	1481.186***
Lamb TB	1	53.440	2	2604.098***	2	4512.693***
Ewe TB x Breed	1	49.493	1	363.776	1	.190
Ewe TB x Nutr.	1	12.453	1	185.189	1	67.699
Ewe TB x Age			2	109.456	2	123.583
Ewe TB x Year	4	29.878	4	20.198	3	27.346
Ewe TB x Lamb TB	1	151.693**	2	46.693	2	264.048
Breed x Nutr.	1	10.873	1	8.837	1	66.436
Breed x Age			2	34.451	2	179.750
Breed x Year	4	40.188	4	11.554	3	566.774**
Breed x Lamb TB	1	251.982***	2	2086.325***	1	105.692
Nutr. x Age			2	24.847	2	405.231
Nutr. x Year	4	16.477	4	321.892*	3	74.970
Nutr. x Lamb TB	1	.782	2	20.266	2	1170.515***
Age x Year			8	104.906	6	187.996
Age x Lamb TB			3	582.237***	3	1082.502***
Year x Lamb TB	4	47.310	5	213.905	3	545.343**
Error	144	23.307	297	103.379	239	138.161

* P<.05.
** P<.01.
*** P<.005.

TABLE 12 CONTINUED

Source	Age (month) 48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	1647.601***	1	23.665	1	139.781
Ewe breed	1	796.983*	1	2442.219***	1	10.936
Postweaning nutrition (Nutr.)	1	3.063	1	8.668	1	2.972
Age at first breeding (Age)	2	686.387*	2	69.873	2	79.837
Year of production (Year)	2	498.025	1	245.469		
Lamb TB	2	4684.791***	2	4949.665***	1	477.606
Ewe TB x Breed	1	198.244	1	117.999	1	152.238
Ewe TB x Nutr.	1	170.744	1	1888.524***	1	275.682
Ewe TB x Age	2	26.216	2	27.402	2	172.445
Ewe TB x Year	2	30.003	1	17.821		
Ewe TB x Lamb TB	2	928.769*	2	141.513	1	11.507
Breed x Nutr.	1	124.780	1	203.834	1	559.253
Breed x Age	2	8.116	2	302.227	2	94.700
Breed x Year	2	53.558	1	646.741		
Breed x Lamb TB	1	106.189	2	345.881	1	152.434
Nutr. x Age	2	28.432	2	704.608*	2	80.480
Nutr. x Year	2	198.942	1	66.947		
Nutr. x Lamb TB	1	20.949	2	11.444	1	29.629
Age x Year	4	25.246	2	122.654		
Age x Lamb TB	4	425.428	4	46.666	2	24.341
Year x Lamb TB	3	328.315	2	33.873		
Error	169	204.467	85	216.022	21	241.301

TABLE 13. LEAST SQUARES ANALYSIS OF VARIANCE FOR LAMB WEANING WEIGHT (KG)

Source	Age (month) 12 df	12 MS	36 df	36 MS	48 df	48 MS
Ewe type of birth (TB)	1	26.487	1	45.197	1	653.327***
Ewe breed	1	227.176***	1	218.588	1	864.877***
Postweaning nutrition (Nutr.)	1	.024	1	1.574	1	434.510***
Age at first breeding (Age)			2	107.141	2	402.096***
Year of production (Year)	4	68.721***	4	1560.008***	3	962.518***
Lamb TB	1	221.674***	2	2974.359***	2	475.717***
Sex of lamb	2	21.397	1	3.590	1	257.948**
Ewe TB x Breed	1	61.060*	1	296.854	1	.178
Ewe TB x Nutr.	1	.003	1	15.714	1	.018
Ewe TB x Age			2	92.347	2	128.126*
Ewe TB x Year	4	3.263	4	9.633	3	2.760
Ewe TB x Lamb TB	1	60.569*	2	51.935	2	283.846***
Ewe TB x Sex	2	5.574	1	217.679	1	28.643
Breed x Nutr.	1	.097	1	117.939	1	18.982
Breed x Age			2	15.895	2	3.061
Breed x Year	4	9.568	4	6.565	3	87.924
Breed x Lamb TB	1	4.713	2	50.958	1	125.709
Breed x Sex	2	22.089	1	.710	1	64.164
Nutr. x Age			2	75.679	2	100.629
Nutr. x Year	4	7.599	4	30.327	3	31.524
Nutr. x Lamb TB	1	.041	2	3.185	2	287.392***
Nutr. x Sex	2	8.803	1	342.076*	1	16.245
Age x Year			8	97.841	6	172.011***
Age x Lamb TB			3	34.310	3	239.637***
Age x Sex			2	120.572	2	74.086
Year X Lamb TB	4	8.338	5	886.203***	3	30.264
Year x Sex			4	23.232	3	253.575***
Lamb TB x Sex	2	15.035	2	41.966	2	363.611***
Error	161	12.179	367	80.492	308	35.506

* P<.05. ** P<.01. *** P<.005.

TABLE 13 CONTINUED

Source	Age (month) 48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (TB)	1	46.043	1	1.056	1	.637
Ewe breed	1	348.607***	1	11.109	1	4.177
Postweaning nutrition (Nutr.)	1	.038	1	5.923	1	10.717
Age at first breeding (Age)	2	18.227	2	105.125*	2	2.660
Year of production (Year)	2	42.369	1	34.152		
Lamb TB	2	545.138***	2	238.809***	1	101.568*
Sex of lamb	1	.065	1	.083	1	4.423
Ewe TB x Breed	1	2.194	1	47.046	1	4.375
Ewe TB x Nutr.	1	14.173	1	57.291	1	20.334
Ewe TB x Age	2	17.790	2	8.924	2	5.522
Ewe TB x Year	2	12.961	1	3.147		
Ewe TB x Lamb TB	2	101.833*	2	7.821	1	5.088
Ewe TB x Sex	1	31.142	1	.033	1	29.583
Breed x Nutr.	1	15.410	1	38.742	1	28.767
Breed x Age	2	25.973	2	12.329*	2	41.728
Breed x Year	2	47.512	1	57.406		
Breed x Lamb TB	1	43.867	2	20.834	1	60.878
Breed x Sex	1	5.455	1	2.207	1	.062
Nutr. x Age	2	21.246	2	49.515	2	2.888
Nutr. x Year	2	11.172	1	1.499		
Nutr. x Lamb TB	1	5.503	2	36.694	1	4.465
Nutr. x Sex	1	1.832	1	2.121	1	39.769
Age x Year	4	2.539	2	11.556		
Age x Lamb TB	4	27.313	4	79.435*	2	10.070
Age x Sex	2	3.226	2	84.305	2	1.711
Year x Lamb TB	3	102.010*	2	90.503*		
Year x Sex	2	16.660	1	4.509		
Lamb TB x Sex	2	44.548	2	74.243	1	.187
Error	251	29.639	138	28.932	31	20.169

TABLE 14. LEAST SQUARES ANALYSIS OF VARIANCE FOR FLEECE WEIGHT (KG)

Source	Age (month) 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS
Ewe type of birth (TB)	1	1.3973**	1	1.3456	1	.5611	1	.0520	1	.1724
Ewe breed	1	9.4220***	1	37.8780***	1	23.9259***	1	18.9436***	1	6.2841***
Postweaning nutrition (Nutr.)	1	1.0824*	1	1.0316	1	1.1255	1	.5351	1	.6066
Age at first breeding (Age)			2	2.8254***	2	.0764	2	.5182	2	.2161
Year of production (Year)	4	7.5368***	4	7.3364***	3	8.5203***	2	1.0383	1	35.2172***
TB x Breed	1	.3274	1	1.7597*	1	1.9182*	1	1.4452	1	.1089
TB x Nutr.	1	.6258	1	.0537	1	.2738	1	.2278	1	.1718
TB x Age			2	.1743	2	.9286	2	.5387	2	.3792
TB x Year	4	.1139	4	.4484	3	.1100	2	.6333	1	.6960
Breed x Nutr.	1	.0171	1	.1747	1	.0149	1	2.4128*	1	.3044
Breed x Age			2	.7025	2	.0951	2	1.2069	2	1.4121
Breed x Year	4	1.2272***	4	1.0692*	3	1.5519**	2	4.2675***	1	1.7853
Nutr. x Age			2	.5428	2	.0983	2	1.6917	2	.1822
Nutr. x Year	4	.2997	4	.4339	3	.4281	2	.6972	1	.8479
Age x Year			8	3.8918***	6	.5142	4	1.2100	2	.4651
Error	200	.1992	416	.3890	276	.4048	211	.6208	110	.5179

* P<.05.
** P<.01.
*** P<.005.

TABLE 15. LEAST SQUARES MEANS AND STANDARD ERRORS FOR SIGNIFICANT TWO-WAY INTERACTIONS

Breed x Year Interaction for Birth Date
Least Squares Means (Days after January 1) = 63.8 ± .34

	Breed	
Year	Targhee	S x T[a]
1971	58.8 ± 1.01	61.3 ± .96
1972	64.0 ± .80	63.5 ± .97
1973	69.8 ± .92	67.6 ± 1.04
1974	62.8 ± 1.01	59.5 ± 1.12
1975	65.4 ± 1.07	65.1 ± 1.14

Breed x Year Interaction for 7-Month Weight
Least Squares Means (Kg) = 47.6 ± .27

	Breed	
Year	Targhee	S x T
1971	41.1 ± .82	41.8 ± .77
1972	47.2 ± .64	51.1 ± .77
1973	49.4 ± .75	55.8 ± .84
1974	43.8 ± .81	51.4 ± .90
1975	44.9 ± .84	49.3 ± .90

Postweaning Nutrition x Year Interaction for 7-Month Weight
Least Squares Means (Kg) = 47.6 ± .27

	Nutrition Level	
Year	High	Moderate
1971	42.8 ± .79	40.2 ± .77
1972	53.5 ± .69	44.8 ± .70
1973	53.8 ± .81	51.4 ± .77
1974	50.5 ± .83	44.7 ± .85
1975	50.8 ± .84	43.5 ± .91

Breed x Year Interaction for 7-Month Wither Height
Least Squares Means (Cm) = 61.34 ± .146

	Breed	
Year	Targhee	S x T
1971	59.31 ± .445	57.10 ± .419
1972	63.85 ± .349	62.47 ± .420
1973	60.47 ± .406	60.74 ± .455
1974	62.51 ± .478	64.10 ± .486
1975	61.68 ± .457	61.17 ± .490

TABLE 15 CONTINUED

Postweaning Nutrition x Year Interaction for 7-Month Weight
Least Squares Means (Cm) = 61.34 ± .146

Year	Nutrition Level	
	High	Moderate
1971	58.65 ± .429	57.77 ± .418
1972	63.93 ± .374	62.37 ± .378
1973	62.20 ± .437	59.01 ± .419
1974	63.85 ± .447	62.76 ± .460
1975	61.72 ± .456	61.09 ± .490

Type of Birth x Year Interaction for Ewe Weaning Weight
Least Squares Means (Kg) = 27.5 ± .19

Year	Type of Birth	
	Single	Multiple
1971	24.7 ± .51	20.3 ± .56
1972	35.3 ± .54	27.7 ± .43
1973	28.0 ± .72	22.7 ± .39
1974	34.7 ± .74	28.5 ± .44
1975	27.4 ± .66	25.4 ± .55

Breed x Year Interaction for Ewe Weaning Weight
Least Squares Means (Kg) = 27.5 ± .19

Year	Breed	
	Targhee	S x T
1971	22.4 ± .56	22.6 ± .53
1972	30.4 ± .45	32.5 ± .54
1973	23.9 ± .51	26.8 ± .58
1974	29.3 ± .56	33.9 ± .62
1975	25.3 ± .58	27.5 ± .63

Postweaning Nutrition x Year Interaction for
Weight:Height Ratio
Least Squares Means (Kg/cm) = .775 ± .0040

Year	Nutrition Level	
	High	Moderate
1971	.730 ± .0117	.694 ± .0114
1972	.837 ± .0102	.717 ± .0104
1973	.866 ± .0120	.869 ± .0115
1974	.791 ± .0122	.711 ± .0126
1975	.821 ± .0125	.711 ± .0134

TABLE 15 CONTINUED

Ewe Breed x Age at First Breeding Interaction for 12-Month Weight
Least Squares Means (Kg) = 51.3 ± .29

Breed	Age at First Breeding		
	7 months	7 months, open	19 months
Targhee	47.6 ± .68	49.4 ± .63	49.3 ± .60
S x T	50.6 ± .57	56.5 ± .76	54.2 ± .56

Ewe Breed x Year Interaction for 12-Month Weight
Least Squares Means (Kg) = 51.3 ± .29

Year	Breed	
	Targhee	S x T
1972	41.3 ± .88	43.5 ± .83
1973	52.8 ± .69	57.4 ± .83
1974	48.6 ± .79	53.0 ± .91
1975	47.9 ± .85	55.2 ± .99
1976	53.4 ± .91	59.7 ± .94

Age at First Breeding x Year Interaction for 12-Month Weight
Least Squares Means (Kg) = 51.3 ± .29

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1972	39.6 ± .96	43.8 ± 1.23	43.8 ± .96
1973	56.6 ± .85	56.8 ± 1.03	51.8 ± .87
1974	50.5 ± .82	51.1 ± 1.39	50.8 ± .89
1975	47.2 ± .93	54.2 ± 1.25	53.3 ± 1.13
1976	51.7 ± 1.37	58.6 ± .99	59.3 ± 1 05

Age at First Breeding x Year Interaction for 24-Month Weight
Least Squares Means (Kg) = 66.7 ± .35

Year of Production	Age at First Breeding		
	7 months	7 months, open	19 months
1973	60.9 ± 1.12	61.0 ± 1.40	61.1 ± 1.12
1974	70.3 ± 1.02	69.8 ± 1.25	66.5 ± .98
1975	68.5 ± .98	65.1 ± 1.62	67.1 ± 1.02
1976	64.5 ± 1.12	67.6 ± 1.48	68.5 ± 1.39
1977	69.9 ± 1.71	70.3 ± 1.11	69.8 ± 1.29

TABLE 15 CONTINUED

Type of Birth x Postweaning Nutrition Interaction for 48-Month Weight
Least Squares Means (Kg) = 73.5 ± .51

Nutrition Level	Type of Birth	
	Single	Twin
High	73.2 ± 1.02	73.8 ± .87
Moderate	75.2 ± 1.10	72.0 ± .88

Age at First Breeding x Year Interaction for 48-Month Weight
Least Squares Means (Kg) = 73.5 ± .51

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1975	64.3 ± 1.39	70.7 ± 1.74	66.0 ± 1.23
1976	78.5 ± 1.23	77.9 ± 1.77	76.3 ± 1.25
1977	78.5 ± 1.17	73.0 ± 1.96	76.7 ± 1.22

Age at First Breeding x Year Interaction for 60-Month Weight
Least Squares Means (Kg) = 72.5 ± .76

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1976	65.4 ± 1.70	70.8 ± 2.06	72.4 ± 1.57
1977	75.9 ± 1.55	75.7 ± 2.22	75.0 ± 1.53

Postweaning Nutrition x Age at First Breeding Interaction for 72-Month Weight
Least Squares Means (Kg) = 70.0 ± 1.17

Nutrition Level	Age at First Breeding		
	7 months	7 months, open	19 months
High	56.79 ± .685	56.31 ± .918	58.63 ± .791
Moderate	56.20 ± 1.006	59.12 ± 1.033	57.76 ± .723

TABLE 15 CONTINUED

Age at First Breeding x Year Interaction for 24-Month Weight of Ewes Weaning a Lamb(s) Least Squares Means (Kg) = 65.6 ± .41

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1973	56.8 ± 1.41	60.6 ± 2.12	59.8 ± 1.42
1974	68.8 ± 1.07	68.7 ± 1.38	65.4 ± 1.01
1975	67.7 ± 1.64	63.1 ± 2.12	66.6 ± 1.61
1976	63.7 ± 1.11	66.8 ± 1.56	66.8 ± 1.37
1977	69.4 ± 1.79	70.4 ± 1.08	69.7 ± 1.21

Type of Birth x Postweaning Nutrition Interaction for 48-Month Weight of Ewes Weaning a Lamb(s) Least Squares Means (Kg) = 72.7 ± 1.07

Nutrition Level	Type of Birth	
	Single	Twin
High	71.8 ± 1.07	73.5 ± .92
Moderate	74.2 ± 1.15	71.2 ± .89

Postweaning Nutrition x Year Interaction for 48-Month Weight of Ewes Weaning a Lamb(s) Least Squares Means (Kg) = 72.7 ± 1.07

Year	Nutrition Level	
	High	Moderate
1975	67.1 ± 1.44	63.3 ± 1.33
1976	77.2 ± 1.03	78.2 ± 1.18
1977	73.8 ± 1.16	76.6 ± 1.12

Age at First Breeding x Year Interaction for 48-Month Weight of Ewes Weaning a Lamb(s) Least Squares Means (Kg) = 72.7 ± 1.07

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1975	62.9 ± 1.43	68.5 ± 2.21	64.2 ± 1.58
1976	78.4 ± 1.22	78.6 ± 1.78	76.1 ± 1.18
1977	77.9 ± 1.13	71.0 ± 1.83	76.6 ± 1.14

TABLE 15 CONTINUED

Age at First Breeding x Year Interaction for 60-Month Weight of Ewes Weaning a Lamb(s)
Least Squares Means (Kg) = 71.8 ± .74

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1976	65.0 ± 1.55	71.2 ± 1.80	71.4 ± 1.43
1977	75.2 ± 1.86	73.2 ± 2.19	74.8 ± 1.55

Postweaning Nutrition x Age at First Breeding Interaction for 72-Month Weight of Ewes Weaning a Lamb(s)
Least Squares Means (Kg) = 68.1 ± 1.49

Nutrition Level	Age at First Breeding		
	7 months	7 months, open	19 months
High	69.4 ± 2.14	62.8 ± 3.01	74.0 ± 2.64
Moderate	57.4 ± 3.73	72.2 ± 4.06	72.8 ± 3.33

Age at First Breeding x Year Interaction for 12-Month Wither Height
Least Squares Means (Cm) = 65.96 ± .122

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1972	61.47 ± .402	62.84 ± .513	62.46 ± .400
1973	68.83 ± .362	68.90 ± .430	67.08 ± .363
1974	65.63 ± .342	66.08 ± .582	66.00 ± .371
1975	65.11 ± .388	66.18 ± .524	66.36 ± .474
1976	67.21 ± .573	67.84 ± .414	67.48 ± .440

Breed x Year Interaction for 24-Month Wither Height
Least Squares Means (Cm) = 66.35 ± .104

Year	Breed	
	Targhee	S x T
1973	69.57 ± .408	67.09 ± .393
1974	69.42 ± .336	66.06 ± .392
1975	65.32 ± .389	64.65 ± .447
1976	65.58 ± .432	64.63 ± .466
1977	65.10 ± .423	66.09 ± .479

TABLE 15 CONTINUED

Type of Birth x Postweaning Nutrition Interaction for 36-Month Wither Height
Least Squares Means (Cm) = 67.13 ± .193

Nutrition Level	Type of Birth	
	Single	Twin
High	66.82 ± .394	67.65 ± .311
Moderate	67.64 ± .424	66.41 ± .313

Type of Birth x Year Interaction for 60-Month Wither Height
Least Squares Means (Cm) = 66.63 ± .243

Year	Type of Birth	
	Single	Twin
1976	67.22 ± .426	65.25 ± .491
1977	67.04 ± .521	66.99 ± .380

Age at First Breeding x Year Interaction for 60-Month Wither Height
Least Squares Means (Cm) = 66.63 ± .243

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1976	64.70 ± .542	67.75 ± .659	66.25 ± .502
1977	67.47 ± .495	66.95 ± .709	66.63 ± .487

Type of Birth x Year Interaction for 12-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 65.29 ± .244

Year	Type of Birth	
	Single	Twin
1972	61.79 ± .637	60.90 ± .848
1973	70.70 ± .613	66.84 ± .575
1974	65.55 ± .745	65.25 ± .400
1975	65.17 ± .791	64.75 ± .493
1976	65.97 ± .945	67.15 ± 1.058

TABLE 15 CONTINUED

Type of Birth x Breed Interaction for 24-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.26 ± .174

Breed	Type of Birth	
	Single	Twin
Targhee	67.51 ± .358	66.37 ± .292
S x T	65.43 ± .381	65.73 ± .269

Breed x Year Interaction for 24-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.26 ± .174

Year	Breed	
	Targhee	S x T
1973	69.40 ± .610	67.18 ± .512
1974	68.82 ± .390	65.86 ± .425
1975	66.07 ± .653	64.38 ± .619
1976	65.38 ± .453	64.57 ± .497
1977	65.03 ± .447	65.89 ± .494

Type of Birth x Postweaning Nutrition Interaction for 36-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.96 ± .224

Nutrition Level	Type of Birth	
	Single	Twin
High	66.47 ± .434	64.91 ± .355
Moderate	67.51 ± .516	66.40 ± .376

Type of Birth x Year Interaction for 60-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.64 ± .271

Year	Type of Birth	
	Single	Twin
1976	67.11 ± .439	65.31 ± .502
1977	66.96 ± .615	67.18 ± .489

TABLE 15 CONTINUED

Age at First Breeding x Year Interaction for 60-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.64 ± .271

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1976	64.75 ± .565	67.82 ± .658	66.06 ± .522
1977	67.87 ± .680	66.64 ± .799	66.70 ± .565

Postweaning Nutrition x Age at First Breeding Interaction for 72-Month Wither Height of Ewes Weaning a Lamb(s)
Least Squares Means (Cm) = 66.25 ± .488

Nutrition Level	Age at First Breeding		
	7 months	7 months, open	19 months
High	66.09 ± .700	64.25 ± .985	68.36 ± .865
Moderate	64.04 ± 1.220	68.17 ± 1.330	66.59 ± 1.095

Type of Birth x Postweaning Nutrition Interaction for 24-Month Lambing Date
Least Squares Means (Days after January 1) = 100.38 ± .506

Nutrition Level	Type of Birth	
	Single	Twin
High	100.67 ± 1.041	100.65 ± .839
Moderate	98.22 ± 1.076	101.97 ± .844

Breed x Year Interaction for 24-Month Lambing Date
Least Squares Means (Days after January 1) = 100.38 ± .506

Year	Breed	
	Targhee	S x T
1973	109.95 ± 1.863	114.25 ± 1.590
1974	69.63 ± 1.171	64.69 ± 1.340
1975	126.02 ± 1.390	122.62 ± 1.597
1976	125.29 ± 1.488	124.22 ± 1.582
1977	74.64 ± 1.479	72.46 ± 1.537

TABLE 15 CONTINUED

Postweaning Nutrition x Year Interaction for 24-Month Lambing Date

Least Squares Means (Days after January 1) = 100.38 ± .506

Year	Nutrition Level	
	High	Moderate
1973	109.68 ± 1.769	114.52 ± 1.651
1974	67.04 ± 1.233	67.29 ± 1.232
1975	124.41 ± 1.506	124.24 ± 1.465
1976	127.52 ± 1.455	122.00 ± 1.563
1977	74.65 ± 1.370	72.44 ± 1.638

Breed x Postweaning Nutrition Interaction for 36-Month Lambing Date

Least Squares Means (Days after January 1) = 97.17 ± .675

Breed	Nutrition Level	
	High	Moderate
Targhee	98.16 ± 1.188	101.91 ± 1.246
S x T	94.84 ± 1.185	93.75 ± 1.441

Type of Birth x Breed Interaction for 48-Month Lambing Date

Least Squares Means (Days after January 1) = 80.16 ± 1.899

Breed	Type of Birth	
	Single	Twin
Targhee	77.21 ± 3.448	75.10 ± 3.522
S x T	94.69 ± 4.356	73.65 ± 3.281

Type of Birth x Age at First Breeding Interaction for for 48-Month Lambing Date

Least Squares Means (Days after January 1) = 80.16 ± 1.899

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	73.20 ± 3.959	103.23 ± 6.192	81.41 ± 3.975
Twin	77.11 ± 3.783	73.27 ± 5.161	72.76 ± 3.384

TABLE 15 CONTINUED

Type of Birth x Year Interaction for 48-Month Lambing Date
Least Squares Means (Days after January 1) = 80.16 ± 1.899

Year	Type of Birth: Single	Type of Birth: Twin
1975	124.84 ± 3.915	124.19 ± 5.033
1976	66.16 ± 4.388	42.25 ± 3.557
1977	66.84 ± 5.554	56.70 ± 3.400

Breed x Age at First Breeding Interaction for
48-Month Lambing Date
Least Squares Means (Days after January 1) = 80.16 ± 1.899

Breed	Age at First Breeding: 7 months	Age at First Breeding: 7 months, open	Age at First Breeding: 19 months
Targhee	75.67 ± 4.390	75.50 ± 4.454	77.30 ± 3.731
S x T	74.64 ± 3.215	101.00 ± 6.903	76.87 ± 3.578

Breed x Year Interaction for 48-Month Lambing Date
Least Squares Means (Days after January 1) = 80.16 ± 1.899

Year	Breed: Targhee	Breed: S x T
1975	125.01 ± 4.753	124.02 ± 4.513
1976	43.10 ± 3.748	65.32 ± 4.420
1977	60.36 ± 4.324	63.17 ± 4.716

Age at First Breeding x Year Interaction for
48-Month Lambing Date
Least Squares Means (Days after January 1) = 80.16 ± 1.899

Year	Age at First Breeding: 7 months	Age at First Breeding: 7 months, open	Age at First Breeding: 19 months
1975	127.79 ± 5.356	121.62 ± 7.013	124.13 ± 4.552
1976	40.48 ± 4.386	74.31 ± 5.989	47.83 ± 4.325
1977	57.19 ± 4.288	68.82 ± 7.440	59.29 ± 4.490

TABLE 15 CONTINUED

Breed x Age at First Breeding Interaction for 60-Month Lambing Date
Least Squares Means (Days after January 1) = 67.75 ± .830

Breed	Age at First Breeding		
	7 months	7 months, open	19 months
Targhee	70.22 ± 2.297	67.42 ± 1.848	66.71 ± 1.774
S x T	64.84 ± 1.442	66.89 ± 2.878	70.43 ± 1.478

Type of Birth x Age at First Breeding Interaction for Number of Lambs Born Per Ewe Exposed, 24-Month Production
Least Squares Means = 1.24 ± .031

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	1.15 ± .073	1.12 ± .090	1.40 ± .077
Twin	1.40 ± .062	1.16 ± .069	1.20 ± .057

Type of Birth x Age at First Breeding Interaction for Number of Lambs Born Per Ewe Exposed, 60-Month Production
Least Squares Means = 1.56 ± .076

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	1.81 ± .154	1.28 ± .240	1.55 ± .154
Twin	1.28 ± .167	1.72 ± .206	1.73 ± .152

Breed x Year Interaction for Number of Lambs Weaned Per Ewe Exposed, 24-Month Production
Least Squares Means = .83 ± .030

Year	Breed	
	Targhee	S x T
1973	.46 ± .086	.61 ± .084
1974	.74 ± .070	1.00 ± .083
1975	.39 ± .084	.53 ± .097
1976	1.22 ± .091	.98 ± .099
1977	1.00 ± .091	1.34 ± .094

TABLE 15 CONTINUED

Type of Birth x Age at First Breeding Interaction for Number of Lambs Weaned Per Ewe Exposed, 36-Month Production
Least Squares Means = .94 ± .039

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	.76 ± .083	1.22 ± .127	.86 ± .096
Twin	.96 ± .069	.92 ± .092	.93 ± .069

Type of Birth x Age at First Breeding Interaction for Number of Lambs Weaned Per Ewe Exposed, 60-Month Production
Least Squares Means = 1.20 ± .073

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	1.39 ± .149	1.01 ± .231	1.02 ± .149
Twin	.91 ± .161	1.52 ± .199	1.35 ± .146

Breed x Year Interaction for Number of Lambs Born Per Ewe Lambing, 24-Month Production
Least Squares Means = 1.37 ± .028

Year	Breed	
	Targhee	S x T
1973	1.12 ± .104	1.13 ± .089
1974	1.42 ± .066	1.55 ± .075
1975	1.14 ± .078	1.33 ± .090
1976	1.61 ± .084	1.45 ± .089
1977	1.24 ± .083	1.70 ± .086

Breed x Age at First Breeding Interaction for Number of Lambs Born Per Ewe Lambing, 36-Month Production
Least Squares Means = 1.44 ± .033

Breed	Age at First Breeding		
	7 months	7 months, open	19 months
Targhee	1.51 ± .078	1.22 ± .070	1.29 ± .070
S x T	1.51 ± .056	1.53 ± .104	1.57 ± .070

TABLE 15 CONTINUED

Breed x Year Interaction for Number of Lambs Born Per Ewe Lambing, 36-Month Production
Least Squares Means = 1.44 ± .033

Year	Breed	
	Targhee	S x T
1974	1.25 ± .100	1.38 ± .089
1975	1.61 ± .070	1.60 ± .079
1976	1.41 ± .077	1.88 ± .093
1977	1.09 ± .090	1.28 ± .096

Type of Birth x Breed Interaction for Number of Lambs Born Per Ewe Lambing, 60-Month Production
Least Squares Means = 1.72 ± .063

Breed	Type of Birth	
	Single	Twin
Targhee	1.78 ± .108	1.58 ± .134
S x T	1.62 ± .139	1.90 ± .107

Breed x Year Interaction for Number of Lambs Weaned Per Ewe Lambing, 24-Month Production
Least Squares Means = .91 ± .031

Year	Breed	
	Targhee	S x T
1973	.80 ± .114	.87 ± .097
1974	.79 ± .071	1.01 ± .082
1975	.41 ± .085	.55 ± .097
1976	1.27 ± .091	.96 ± .096
1977	1.06 ± .090	1.39 ± .094

Breed x Postweaning Nutrition Interaction for Number of Lambs Weaned Per Ewe Lambing, 72-Month Production
Least Squares Means = 1.16 ± .105

Nutrition Level	Breed	
	Targhee	S x T
High	1.58 ± .208	.99 ± .176
Moderate	.86 ± .244	1.21 ± .220

TABLE 15 CONTINUED

Ewe Type of Birth x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 12-Month Production
Least Squares Means (Kg) = 19.7 ± .66

Lamb Type of Birth	Ewe Type of Birth	
	Single	Twin
Single	20.2 ± .74	17.2 ± .73
Multiple	19.3 ± 1.67	22.0 ± 1.41

Breed x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 12-Month Production
Least Squares Means (Kg) = 19.7 ± .66

Lamb Type of Birth	Breed	
	Targhee	S x T
Single	17.1 ± .75	20.4 ± .74
Multiple	15.5 ± 1.93	25.7 ± 1.01

Breed x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 24-Month Production
Least Squares Means (Kg) = 48.6 ± 1.65

Lamb Type of Birth	Breed	
	Targhee	S x T
Single	36.5 ± 1.07	37.5 ± 1.24
Twin	39.0 ± 1.85	48.5 ± 1.50
Triplet	90.6 ± 7.60	39.7 ± 5.75

Postweaning Nutrition x Year Interaction for Total Kilograms of Lamb Weaned, 24-Month Production
Least Squares Means (Kg) = 48.6 ± 1.65

Year	Nutrition Level	
	High	Moderate
1973	45.1 ± 3.73	44.3 ± 3.53
1974	48.1 ± 2.71	50.8 ± 2.73
1975	48.0 ± 3.25	50.4 ± 3.41
1976	44.7 ± 3.16	54.4 ± 2.72
1977	51.4 ± 3.09	49.3 ± 3.76

TABLE 15 CONTINUED

Age at First Breeding x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 24-Month Production
Least Squares Means (Kg) = 48.6 ± 1.65

Lamb Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	35.7 ± 1.39	36.7 ± 1.51	38.6 ± 1.28
Twin	47.1 ± 1.86	39.7 ± 1.51	44.5 ± 1.73
Triplet	81.3 ± 6.91	47.9 ± 6.41	

Breed x Year Interaction for Total Kilograms of Lamb Weaned, 36-Month Production
Least Squares Means (Kg) = 47.2 ± 2.19

Year	Breed	
	Targhee	S x T
1974	43.6 ± 3.47	48.2 ± 3.13
1975	42.7 ± 2.89	43.0 ± 2.95
1976	47.9 ± 2.90	61.7 ± 2.74
1977	40.3 ± 3.70	50.5 ± 3.42

Postweaning Nutrition x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 36-Month Production
Least Squares Means (Kg) = 47.2 ± 2.19

Lamb Type of Birth	Nutrition Level	
	High	Moderate
Single	35.3 ± 1.41	36.0 ± 1.65
Twin	51.7 ± 1.81	47.4 ± 1.96
Triplet	30.6 ± 6.55	82.1 ± 11.66

Age at First Breeding x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 36-Month Production
Least Squares Means (Kg) = 47.2 ± 2.19

Lamb Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	33.1 ± 1.86	35.7 ± 1.98	38.1 ± 1.83
Twin	50.8 ± 1.98	52.6 ± 2.67	45.2 ± 2.18
Triplet	28.3 ± 7.32		82.9 ± 11.93

TABLE 15 CONTINUED

Year x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 36-Month Production
Least Squares Means (Kg) = 47.2 ± 2.19

Year	Lamb Type of Birth		
	Single	Twin	Triplet
1974	30.5 ± 2.04	52.0 ± 3.06	
1975	33.5 ± 2.13	42.9 ± 1.79	
1976	41.3 ± 2.34	59.0 ± 2.24	63.9 ± 6.13
1977	37.2 ± 1.98	44.2 ± 3.87	

Ewe Type of Birth x Lamb Type of Birth Interaction for Total Kilograms of Lamb Weaned, 48-Month Production
Least Squares Means (Kg) = 63.0 ± 3.58

Lamb Type of Birth	Ewe Type of Birth	
	Single	Twin
Single	41.9 ± 3.51	40.1 ± 2.46
Twin	53.6 ± 2.50	59.1 ± 2.24
Triplet	61.8 ± 8.38	121.3 ± 19.52

Ewe Type of Birth x Postweaning Nutrition Interaction for Total Kilograms of Lamb Weaned, 60-Month Production
Least Squares Means (Kg) = 57.6 ± 2.65

Nutrition Level	Ewe Type of Birth	
	Single	Twin
High	54.3 ± 4.25	61.9 ± 3.89
Moderate	62.6 ± 5.25	51.8 ± 4.78

Postweaning Nutrition x Age at First Breeding Interaction for Total Kilograms of Lamb Weaned, 60-Month Production
Least Squares Means (Kg) = 57.6 ± 2.65

Nutrition Level	Age at First Breeding		
	7 months	7 months, open	19 months
High	63.4 ± 3.47	60.4 ± 6.36	50.5 ± 6.07
Moderate	51.9 ± 5.12	62.3 ± 9.43	57.3 ± 4.63

TABLE 15 CONTINUED

Ewe Type of Birth x Breed Interaction for Lamb Weaning Weight, 12-Month Production
Least Squares Means (Kg) = 16.7 ± .54

Ewe Type of Birth	Breed	
	Targhee	S x T
Single	14.5 ± 1.25	20.4 ± .86
Twin	14.6 ± .99	17.4 ± .54

Ewe Type of Birth x Lamb Type of Birth Interaction for Lamb Weaning Weight, 12-Month Production
Least Squares Means (Kg) = 16.7 ± .54

Ewe Type of Birth	Lamb Type of Birth	
	Single	Twin
Single	20.5 ± .83	14.3 ± 1.34
Multiple	17.3 ± .60	14.7 ± .98

Postweaning Nutrition x Sex of Lamb Interaction for Lamb Weaning Weight, 24-Month Production
Least Squares Means (Kg) = 31.4 ± 1.19

Nutrition Level	Sex of Lamb	
	Ewe	Wether
High	32.4 ± 2.64	29.9 ± 1.75
Moderate	30.9 ± 1.86	32.3 ± 2.97

Year x Lamb Type of Birth Interaction for Lamb Weaning Weight, 24-Month Production
Least Squares Means (Kg) = 31.4 ± 1.19

Year	Lamb Type of Birth		
	Single	Twin	Triplet
1973	30.0 ± 1.55	16.8 ± 2.92	
1974	38.8 ± 1.51	16.7 ± 1.26	
1975	41.8 ± 2.00	37.9 ± 2.57	
1976	40.1 ± 4.81	34.4 ± 1.44	40.1 ± 4.81
1977	34.7 ± 1.50	28.0 ± 1.43	25.5 ± 6.50

TABLE 15 CONTINUED

Ewe Type of Birth x Age at First Breeding Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	22.8 ± 1.66	32.0 ± 1.71	38.7 ± 2.60
Twin	31.1 ± 1.38	39.4 ± 1.78	42.6 ± 2.77

Ewe Type of Birth x Lamb Type of Birth Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Ewe Type of Birth	Lamb Type of Birth		
	Single	Twin	Triplet
Single	35.4 ± .90	30.2 ± .97	27 8 ± 3.92
Twin	35.5 ± .67	32.4 ± .74	45.3 ± 4.38

Postweaning Nutrition x Lamb Type of Birth Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Nutrition Level	Lamb Type of Birth		
	Single	Twin	Triplet
High	35.0 ± .72	32.0 ± .77	22.8 ± 3.22
Moderate	35.9 ± .85	30.6 ± .86	50.3 ± 6.63

Age at First Breeding x Year Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1974	21.0 ± 1.80	34.4 ± 1.97	32.6 ± 2.85
1975	28.4 ± 1.59	32.1 ± 1.76	40.5 ± 2.70
1976	31.7 ± 1.29	38.1 ± 1.95	48.2 ± 2.48
1977	26.7 ± 1.83	38.2 ± 2.06	41.3 ± 3.04

TABLE 15 CONTINUED

Age at First Breeding x Lamb Type of Birth Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Lamb Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	33.4 ± .94	35.8 ± 1.00	37.2 ± .96
Twin	29.7 ± .85	33.5 ± 1.12	30.6 ± .99
Triplet	17.8 ± 3.33		54.0 ± 7.48

Year x Sex of Lamb Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Year	Sex of Lamb	
	Ewe	Wether
1974	29.2 ± 1.33	29.5 ± 2.45
1975	29.3 ± 1.26	38.1 ± 2.32
1976	34.9 ± 1.08	43.8 ± 2.19
1977	32.2 ± 1.64	38.6 ± 2.54

Lamb Type of Birth x Sex of Lamb Interaction for Lamb Weaning Weight, 36-Month Production
Least Squares Means (Kg) = 34.4 ± 1.23

Sex of Lamb	Lamb Type of Birth		
	Single	Twin	Triplet
Ewe	34.9 ± .82	32.9 ± .76	26.4 ± 2.49
Wether	36.0 ± .46	29.7 ± .88	46.7 ± 6.41

Ewe Type of Birth x Lamb Type of Birth Interaction for Lamb Weaning Weight, 48-Month Production
Least Squares Means (Kg) = 36.1 ± 1.00

Ewe Type of Birth	Lamb Type of Birth		
	Single	Twin	Triplet
Single	42.1 ± 1.30	34.7 ± .81	36.2 ± 2.94
Twin	41.1 ± .91	37.3 ± 3.80	25.1 ± 5.98

TABLE 15 CONTINUED

Year x Lamb Type of Birth Interaction for Lamb Weaning Weight, 48-Month Production
Least Squares Means (Kg) = 36.1 ± 1.00

Year	Lamb Type of Birth		
	Single	Twin	Triplet
1975	41.3 ± 1.16	38.8 ± 1.41	
1976	42.8 ± 1.18	37.5 ± .64	19.6 ± 12.71
1977	40.7 ± 1.54	31.7 ± .70	40.5 ± 8.10

Breed x Age at First Breeding Interaction for Lamb Weaning Weight, 60-Month Production
Least Squares Means (Kg) = 40.3 ± .83

Breed	Age at First Breeding		
	7 months	7 months, open	19 months
Targhee	37.9 ± 1.67	44.3 ± 2.63	37.1 ± 1.74
S x T	43.0 ± 1.06	43.8 ± 2.30	35.6 ± 1.96

Age at First Breeding x Lamb Type of Birth Interaction for Lamb Weaning Weight, 60-Month Production
Least Squares Means (Kg) = 40.3 ± .83

Lamb Type of Birth	Age at First Breeding		
	7 months	7 months, open	19 months
Single	44.7 ± 5.97	40.9 ± 2.06	42.2 ± 1.52
Twin	37.5 ± 1.06	38.3 ± 1.35	37.8 ± .91
Triplet	39.1 ± 2.07	52.9 ± 5.95	29.0 ± 4.27

Year x Lamb Type of Birth Interaction for Lamb Weaning Weight, 60-Month Production
Least Squares Means (Kg) = 40.3 ± .83

Year	Lamb Type of Birth		
	Single	Twin	Triplet
1976	41.4 ± 1.45	37.0 ± .85	45.5 ± 3.30
1977	43.8 ± 1.43	38.8 ± .96	35.1 ± 3.45

TABLE 15 CONTINUED

Breed x Year Interaction for 12-Month Fleece Weight
Least Squares Means (Kg) = 3.02 ± .030

Year	Breed	
	Targhee	S x T
1972	3.95 ± .137	3.15 ± .085
1973	2.46 ± .097	2 41 ± .087
1974	3.74 ± .090	2.92 ± .091
1975	3.31 ± .112	2.80 ± .090
1976	3.05 ± .162	2.82 ± .137

Type of Birth x Breed Interaction for 24-Month Fleece Weight
Least Squares Means (Kg) = 4.60 ± .029

Breed	Type of Birth	
	Single	Twin
Targhee	5.04 ± .068	4.78 ± .063
S x T	4.25 ± .080	4.27 ± .055

Breed x Year Interaction for 24-Month Fleece Weight
Least Squares Means (Kg) = 4.60 ± .029

Year	Breed	
	Targhee	S x T
1973	4.33 ± .135	3.74 ± .110
1974	5.17 ± .081	4.61 ± .092
1975	4.93 ± .095	4.03 ± .109
1976	5.14 ± .102	4.28 ± .109
1977	4.98 ± .101	4.65 ± .105

Age at First Breeding x Year Interaction for 24-Month Fleece Weight
Least Squares Means (Kg) = 4.60 ± .029

Year	Age at First Breeding		
	7 months	7 months, open	19 months
1973	3.74 ± .141	4.06 ± .177	4.32 ± .129
1974	5.12 ± .099	5.30 ± .119	4.25 ± .094
1975	4.56 ± .103	4.42 ± .157	4.46 ± .109
1976	4.39 ± .109	4.94 ± .140	4.80 ± .132
1977	4.42 ± .159	5.11 ± .106	4.91 ± .114

TABLE 15 CONTINUED

Type of Birth x Breed Interaction for 36-Month Fleece Weight
Least Squares Means (Kg) = 4.17 ± .036

Breed	Type of Birth: Single	Type of Birth: Twin
Targhee	4.64 ± .094	4.35 ± .095
S x T	3.70 ± .110	3.79 ± .073

Breed x Year Interaction for 36-Month Fleece Weight
Least Squares Means (Kg) = 4.17 ± .036

Year	Breed: Targhee	Breed: S x T
1974	4.00 ± .223	3.83 ± .155
1975	5.18 ± .089	4.07 ± .102
1976	4.47 ± .102	3.44 ± .122
1977	4.32 ± .117	3.64 ± .125

Breed x Postweaning Nutrition Interaction for 48-Month Fleece Weight
Least Squares Means (Kg) = 4.39 ± .051

Nutrition Level	Breed: Targhee	Breed: S x T
High	4.67 ± .117	4.21 ± .112
Moderate	4.78 ± .110	3.88 ± .134

Breed x Year Interaction for 48-Month Fleece Weight
Least Squares Means (Kg) = 4.39 ± .051

Year	Breed: Targhee	Breed: S x T
1975	4.28 ± .157	4.22 ± .146
1976	4.90 ± .124	3.87 ± .145
1977	5.00 ± .140	4.06 ± .153

[a] S x T = Suffolk x Targhee.