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To the Graduate Council:

I am submitting herewith a thesis written by Ram D. Singh entitled "Performance of Different Breed Types of Ewes." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

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PERFORMANCE OF DIFFERENT
BREED TYPES
OF EWES

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requirement for the Degree
Master of Science

by
Ram D. Singh
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CHAPTER I

INTRODUCTION

The production of milk-fat spring lambs is the predominant system of commercial sheep production in Tennessee. These lambs are produced primarily by mating native, western crossbred, or fine-wool grade ewes to purebred rams of the mutton breeds, including Hampshire, Southdown and Suffolk. Most producers of spring lambs prefer to sell their ewe lambs and to buy replacement ewes from western sources rather than produce home-raised replacements. One of the major problems confronting spring lamb producers in this area is a source of productive ewes. The breeding of replacement ewes has considerable economic significance to the producer for greater and more efficient production of lamb and wool. The breeding of the sire and dam is important factor in the production of a high percentage lamb crop and lambs with superior growth and meat qualities.

Previous research has shown that crossbreeding is one means of increasing fertility and prolificacy in ewes and livability and growth rate in lambs, thus resulting in greater and more efficient lamb production. Three and four-breed crosses have been generally superior in performance to purebreds, grades and two-breed crosses in terms of overall productivity.

The purposes of this study were: (1) to evaluate the adaptability and productivity of different kinds of high-grade and crossbred ewes from various sources for spring lamb production; and (2) to study the

performance of lambs from different crossbreeding systems.

CHAPTER II

REVIEW OF LITERATURE

A considerable amount of work has been with sheep to evaluate factors influencing ewe productivity and the performances of lambs from birth to weaning. This research has been conducted with different breeds and under varying conditions and some variations are found in the results.

Hultz, Gorman and Wheeler (1935) reported the results of cross-breeding studies involving grade Rambouillet range ewes and five breeds of rams. The breeds of rams used were Rambouillet, Corriedale, Hampshire, Southdown and Lincoln. The various breeds of rams were rotated on different groups of one hundred ewes, and different representatives of each of the breeds of rams were used each year of the experiment.

They found that the Hampshire crossbred lambs averaged 0.4 pound heavier at market age than lambs sired by Lincoln rams, 1.6 pounds heavier than lambs sired by Rambouillet rams, 2.9 pounds heavier than Southdown crossbreds and 4.8 pounds heavier than Corriedale crossbreds.

In carcass grade the rank of the crossbreds by breed of sire was Southdown, Hampshire, Corriedale, Lincoln and Rambouillet. Eighty-three and seven-tenths percent of the Southdown, 70.2 percent of the Hampshire, 60.5 percent of the Corriedale, 43.2 percent of the Lincoln and 28.9 percent of the Rambouillet carcasses graded Medium to Choice.

The wool analyses, averaged by breeds for the ewe lambs from longest to shortest, were Lincoln, Corriedale, Hampshire, Southdown and

Rambouillet. In the number of crimps per linear inch the ranking, from most crimp to least, was Rambouillet, Southdown, Hampshire and Lincoln. In fineness of fiber the ranking from the finest to coarsest was Rambouillet, Corriedale, Southdown, Hampshire and Lincoln. In number of fibers per square inch of skin area the ranking, from greatest to least, was Rambouillet, Corriedale, Southdown, Hampshire and Lincoln.

Miller (1935) conducted crossbreeding investigations in the production of spring lambs at the California Experiment Station using Rambouillet and Romney-Rambouillet ewes. The rams used were Hampshire, Shropshire and Southdown. The experiment extended over a six-year period beginning July 1, 1927.

The average breeding date for the Rambouillet ewes was twenty days earlier than that for Romney-Rambouillet crossbred ewes. In yearly wool clip, Rambouillet ewes produced 2.7 pounds more grease wool per head than Romney-Rambouillet ewes; but on a scoured basis the production of wool was about equal. Rambouillet wool was finer and brought greater returns.

A larger number of lambs was raised in the group of Rambouillet than in the group of crossbred ewes. This primarily was due to larger number of twins born to Rambouillet ewes. When the weight was adjusted to a constant age, lambs from crossbred ewes weighed four pounds more, on an average, than those of the Rambouillet ewes. This was due to the greater rate of daily gain in lambs in the crossbred ewe group. When the grade of lambs on foot was considered, there was no significant difference. In carcass grade the lambs out of the crossbred ewes ranked superior to the straightbred Rambouillet lambs. They also yielded a

higher dressing percentage and the average sale price per hundredweight was \$1.05 higher on the New York market.

Miller further stated that a well-adapted ewe for spring lamb production (for California conditions) is the large and smooth-bodied Rambouillet. These ewes are hardy, long lived, easily herded and good wool producers. They are also early breeders but lack somewhat in milking qualities. However, some producers prefer to buy crossbred ewes because they have superior mutton conformation, are free from wrinkles or folds and shear a longer fleece than the fine woolled type, although they do not breed quite so early in summer.

Maddox, Mowery and Miller (1953), using 300 Rambouillet ewes and rams of Corriedale, Columbia, Southdown, Suffolk, Hampshire and Rambouillet, found that lambs sired by Hampshire rams were the heaviest at market time. Those sired by Suffolk, Columbia, Corriedale, Southdown and Rambouillet rams followed in that order. Thus, crossbred lambs were heavier than purebreds. Eighty-three percent of the lambs sired by Hampshire rams graded Choice, while 75 percent of those sired by Suffolk were Choice, followed by Southdown, 64 percent; Columbia, 58.8 percent; Corriedale, 40 percent; and Rambouillet, 18.2 percent. Lambs sired by Suffolk rams had the highest value and that of the other breed crosses were in this order: Hampshire, Columbia, Southdown, Corriedale and Rambouillet. They also found better performance as far as carcass quality was concerned in crossbred lambs than in purebreds.

Miller and Dailey (1951) reported that Shropshire, Columbia and Hampshire ewes produced 19 percent more lamb per 100 pounds of ewe when

mated to rams of another breed. There was an overall increase in productivity of 16 percent when the ewes were used in crossing. They found that the crossbred lambs were heavier and had higher livability than the purebreds. Rambouillet ewes were 27 percent more productive, when they were used in crossing, than the Shropshire ewes mated to Shropshire rams. This greater productivity was due to more wool and faster growing lambs. Border Leicester, Hampshire and Columbia rams sired the fastest growing lambs when mated to Rambouillet ewes.

Bell et al. (1950) conducted an experiment in which ewes predominantly of Rambouillet breeding were bred to Columbia and Rambouillet rams. They found that the average weaning weights of lambs sired by Columbia rams were consistently larger than the weights of the lambs sired by Rambouillet rams. When all lambs were considered regardless of type of birth, the difference in weaning weight ranged from 1.3 pounds to 6.3 pounds in favor of Columbia sired lambs during the five years of the study. Columbia crossbred lambs were heavier at birth than the straight Rambouillet lambs. The average difference in weaning weight for the five-year test was 4.1 pounds. Columbia cross lambs were fatter at weaning time and a higher proportion of them were sent directly to market.

Dressing percentages were slightly higher for Rambouillet sired lambs. The authors suggested the higher dressing percentages were probably due to the greater amount of wool on the crossbred pelt. Carcass grades were higher for crossbred lambs than for Rambouillets when both were fed over the same period.

Sidwell, Everson and Terrill (1962) studied the fertility, prolificacy and lamb livability of some pure breeds and their crosses. Hampshire, Shropshire, Southdown and Merino breeds of sheep and their crosses and Columbia-Southdale sheep were used. The study was conducted for a period of eight years, from 1952-1959, with a total of 3,620 lambs born and 2,646 lambs weaned from 2,962 ewes bred. Traits studied were: fertility as measured by the percentage of ewes lambing of ewes bred; prolificacy as measured by the percentage of lambs born alive; and the overall measure of reproductive ability as measured by the percent lambs weaned of ewes bred.

Fertility, prolificacy, lamb livability and overall reproductive ability were generally higher for crossbreds than for purebreds. Furthermore, there was an upward trend in productivity with an increase in the number of breeds involved in the cross. Two-breed crosses tended to rank in somewhat the same order as the dam breed and were not significantly greater than the purebred matings for any of the traits studied. Consistent effects of breeds or breed combinations were not readily apparent in reproductive traits of three and four-breed crosses. Average increase in percent lambs weaned of ewes bred was 2.1, 14.9 and 27.1 for two, three and four-breed crosses, respectively, over the purebred parents.

Gorman et al. (1942) studied crosses between grade Rambouillet ewes and purebred rams representing the Corriedale, Lincoln, Suffolk and Southdown breeds. They found that at 140 days of age the Columbia crosses were heaviest followed by Lincoln, Romney and Corriedale crosses.

Slaughter grades were similar for the Corriedale, Columbia and Romney crosses. Carcass grades of Lincoln crosses were slightly lower. Only small differences were found in the proportion of cuts among the groups of crossbreds.

A U.S.D.A. report (1935) gave the following result from an experiment conducted at Dubois, Idaho. Hampshire and Suffolk rams were mated to Rambouillet and Corriedale ewes to test the relative suitability of the rams as sires of market lambs. The first year's study indicated that the lambs sired by Hampshire rams were heavier at birth but the lambs sired by Suffolk rams gained more rapidly after birth. Thus, at weaning time they averaged four pounds heavier than lambs sired by Hampshire rams. Ewes bred to Hampshire rams weaned 54.7 pounds of lamb whereas the ewes bred to Suffolk rams weaned 57.6 pounds of lamb per ewe bred. The Hampshire sired lambs sold for a slightly higher price per hundredweight.

Rae (1952) stated that in comparing ewes of different breeding for lamb production the most striking difference he found was between the performance of purebred lambs and crossbred lambs. He stated that three-breed crosses gave superior results to two-breed crosses.

Bonsma (1939) showed that purebred Merino and Black Head Persian ewes produced a lower milk yield than the first cross ewe resulting from crossing these to rams of mutton type. This high milk yield was reflected in the average daily gain of the lambs.

Sidwell, Grandstaff and Price (1951) conducted studies in crossbreeding of sheep comparing various crosses for staple length of wool.

They found the best cross was a Cotswold ram on ewes of $1/2$ Navajo- $1/4$ Corriedale- $1/4$ Romney breeding. In other experiments, Romney and Corriedale rams were superior to Lincoln and Cotswold for crossing with Navajo and crossbred $1/2$ Navajo- $1/4$ Corriedale- $1/4$ Romney ewes in respect to number of lambs weaned per ewe, but there was little difference between Romney and Corriedale crosses in percentage of ewe lambing.

Neale and Bell (1943) conducted an experiment with feeder lambs in which Hampshire x Rambouillet and Romney x Rambouillet crossbreds were compared with Rambouillet straightbreds. They found that Hampshire x Rambouillet, Romney x Rambouillet and Rambouillet lambs averaged 0.255, 0.245 and 0.230 pound daily gain, respectively. Thus, the average daily gain was slightly in favor of the crossbred lambs. All lambs were sold for the same price, although the packing house buyers preferred the Hampshire crossbred carcasses.

Nelson et al. (1950) conducted two experiments, one from 1942 through 1946 and the other from 1947 through 1950. In the first study Lincoln x Rambouillet crossbred ewes were bred to Romney, Hampshire and Southdown sires. In the second study first cross Lincoln and Rambouillet ewes were bred to Romney, Hampshire, Border Leicester and Cheviot rams.

In the first study, they found that survival of lambs in each of the sire group was in this order: Southdown, Hampshire and Romney. The percent of fat lambs at weaning was in the same order. In the second study, the percentage of fat lambs was about the same for the Hampshire and Cheviot sired lambs. Lambs sired by Hampshire rams were larger

whereas those of Cheviot rams were smaller. Lambs sired by rams of these two breeds had a greater percentage of fat than those sired by the Border Leicester or Romney rams each of the four years. Romney sired lambs consistently had the lowest percentage of fat lambs each of the four years.

Duncan et al. (1940-48) reported the results of an eight-year comparison at the Middle Tennessee Station, Columbia, Tennessee, among (a) Northwest ewes (Hampshire x Rambouillet), (b) grade Hampshire raised from selected ewe lambs from the Station flocks, and (c) Mountain ewes (mostly black-faced) from the Cumberland plateau. In most of eight years of the experiment, based on gross returns per ewe from lambs and wool, the Northwest crossbred ewes ranked first and the Mountain ewes second.

Leveck (1947) found that Texas and Corriedale x Native ewes lambed earlier and were more prolific than Montana ewes. Lambs from the Montana ewes had a slightly faster growth rate. Slaughter grades of lambs from the Montana and Texas ewes were about equal and both were substantially higher than those from the Corriedale x Native ewes. The wool clip from the Montana ewes was the highest (7.7 pounds) followed closely by the Corriedale x Native ewes (7.6 pounds) and Texas ewes (7.2 pounds).

Elliott (1935) summarized the results of a six-year trial at Cowra Experiment Station in South Australia. He found that the lambs from Merino ewes were the least attractive and the worst crosses were the Southdown and Merino. The best prices were obtained for Ryeland x Merino lambs. The earlier maturing qualities of Dorset Horn x Ryeland cross lambs over those by the Southdown were very marked. He concluded that Southdown rams should not be mated to Merino ewes.

Barrentine (1952) compared (a) home raised grade Corriedale ewes, (b) Hampshire x Rambouillet crossbred ewes from the Northwest, (c) Columbia x Rambouillet crossbred ewes from the Northwest, and (d) Suffolk x Rambouillet crossbred ewes from the Southwest. The locally raised ewes lambed earlier than other ewes of the Western type but the lambs weighed less at market time. He concluded that Suffolk x Rambouillet crossbred ewes and Corriedale x Rambouillet ewes were better suited for breeding for Mississippi conditions than were the Hampshire x Rambouillet crossbred ewes of the Northwest. In the same experiment he found that the Columbia x Rambouillet ewes were superior to the Hampshire x Rambouillet group. The ewes of the Columbia or Corriedale breeding produced the heaviest fleeces and the Suffolk x Rambouillet crossbreeds produced the lightest.

Bailey, Chapman and Pope (1961) conducted a two-year study involving 1,228 lambs sired by Columbia, Corriedale, Hampshire and Suffolk rams and out of grade Hampshire ewes on Wisconsin farms to determine breed-of-sire differences for weaning and carcass traits.

Lambs sired by Suffolk, Hampshire and Columbia rams differed little in weaning weight. These crosses averaged several pounds heavier than Corriedale-cross lambs. Suffolk sired lambs tended to produce heavier carcasses than those sired by Columbia and Corriedale rams. Carcasses from Hampshires and Corriedale sired lambs tended to be shorter and to grade higher than those sired by Suffolk and Columbia rams.

They concluded that first cross lambs had no advantage over

straightbred Hampshire under Wisconsin conditions, if all lambs were marketed.

Lasley (1963) quoted the results of an experiment involving the Border Leicester and Romney breeds by Clark (1957-58) in New Zealand and stated that crossbred ewes had an advantage of 20 to 25 percent over the purebred ewes in the percent of lambs alive at 28 days per 100 ewes mated. The backcross of crossbred ewes to Romney rams gave inferior results in this respect, as compared to the first cross ewes. Crossing two breeds noted for a high percentage lamb crop would give more lambs at weaning than crossing two breeds that are known for producing a low percentage lamb crop. Crossbreeding increases the weaning weights of lambs by about 6 to 7 percent and mature weight of ewes by 10 to 15 percent over the average of the pure breeds used in the cross. On the same basis, he stated that crossbreeding increased the weight of wool produced, which could be closely related to increased growth rate and viability of the individuals involved. Staple length may also be increased.

Fox et al. (1964) studied the performance of selected Hampshire, Columbia, and Targhee ewe lambs and compared them with that of selected crossbred ewe lambs. This experiment was conducted at two stations, first Union Station and second Corvallis Station. They found that 75 percent of the crossbred ewes lambed at the Corvallis Station and 61 percent lambed at the Union Station. Only 64 percent and 53 percent of the purebred ewes lambed at the Corvallis and Union Stations, respectively. Based on the ewes lambing, crossbred ewes produced a 164 percent lamb crop at each station while the purebred ewes produced a 148 percent lamb

crop at Corvallis and a 154 percent lamb crop at the Union Station. They concluded that under each of the two different post-weaning environments, selected crossbred ewes had an advantage of 9 to 23 percent in reproductive performance over selected purebred ewes when each group was bred as ewe lambs.

Sidwell, Everson and Terrill (1964) studied the birth weight, weaning weight and gain from birth to weaning of Hampshire, Shropshire, Southdown and Merino breeds of sheep and their crosses and of the Columbia-Southdale strain of sheep at Beltsville, Maryland. Least squares means for both birth weight and weaning weight ranked breeds in the same order, with Hampshires highest, followed by Columbia-Southdales, Shropshires, Merinos and Southdowns. Two-breed cross offspring tended to rank in the same order for all three traits as the purebred lambs from the dam's breed, but there were some exceptions. Trends were less apparent with three- and four-breed crosses.

Crossbred rams mated to purebred ewes excelled over purebred rams, but not over purebred rams when mated to crossbred ewes. Advantages of all crossbred lambs over purebred lambs involving the same breeds were 7.0 pounds for weaning weight, 0.63 pound for birth weight and 6.5 pounds gain from birth to weaning. Crossbred always excelled over comparable averages for purebreds for each trait. The average gains in weaning weight over the purebreds were 5.2 pounds for two-breed crosses, 9.5 pounds for three-breed crosses and 10.4 pounds for four-breed crosses.

Botkin (1963) conducted experiments over a period of six years

to compare the producing ability of crossbred ewes with that of parent breeds (Suffolk and Corriedale). He found that the lambs weaned as a percent of ewes exposed for breeding were 71.3, 103.4 and 105.4 in the case of Suffolk, Corriedale and crossbred ewes, respectively. Lambs weaned as a percent of ewes lambing were 124.1, 134.9 and 145.6, respectively.

Carter et al. (1957) used four types of ewes to compare their suitability as flock replacements. The four types of ewes were: (a) "Texas" (Suffolk x Rambouillet) crossbreds; (b) "Northwest Blackface" (Hampshire x Rambouillet) crossbreds; (c) Whiteface crossbreds produced by crossing Columbia, Corriedale or Lincoln rams on range ewes; and (d) grade Rambouillet ewes from the Northwest. They found that the four types of ewes were quite similar in percent of lambs raised to weaning or market age per ewe bred in the fall. The average productivity was: Suffolk x Rambouillet, 1.02; Hampshire x Rambouillet, 1.04; Whiteface crossbred, 1.02; and grade Rambouillet, 1.01. Lambs from the Suffolk x Rambouillet ewes were heaviest at birth, averaging 11.0 pounds, followed by lambs from the Rambouillet ewes (10.7 pounds), Hampshire x Rambouillet ewes (10.6 pounds) and Whiteface crossbred ewes (10.6 pounds). The rank and average daily gain from birth to weaning were by type of ewes: Suffolk x Rambouillet, 0.60 pound; Hampshire x Rambouillet, 0.59 pound; Whiteface crossbred, 0.57 pound; and Rambouillet, 0.56 pound. The lambs from Suffolk x Rambouillet and Rambouillet ewes were first in rank with respect to live grade at slaughter, averaging 14.1 (high Choice plus). Lambs from the Whiteface crossbred

and Hampshire x Rambouillet ewes averaged 13.6 and 13.5, respectively. Lambs from Suffolk x Rambouillet ewes ranked first in carcass grade with an average of 13.9 (Choice plus), followed by those from the Hampshire x Rambouillet (13.7), Whiteface crossbred (13.2) and Rambouillet ewes (13.3). The average and rank in carcass yield by type of ewe were as follows: Suffolk x Rambouillet, 52.2 percent; Hampshire x Rambouillet 51.4 percent; Whiteface crossbred, 51.3 percent; and grade Rambouillet, 50.5 percent.

Whitehurst et al. (1947) reported that ewes produced by mating Columbia rams to native ewes reproduced at a level superior to either parent strain and their fleeces were considerably heavier than those of the Native ewes. The annual report of Kentucky Agricultural Experiment Station (1940) presented results which showed that the offspring produced by crossbred ewes (Panama x Rambouillet) were superior in performance in comparison to offspring of straightbred Rambouillet ewes.

Wilkinson (1950) investigated the value of Welsh Mountain ewes as source of grassland halfbred ewes. Crosses of Welsh Mountain ewes with Border Leicester and Dorset Horn rams were compared. Results of over three years of experiment showed that the Border Leicester cross was more prolific, averaging 158 percent of lambs born alive and 154 percent reared as compared with 136 percent of lambs born alive and 129 percent of lambs reared from the Dorset Horn x Welsh cross. The Border Leicester cross lambs were also more uniform although wether lambs of both crosses fattened well.

Bradley et al. (1965) compared the performance of Shropshire,

Suffolk and Targhee breeds of sheep and their reciprocal first crosses. They found that the lambs sired by Suffolk were superior in 120-day weight to those sired by Targhee, but inferior in 120-day staple length of wool to Targhee and Shropshire-sired lambs. Estimates of breed maternal effects from reciprocal crosses indicated that Suffolks were superior in 120-day weight and Targhees in staple length. Targhee dams produced the greatest amount of wool and, when bred to Suffolk sires, produced the greatest weight of lamb per ewe at weaning.

CHAPTER III

EXPERIMENTAL PROCEDURE

Source of Data

The data used in this study were obtained as a part of the sheep breeding project of the Tennessee Agricultural Experiment Station conducted at the Plateau Experiment Station, Crossville, Tennessee, and included data collected during the period from 1952 to 1957, inclusive.

Experimental Flocks

During the period included in this study, five flocks of ewes from different sources and of different breeding were maintained at the station. Three of these flocks were established in the summer of 1951 and lambed for the first time in the winter of 1951-52. The other two flocks were established in the summer of 1954 and 1955 and lambed for the first time in the winter of 1955-56 and 1956-57. The source and breeding of ewes in each of the flocks were:

1. Northwestern (Hampshire x Rambouillet).
2. California (Columbia, Corriedale or Hampshire x Rambouillet).
3. Native (Grade Hampshire).
4. Southwestern (Grade Rambouillet).
5. Mixed Native (Hampshire or Southdown x Northwestern, California or Native).

Northwestern ewe flock. The ewes in this flock consisted of

black-faced ewes of Hampshire x Rambouillet breeding which originated in Montana. These ewes were purchased in the spring and bred as yearlings in the summer and fall of 1951 and lambed first in the winter of 1951-52.

California ewe flock. Ewes in this flock were largely white, brown or mottled-faced ewes of Columbia, Corriedale or Hampshire x Rambouillet breeding and originated in California. They were purchased in the spring of 1951, bred in the fall and lambed for the first time in the winter of 1951-52.

Native ewe flock. The native ewes in this flock were primarily black-faced ewes of Hampshire x Native breeding and were produced from small, late ewe lambs raised at the station. These ewes were born at the station in the late winter and early spring of 1950 and were bred as yearlings in the summer and fall of 1951 to lamb for the first time during the winter of 1951-52.

Southwestern ewe flock. The Southwestern ewes were mostly of grade Rambouillet breeding and originated in Texas. They were purchased and bred as yearlings in 1954 and lambed for the first time during the winter of 1954-55.

Mixed Native ewe flock. Ewes in this flock consisted of ewes selected from lambs born within the flocks during the winter of 1953-54. They were grown out and bred as yearlings to lamb first during the winter of 1955-56. These ewes consisted of an assortment of different kinds of breeding since they represented the progeny of ewes in the

Northwestern, California and Native flocks.

Initially, the Northwestern, California, Native, Southwestern and Mixed Native flocks of ewes consisted of 21, 35, 21, 26 and 20 ewes, respectively.

Breeding and Management

In most years, the breeding season began about August 1 to August 20 and extended for about 90 days or to November 1. During the first three breeding seasons (1951-1953), the ewes were bred in single sire groups. A sire breeding group consisted of a random allotment of ewes from each ewe flock.

Single rams were used in breeding groups for the entire breeding season of approximately 90 days in 1951 and 1952. In 1953 single rams were in individual ewe groups for 48 days and then all ewes and rams were run together for the remainder of the breeding season.

In order to try to prevent breeding failures because of "shy breeding" rams in single sire groups, two rams were used in breeding groups during the breeding seasons from 1954 through 1956. Beginning with the breeding season of 1954, all sources of ewes were allotted equally to three sire breeding groups on the basis of type, weight and source and breeding. Two rams of different breeds were then used in each breeding group during the entire breeding season. Lambs were identified as to sire breed at the time they were weaned.

During the first three years, Hampshire and Southdown rams were used. In 1954 and subsequent years, Hampshire, Southdown and Suffolk rams were used in pairs in the breeding groups.

The ewes were grazed throughout the year as much as possible either on permanent or temporary pastures. The ewes were "flushed" for two to three weeks before the beginning of the breeding season on good pasture. They were maintained on pasture during the breeding season. At the termination of the breeding season, all ewes were pastured or fed together until they lambed. In some years, winter pasture of either rye grass and crimson clover or small-grain and crimson clover mixtures provided a considerable portion of the feed for the ewes. In other years, silage or hay supplemented with concentrates provided winter feed when pasture was not available. In general, the ewes were fed concentrates (one-half to three-fourths pound per head daily) beginning three to four weeks prior to lambing. Grain feeding was increased to about one pound per head daily after lambing and continued until pastures provided adequate feed.

Beginning at the time the first lamb was born, the ewes were brought to the barn (a shed-type barn used mainly for sheep) at night. During the day they were allowed to graze in a pasture adjacent to the barn. Lambing pens were set up in the barn and ewes and lambs were placed in the pens immediately after lambing. Heat lamps were provided when needed.

The birth date, hour of birth, delivery trouble, birth weight, sex of lamb, type of birth and dam number were recorded when each lamb was born. Ewes and lambs remained in the lambing pens for two to five days. Lambs were castrated and docked at seven to 14 days of age.

The majority of the lambs were born in late December, January and

February in most years. Early lambs weighing 80 pounds or more were weaned and sold in late May and the remainder in late June or early July regardless of weight or condition. After weaning of lambs, ewes were placed on short pastures for about two weeks to aid in drying them up before the beginning of the breeding season.

Ewes were drenched for parasites about May 1, July 1, November 1 and at other times as deemed necessary. They were sheared between April 1 and May each year. Breeding rams were sheared about May 1 and just before the beginning of the breeding season.

Ewes were culled from the flock if they failed to lamb two years in succession or two out of three years and for various physical defects.

Records Obtained

The weight of each ewe was recorded at the beginning of the flushing period and breeding season, when fertile rams were removed, about two weeks before the first ewe was due to lamb and at the time the first lambs were weaned. Grease fleece weights of ewes were recorded when the ewes were sheared.

The following records were obtained with respect to lambs:

1. Date of birth.
2. Type of birth.
3. Birth weight (both live and dead lambs).
4. Sex (both live and dead lambs).
5. Notes on delivery troubles.
6. Weights from birth to weaning at 28-day intervals.
7. Weaning date.

8. Weaning weight.

9. Weaning condition score.

Most of the lambs were sold when they weighed between 80 and 100 pounds. For comparative study, weaning weights were adjusted to standard ages of 120 and 135 days.

Method of Analysis

For ease of study and interpretation, the data for the more important productive traits were summarized for individual traits over all years for the various breeding groups and are presented in Tables I to XVI, inclusive. Complete data for breeding groups by years for ewe and lamb performance are given in Appendix Tables XVII to XXII, inclusive.

The average daily gain of lambs from birth to weaning was calculated using the formula:

$$\text{Average Daily Gain (ADG)} = \frac{\text{Weaning weight} - \text{birth weight}}{\text{Weaning age in days}}.$$

The 120-day and 135-day weights of lambs were calculated as:

$$120\text{-day weight} = (\text{ADG} \times 120) + \text{birth weight},$$

$$135\text{-day weight} = (\text{ADG} \times 135) + \text{birth weight}.$$

The data on performance for lambs from the three groups of ewes included in the study for the complete period from 1952 through 1957 were analyzed by least squares methods to determine the effects of year-age of dam, breed of dam, sex of lamb, type of birth, type of birth and rearing and month of birth on various performance traits including birth weight, weaning weight, total gain, average daily gain from birth to weaning, condition score, 120-day weight and 135-day weight. The least squares

method of analysis as described by Harvey (1960) for analysis of data with unequal and disproportionate subclass numbers was used.

The least squares analysis for birth weight was based on the following mathematical model:

$$Y_{ijklmn} = u + y_i + b_j + s_k + t_l + c_m + e_{ijklmn}.$$

Where:

- Y_{ijklmn} is the observed value of a given trait for the $ijklmn$ -th individual,
- u is the effect common to all observations and is the mean of the population when equal numbers exist in the subclasses (this effect was absorbed in the analysis),
- y_i is the effect of the i -th year-age of dam class,
- b_j is the effect of the j -th breed of dam,
- s_k is the effect of the k -th sex of lamb,
- t_l is the effect of the l -th type of birth,
- c_m is the effect of the m -th month of birth,
- e_{ijklmn} is the random error associated with the $ijklmn$ -th individuals.

For the least squares analysis involving all traits other than birth weight, the mathematical model was altered to delete type of birth and include two other independent variables, type of birth and rearing and weaning age, as follows:

$$Y_{ijklmn} = u + y_i + b_j + s_k + r_l + c_m + b(X - \bar{x}) + e_{ijklmn}.$$

Where:

- r_l is the effect of the l -th type of birth and rearing,

$b (X-\bar{X})$ is the regression of the dependent variable (Y) on weaning age.

In the data included in these analyses, year and age of dam were confounded and estimates of their effects separately could not be made. In the analysis it was assumed that there were no interactions among effects.

Duncan's Multiple range test (1955) as modified by Kramer (1957) was used for mean separation when significant differences were detected by analysis of variance.

Data were available on 313 lambs, including 98 Northwestern, 143 California and 72 Native lambs, for the analysis in all traits.

CHAPTER IV

RESULTS AND DISCUSSION

The data for comparisons among different sources and breed types of ewes fall mainly into two categories: (1) productivity of ewes in terms of lambs born, lambs raised and wool weight; and (2) the performance of the lambs. Data on ewe productivity include number of ewes exposed, number of ewes lambing, percentage of ewes lambing, percentage lamb crop, percentage of twin births, lamb survival rates, lambs raised per ewe bred, pounds of lambs marketed per ewe bred and average wool production per ewe. These data are given in Tables I through X. In these tables, the weighted average over all years is given along with the average for each year. Data on lamb performance including birth weight, average daily gain, weaning weight, total gain, condition score, and weights at standard ages are presented in Tables XI through XV.

I. PRODUCTIVITY OF EWES

Fertility of Ewes

The number of ewes exposed and number of ewes lambing are given in Table I. During the period included in this study (1952-1957), 433 ewes were exposed to rams and 371 ewes lambled. The overall percentage of ewes lambing was 86.68. The weighted average lambing percentage over all years by source and breeding of ewes was: Northwestern, 92.2 percent; Native, 79.1 percent; California, 83.9 percent; Southwestern, 94.7

TABLE I

NUMBER OF EWES EXPOSED AND NUMBER OF EWES LAMBING AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Total
	1952	1953	1954	1955	1956	1957	
Northwestern ^b	21/19 ^a	18/17	17/15	14/13	12/11	8/8	90/83
Native ^b	21/18	21/17	19/13	9/6	8/7	8/7	86/68
California ^b	35/23	31/29	29/25	22/20	16/15	10/8	143/120
Southwestern ^c				26/24	25/25	24/22	75/71
Mixed Native ^d					20/16	19/16	39/32

^aNumber of ewes exposed to rams during the breeding season and number of ewes lambing, respectively.

^bEwes bred first as yearlings in 1951.

^cEwes bred first as yearlings in 1954.

^dEwes bred first as yearlings in 1955.

percent; and Mixed Native, 82.1 percent (Table II).

Northwestern, California and Native ewes were in the study for the full period of six years, while the Southwestern and Mixed Native ewes were added as yearlings in 1954 and 1955, and lambled during the last three and two years of the study, respectively.

The data presented in Table III provide a basis for comparing the fertility of the various kinds of ewes on the basis of the percentage of lambs dropped per 100 ewes bred. The average lambing percentage for the various kinds of ewes was 150 percent for the Northwestern ewes, 116 percent for the Native ewes, 125 percent for the California ewes, 132 percent for the Southwestern ewes and 118 percent for the Mixed Native ewes. The relatively low lambing percentages for the Native groups of ewes may be explained primarily by the fact that these groups of ewes had the lowest percentage of ewes lambing (Table II) and also the smallest percentages of twin births (Table IV).

The Northwestern ewes had the highest percentage of twin births, averaging 55.6 percent (Table IV). The percentage of twin births for the California, Southwestern, Native and Mixed Native ewes was 40.6, 37.3, 35.8 and 33.7 percent, respectively. Although twinning rates varied somewhat among years, in most groups of ewes the percentage of twin births increased as the ewes became older. Lowest percentages were found in ewes lambing at two and three years of age. These findings are in agreement with those of Ensminger (1952) who stated that age of ewe is a factor in twinning with middle-aged ewes producing a higher percentage lamb crop than either very young or very old ewes.

TABLE 11
 PERCENTAGE OF EWES LAMBING BY BREEDING OF EWES AT THE PLATEAU EXPERIMENT
 STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	90.5	94.4	88.2	92.9	92.0	100.0	92.2
Native ^a	85.7	81.0	68.4	66.7	88.0	87.5	79.1
California ^a	65.7	93.5	86.2	90.9	90.9	80.0	83.9
Southwestern ^b				92.3	100.0	91.7	94.7
Mixed Native ^c					80.0	84.2	82.1

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE III

PERCENTAGE LAMB CROP (TO EWES BRED) BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	133.3	150.0	152.9	164.3	167.0	137.5	150.0
Native ^a	128.5	128.6	105.3	66.7	150.0	100.0	116.3
California ^a	74.3	119.4	141.4	159.1	162.0	150.0	125.9
Southwestern ^b				111.5	140.0	145.8	132.0
Mixed Native ^c					115.0	121.0	118.0

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE IV
PERCENT TWIN BIRTHS BY BREEDING OF EWES AT THE PLATEAU EXPERIMENT
STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	47.6	52.6	58.8	61.3	75.0	37.5	55.6
Native ^a	38.1	42.9	31.6	00.0	62.0	12.5	33.7
California ^a	8.1	25.8	51.7	63.6	69.0	70.0	40.6
Southwestern ^b				19.2	40.0	54.2	37.3
Mixed Native ^c					35.0	36.8	35.8

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

Lamb Survival

A lamb producer will realize greater returns from his enterprise if lamb survival is maximum. Lamb survival in this study was calculated on the basis of number of lambs raised divided by the number of lambs born and then converted into percentage. These data are presented in Table V. The average percentage of lambs raised to weaning was 82.8 percent for California ewes, 78.0 percent for Native ewes, 76.3 percent for Northwestern ewes, 81.8 percent for Southwestern ewes and 80.4 percent for Mixed Native ewes.

Lambs Raised Per Ewe Bred

The number of lambs raised per ewe bred or exposed is one of the best single criterion or index of the productivity of ewes in a flock. This figure takes into account the percentage of ewes lambing, the number of lambs produced and the survival rate of the lambs. The averages for the various breeding groups as shown in Table VI were: Northwestern, 1.14; Southwestern, 1.08; California, 1.04; Mixed Native, 0.95; and Native, 0.91. The differences primarily reflect variations in the percentages of ewes lambing and lambing percentages, as lamb survival rates were similar for all groups. The Northwestern ewes had the highest percentage of ewes lambing and a higher percentage of twin births than any other group of ewes.

Pounds Lamb Marketed Per Ewe Bred

The pounds of lamb weaned and marketed per ewe bred reflects not only the number of lambs raised per ewe in the flock but also the growth

TABLE V

PERCENTAGE OF LAMBS RAISED TO WEANING BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	46.4	92.6	84.6	69.6	85.0	90.9	76.3
Native ^a	85.2	77.8	85.0	66.7	67.0	62.5	78.0
California ^a	80.8	89.2	78.0	82.9	85.0	80.0	82.8
Southwestern ^b				79.3	80.0	85.7	81.8
Mixed Native ^c					74.0	86.9	80.4

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE VI
LAMBS RAISED TO WEANING PER EWE BRED AT THE PLATEAU EXPERIMENT STATION
DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	0.62	1.39	1.29	1.14	1.42	1.25	1.14
Native ^a	1.10	1.00	0.90	0.44	1.00	0.62	0.91
California ^a	0.60	1.06	1.10	1.32	1.38	1.20	1.04
Southwestern ^b				0.89	1.12	1.25	1.08
Mixed Native ^c					0.85	1.05	0.95

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

rate and consequent weaning and market weight of lambs produced. The number of lambs raised per ewe bred has been presented in Table VI and the average daily gain of lambs by source and breeding of ewes is shown in Table VII. The average daily gains of lambs by source and breeding of ewes were: Northwestern, 0.54 pound; California, 0.52 pound, Native, 0.48 pound; Southwestern, 0.59 and Mixed Native, 0.55 pound. As the number of lambs raised per ewe bred was greater for Northwestern ewes, the pounds of lamb marketed per ewe ranked first in comparison to Native and California ewes. The averages by source and breeding of ewes for pounds of lamb marketed per ewe bred are presented in Table VIII. The averages were 93.2 pounds for Northwestern ewes, 68.6 pounds for Native ewes, 63.2 pounds for California ewes, 94.0 pounds for Southwestern ewes and 72.2 pounds for Mixed Native ewes.

Condition Scores of Lambs

The condition score or degree of finish of the lamb at weaning or market time is a reflection of the milking and mothering ability of the ewes as well as growth rate and health of the lamb. Condition scores of lambs are presented in Table IX. The average condition scores of lambs by breeding of ewes were: Northwestern, 12.3; Native, 11.7; California, 12.1; Southwestern, 11.2; and Mixed Native, 11.4.

Wool Production

The average annual wool production per ewe for the various kinds of ewes is given in Table X. Overall average production was 8.42 pounds for Northwestern ewes, 8.27 pounds for California ewes, 6.32

TABLE VII

AVERAGE DAILY GAIN OF LAMBS BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
	-----Pound-----						
Northwestern ^a	0.43	0.53	0.54	0.51	0.60	0.67	0.54
Native ^a	0.41	0.50	0.51	0.46	0.51	0.49	0.48
California ^a	0.39	0.53	0.53	0.50	0.58	0.59	0.52
Southwestern ^b				0.48	0.64	0.62	0.59
Mixed Native ^c					0.53	0.56	0.55

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE VIII

POUNDS OF LAMBS MARKETED PER EWE BRED BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
	-----Pounds-----						
Northwestern ^a	38.7	111.1	106.1	97.0	116.0	114.2	93.2
Native ^a	70.6	74.8	73.3	36.3	73.0	51.2	68.6
California ^a	35.0	84.1	90.9	106.9	111.4	104.6	63.2
Southwestern ^b				70.3	89.2	112.5	94.0
Mixed Native ^c					61.6	83.1	72.2

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE IX

AVERAGE CONDITION SCORE^a OF LAMBS BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^e
	1952	1953	1954	1955	1956	1957	
Northwestern ^b	9.2	12.7	14.0	12.4	11.3	13.0	12.3
Native ^b	8.7	12.5	14.3	12.8	11.2	12.3	11.7
California ^b	8.4	13.1	14.3	11.6	11.7	12.1	12.1
Southwestern ^c				11.4	11.2	11.9	11.2
Mixed Native ^d					10.7	12.0	11.4

^a7, av. utility; 9, low good; 10, av. good; 11, high good, 12, low choice; 13, av. choice; and 14, high choice.

^bEwes bred first as yearlings in 1951.

^cEwes bred first as yearlings in 1954.

^dEwes bred first as yearlings in 1955.

^eWeighted average over-all years.

TABLE X

AVERAGE WOOL WEIGHT OF EWES SHEARED BY BREEDING EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	7.93	9.00	9.06	8.10	8.23	7.66	8.42
Native ^a	6.07	6.57	6.68	6.80	6.23	5.86	6.32
California ^a	7.04	8.61	8.87	8.40	8.41	8.24	8.27
Southwestern ^b				9.60	9.78	9.27	9.30
Mixed Native ^c					6.98	6.31	6.64

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

pounds for Native ewes, 9.30 pounds for Southwestern ewes, and 6.64 pounds for the Mixed Native ewes. The Southwestern ewes of grade Rambouillet breeding sheared the heaviest fleeces. The crossbred North-western and California ewes with 50 percent Rambouillet breeding produced about one pound less wool than the grade Rambouillet ewes but 1.63 to 2.10 pounds more than Native ewes. Native and Mixed Native ewes with a high percentage of mutton breeding sheared the lightest fleeces.

II. LAMB PERFORMANCE

Data from 313 lambs were analyzed by least squares methods to determine the effects of year-age of dam, breeding of dam, sex of lamb, type of birth, type of birth and rearing and month of birth on various lamb performance traits. Lambs from Southwestern and Mixed Native ewes were not included as they were not in the study for the entire period. Lambs born as triplets and those born in the month of May were excluded because only limited numbers were available.

Birth Weight

The unadjusted average birth weights of lambs by source and breeding of ewes are given in Table XI. The least square constants and analysis of variance for birth weight are given in Tables XII and XIII, respectively. The overall means and standard errors for birth weight and for weaning traits are found in Table XIV.

The analysis of variance for birth weight shows that this trait was significantly influenced by breeding of the dam, type of birth, sex of lamb, and month of birth. Least squares constants (Table XII) show

TABLE XI
AVERAGE BIRTH WEIGHT OF LAMBS BY BREEDING OF EWES AT THE PLATEAU
EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av. ^d
	1952	1953	1954	1955	1956	1957	
Northwestern ^a	7.38	8.77	8.65	10.10	8.50	10.00	8.75
Native ^a	7.38	7.80	7.75	10.40	7.88	9.30	8.00
California ^a	7.93	9.05	7.76	9.40	8.35	8.60	8.42
Southwestern ^b				9.90	8.28	8.60	8.88
Mixed Native ^c					6.85	7.00	6.91

^aEwes bred first as yearlings in 1951.

^bEwes bred first as yearlings in 1954.

^cEwes bred first as yearlings in 1955.

^dWeighted average over-all years.

TABLE XII

LEAST SQUARES ESTIMATES OF THE EFFECTS OF VARIOUS FACTORS ON BIRTH WEIGHT, WEANING WEIGHT, TOTAL GAIN, AVERAGE DAILY GAIN, CONDITION SCORE, 120-DAY WEIGHT AND 135-DAY WEIGHT

	No. of lambs	Birth weight	Weaning weight	Total gain	Average daily gain	Condition score	120-day weight	135-day weight
Year - Age of dam								
1952 - 2 years old	54	-1.337 ^d	-12.627 ^c	-11.179 ^e	-.088 ^d	-2.824 ^d	-11.772 ^c	-13.174 ^e
1953 - 3 years old	77	-.099 ^b	-.315 ^b	-.087 ^{bcd}	.000 ^c	0.788 ^b	-.206 ^b	-.213 ^c
1954 - 4 years old	67	-.292 ^c	6.250 ^a	6.484 ^a	0.045 ^a	2.564 ^a	5.232 ^a	-5.959 ^d
1955 - 5 years old	41	1.376 ^a	4.244 ^a	2.796 ^{bc}	0.018 ^{bc}	0.175 ^{bc}	3.647 ^a	3.781 ^b
1956 - 6 years old	47	-.066 ^{bc}	-1.354 ^b	-1.456 ^d	-.066 ^c	-.570 ^c	-.684 ^b	-.726 ^c
1957 - 7 years old	27	0.418 ^b	3.802 ^a	3.442 ^{ab}	0.031 ^{ab}	-.133 ^c	3.783 ^a	16.291 ^a
Breed of dam								
Northwestern	98	0.529 ^a	3.128 ^a	2.549 ^a	0.019 ^a	0.245 ^a	2.730 ^a	3.022 ^a
California	143	-.167 ^b	-.472 ^b	-.282 ^b	-.003 ^b	-.146 ^a	-.449 ^b	-.531 ^b
Native	72	-.362 ^b	-2.656 ^b	-2.267 ^b	-.016 ^b	-.099 ^a	-2.281 ^b	-2.491 ^b
Sex of lamb								
Male	159	0.309 ^a	1.946 ^a	1.639 ^a	0.012 ^a	0.008 ^a	1.650 ^a	1.901 ^a
Female	154	-.309 ^b	-1.946 ^b	-1.639 ^b	-.012 ^b	-.008 ^a	-1.650 ^b	-1.901 ^b

TABLE XII (continued)

	No. of lambs	Birth weight	Weaning weight	Total gain	Average daily gain	Condition score	120-day weight	135-day weight
----- (lb.) -----								
Type of birth & rearing								
Born single, raised single	107		4.717 ^a	3.137 ^a	0.027 ^a	0.533 ^a	4.642 ^a	5.204 ^a
Born twin, raised single	36		-3.249 ^b	-2.242 ^b	-0.018 ^b	-0.096 ^{ab}	-3.204 ^b	-3.567 ^b
Born twin, raised twin	170		-1.468 ^b	-0.895 ^b	-0.009 ^b	-0.437 ^b	-1.438 ^b	-1.637 ^b
Type of birth								
Single	108	1.113 ^a						
Twin	205	-1.113 ^b						
Month of birth								
December	28	0.649 ^a	13.764 ^a	12.722 ^a	0.084 ^a	1.665 ^a	11.081 ^a	12.628 ^a
January	151	0.522 ^a	10.098 ^b	9.244 ^b	0.061 ^a	1.404 ^a	7.994 ^a	9.295 ^a
February	76	0.432 ^a	1.592 ^c	0.965 ^c	0.004 ^b	0.363 ^b	0.965 ^b	1.084 ^b
March	55	-0.092 ^b	-7.326 ^d	-7.006 ^d	-0.052 ^c	-0.770 ^c	-6.527 ^c	-7.384 ^c
April	3	-1.511 ^b	-18.128 ^e	-15.925 ^d	-0.098 ^c	-2.662 ^c	-13.513 ^c	-15.623 ^c
Regression*	313		-0.0924	-0.0727	-0.0040	-0.0254	-0.4974	-0.5708

*Regression of dependent variable (Y) on age at weaning.

TABLE XIII
ANALYSIS OF VARIANCE FOR BIRTH WEIGHT OF LAMBS

Source of variation	Degrees of freedom	Mean square
Total	312	
Reduction	13	532.178
Year, age of dam	5	27.773**
Breed of dam	2	19.397**
Type of birth	1	318.860**
Sex of lamb	1	29.092**
Month of birth	4	5.966*
Error	299	1.911

*P < .05

**P < .01

TABLE XIV
OVERALL MEANS AND STANDARD ERRORS OF LAMB TRAITS
FOR THE YEARS 1952 THROUGH 1957^a

Trait	Mean	Standard Error
Birth weight, lb.	8.73	0.106
Weaning weight, lb.	77.88	0.759
Total gain birth to weaning, lb.	69.16	0.705
Average daily gain birth to weaning, lb.	0.504	0.006
Condition score	12.18	0.145
120-day weight, lb.	69.18	0.708
135-day weight, lb.	76.84	0.780
Weaning age, days	138.75	1.052

^aIncludes lambs from the Northwestern, California and Native groups only for a total of 313 lambs.

that lambs from Northwestern ewes were 0.891 pound heavier than the lambs from Native ewes and 0.696 pound heavier than the lambs from California ewes.

Lambs born as singles were 2.226 pounds heavier than lambs born as twins. The effect of sex of lamb on birth weight was highly significant ($P < .01$). Male lambs were 0.618 pound heavier than female lambs. These findings are in agreement with the work of Kean and Henning (1949) who found that the birth weight of lambs born as singles was 1.4 pounds greater than the birth weight of those born as twins. They further reported that males weighed 8.9 pounds at birth as compared to 8.3 pounds for females, a difference of 0.6 pound. Harrington, Whiteman and Morrison (1958) also reported that male lambs were heavier at birth than female lambs.

Month of birth significantly influenced birth weight ($P < .01$). Lambs born early in the lambing season were heavier than those born later in the season. The lambs born in December, January and February were significantly heavier than those born in the months of March and April.

Differences in birth weights of lambs due to type of birth were highly significant (Table XIII). Lambs born as singles were 2.226 pounds heavier at birth than lambs born as twins.

The effect of sex of lamb on birth weight was highly significant. Male lambs were 0.609 pound heavier at birth than female lambs (Table XII).

Month of birth significantly influenced birth weight of lambs and considerable differences were obtained among months of birth during the

lambing season (Table XII, page 41). Lambs born during December, January and February had similar birth weights and were significantly heavier than lambs born during March and April. The difference between lambs born during March and April was not significant.

Deviations from the overall adjusted mean (least squares constants) were 0.649, 0.522, 0.432, -.092 and -1.511 pounds for lambs born in December, January, February, March and April, respectively. One possible explanation for the differences in birth weight among months is that ewes which lambed early were on a higher nutritional level during the latter stages of pregnancy as compared to ewes lambing later in the season. Since the major growth of the fetus occurs during late pregnancy, this could account for part of the differences obtained in this study.

Significant correlations (Table XV) were found between birth weight and the following characteristics: weaning weight ($r = 0.515$); total gain ($r = 0.398$); average daily gain ($r = 0.415$); condition score ($r = 0.246$); 120-day weight ($r = 0.533$); and 135-day weight ($r = 0.526$). These correlations indicate that variation in birth weights was associated with about 25 percent of the variation in weaning weights and weights at the standard ages. Although the correlation between birth weight and condition score was significant, only about 6 percent of the variation in condition scores was accounted for by the variation in birth weights.

Weaning Weight

There were highly significant effects ($P < .01$) of year-age of dam, breeding of dam, sex of lamb, type of birth and rearing and month

TABLE XV
CORRELATIONS AMONG LAMB PERFORMANCE TRAITS

	Birth weight	Weaning weight	Total gain	Average daily gain	Condition score	120-day weight	135-day weight	Weaning age
Birth weight	1.00	0.515**	0.398**	0.415**	0.246**	0.533**	0.526**	-.038
Weaning weight		1.00	0.990**	0.748**	0.665**	0.772**	0.768**	0.251**
Total gain			1.00	0.736**	0.672**	0.743**	0.740**	0.279**
Average daily gain				1.00	0.612**	0.989**	0.991**	-.432**
Condition score					1.00	0.609**	0.609**	0.029
120-day weight						1.00	0.998**	-.404**
135-day weight							1.00	-.411**
Weaning age								1.00

**P < .01

of birth on weaning weight (Table XVI).

Breeding of the dam significantly influenced weaning weight ($P < .01$). Lambs out of Northwestern ewes were heaviest at weaning than lambs out of California and Native ewes (Table XII, page 41). Average adjusted weaning weights for lambs were: Northwestern, 81.0 pounds; California, 77.4 pounds; and Native 75.22 pounds.

Weaning weight was affected also by the sex of the lamb. Males weaned at 79.82 pounds and females at 75.93 pounds with a difference of 3.89 pounds in favor of males. Karam, Chapman and Pope (1949) reported that male lambs were 3.5 pounds heavier than females at 25 weeks of age. A greater difference was observed by Hazel and Terrill (1945) who reported that males were 8.3 pounds heavier than females at 25 weeks of age.

Type of birth and rearing had a highly significant effect on weaning weight ($P < .01$). Lambs born and raised as singles were heavier than those born as twins but raised either as singles or twins. Least squares constants for lambs born and raised as singles, born as twins but raised as singles and born and raised as twins were 4.717, -3.249 and -1.468 pounds, respectively. These results agree with those of Givens, Carter and Gaines (1960) who reported that single lambs were 10.7 pounds heavier at 120-days than lambs born and raised as twins.

The effect of month of birth on weaning weight was highly significant ($P < .01$). Lambs born in December, January and February were significantly heavier at weaning than those born in March and April. Least squares constants (deviations from the overall mean) for

TABLE XVI
ANALYSIS OF VARIANCE

Source	Degrees of freedom	Mean square				
		Weaning weight	Total gain	Average daily gain	Condition score	120-day weight
Total	312					135-day weight
Reduction	15	33433.627	27510.098	1.858	1135.846	31408.848
Year, age of dam	5	2144.796**	1819.189**	0.102**	172.313**	1736.659**
Breed of dam	2	674.579**	455.354**	0.025**	4.570	511.565**
Sex of lamb	1	1107.332**	777.332**	0.041**	0.021	798.174**
Type of birth and rearing	2	1321.071**	577.962**	0.043**	25.692**	1278.298**
Month of birth	4	1308.661**	1147.396**	0.055**	20.469**	898.402**
Regression	1	274.437	170.004	0.527**	20.665*	7970.496**
Error	297	76.655	70.727	0.004	3.094	59.100
						73.962

*P < .05

**P < .01

lambs born in December, January, February, March and April were 13.764, 10.098, 1.592, -7.326 and -18.128 pounds, respectively. The overall adjusted mean for weaning weight was 77.875 pounds. The difference between lambs born in December and January was not significant; however, lambs born in these months were heavier ($P < .05$) at weaning than lambs born in February.

Significant correlations (Table XV, page 47) were obtained between weaning weight and the following characteristics: total gain, $r = 0.990$; average daily gain, $r = 0.748$; condition score, $r = 0.665$; 120-day weight, $r = 0.772$; and 135-day weight, $r = 0.768$.

Average Daily Gain

As shown in Table XVI, page 48, the average daily gain of lambs from birth to weaning was significantly affected by all classes of effects included in the analysis.

The effects of breeding of dam on average daily gain was highly significant ($P < .01$). Lambs out of Northwestern ewes gained at a faster rate than lambs out of California or Native ewes ($P < .05$). Deviations from the overall adjusted mean were 0.019, -.003 and -.016 pound for lambs from Northwestern, California and Native ewes, respectively.

Rate of gain was affected significantly ($P < .01$) by the sex of the lambs. Male lambs gained 0.024 pound more per day than the female lambs. Similar results were obtained by Karam, Chapman and Pope (1949) and Givens, Carter and Gaines (1960) who reported differences of 0.020 and 0.037 pound, respectively, between wether and ewe lambs. Kean and Henning (1949) found that males were 0.6 pound heavier at birth and

gained 0.03 pound per day faster than females.

Type of birth and rearing significantly influenced average daily gain of lambs. Lambs born as singles and raised as singles were 0.027 pound above the adjusted average while lambs born as twins and raised as single and those born as twins and raised as twins were -.018 and -.009 pound below the average, respectively.

Lambs born during December and January had similar average daily gains from birth to weaning and gained faster ($P < .05$) than lambs born in other months. February lambs gained significantly faster than lambs born in March and April. The least squares constants for December, January, February, March and April lambs were 0.084, 0.061, 0.004, -.052 and -.098 pound, respectively.

Positive and highly significant correlations were obtained between average daily gain and birth weight ($r = 0.415$), weaning weight ($r = 0.748$), total gain ($r = 0.736$), condition score ($r = 0.612$), 120-day weight ($r = 0.989$) and 135-day weight ($r = 0.991$).

Condition Scores

Condition scores of lambs were significantly influenced by type of birth and rearing and month of birth. Breeding of dam and sex of lamb did not significantly affect this trait (Table XII, page 41).

Lambs born and raised as singles had higher condition scores at weaning ($P < .05$) than lambs born and raised as twins. They graded about one grade unit or one-third of a full grade higher at weaning than lambs born and raised as twins. The difference in condition scores between lambs born and raised as singles and lambs born as twins but raised as

singles was not significant. The differences in condition scores due to type of birth and weaning may be due partially to the heavier weaning weights of lambs born and raised as singles. Lambs born and raised as singles were 6.17 pounds heavier at weaning than lambs born and raised as twins and 7.95 pounds heavier than lambs born as twins but raised as singles.

The condition scores of lambs born during December and January were similar but significantly higher ($P < .05$) than those of lambs born during February, March and April. Lambs born in February graded significantly higher than those born in March and April. The difference between lambs born in March and April was not significant. The deviations from the overall adjusted mean score were 1.665, 1.404, 0.363, -.770 and -2.662 units for December, January, February, March and April, lambs, respectively.

Weight at 120-days

At a standard age of 120-days lambs from Northwestern ewes were 3.179 and 5.011 pounds heavier than lambs from California and Native ewes, respectively ($P < .05$).

Sex of lamb significantly affected performance in this trait. Males were 3.30 pounds heavier than females on a 120-day basis. Botkin et al. (1956) found a greater difference between sexes and reported that ram lambs were 9 pounds heavier than ewe lambs when weaned at 129 days of age.

Type of birth and rearing effects on 120-day weight were highly significant. Lambs born as singles and raised as singles were 7.85 and

6.08 pounds heavier than lambs born as twins and raised as singles and lambs born either single or as twins and raised as twins, respectively. Lambs born as singles and raised as singles were 4.642 pounds above the adjusted overall mean while lambs born and raised as twins were 1.438 pounds below the mean.

Month of birth effects on 120-day weight were highly significant. Lambs born in December and January were heavier ($P < .05$) than lambs born in other months. Deviations from the overall mean for lambs born in December, January, February, March and April were 11.061, 7.994, 0.965, -6.527 and -13.513 pounds, respectively. Similar results were reported by Phillips and Dawson (1937) who found that lambs born early in the lambing season were heavier than late lambs at three months of age.

Highly significant correlations (Table XV, page 47) were obtained between 120-day weight and weaning weight ($r = 0.772$), birth weight ($r = 0.533$), average daily gain ($r = 0.989$), total gain ($r = 0.743$), condition score ($r = 0.609$) and 135-day weight ($r = 0.998$).

Weight at 135-days

The analysis for the effects of various factors on 135-day weight showed that the effects of breeding of dam, sex of lamb, type of birth and rearing and month of birth were similar to those obtained in the analysis of 120-day weight (Table XII, page 41). Lambs out of North-western ewes were 3.553 and 5.513 pounds heavier ($P < .05$) than lambs out of California and Native ewes. Male lambs were significantly heavier than female lambs by 3.801 pounds. Lambs born and reared as singles were heavier ($P < .05$) than lambs born as twins but reared as singles and

lambs born and raised as twins. December and January lambs had greater 135-day weights than lambs born in February, March and April.

Weight at 135 days was significantly correlated with 120-day weight ($r = 0.998$). Thus, in these data 99.6 percent of the variation in 135-day weight was associated with variation in 120-day weight. This indicates that a comparison of lamb weights at a standard age of 120 days would be as reliable as a comparison at 135 days.

Application of Results

The results of these analyses indicate that sex of lamb, type of birth and rearing, and month of birth are significant sources of variation in lamb performance traits. This indicates the need for correcting records for these effects if comparisons among lambs or breeding groups are reliable and reveal true differences. In this study, estimates of the effects of year and age of dam could not be made since the two sources of variation were confounded. However, the estimates for the combined effect, estimated as year-age of dam effect, indicate that one or both of the effects may be significant sources of variation and would need to be considered also in adjusting lamb records for comparisons among individuals and breeding groups.

CHAPTER V

SUMMARY AND CONCLUSIONS

During the period included in this study (1952-1957), 433 ewes were exposed to rams and 371 ewes lambed at the Plateau Experiment Station, Crossville. Data on ewe productivity which included number of ewes exposed, number of ewes bred, percentage of ewes lambing, percentage of lamb crop, percentage of twin births, lamb survival rates, lambs raised per ewe bred, pounds of lambs marketed per ewe bred and average wool production per ewe were analyzed to study differences among various kinds of ewes. Data on lamb performance including birth weight, average daily gain, weaning weight, total gain, condition score, and weights at standard ages were analyzed by least squares methods to determine the effects of various factors influencing performance.

The average lambing percentage for the various kinds of ewes was 150 percent for Northwestern ewes, 116 percent for Native ewes, 125 percent for California ewes, 132 percent for Southwestern ewes and 118 percent for Mixed Native ewes. The relatively low lambing percentage for the Native ewes may be explained by the low percentage of ewes lambing and the small percentage of twin births.

The percentage of twin births for the Northwestern, California, Southwestern, Native and Mixed Native ewes was 55.6, 40.6, 37.3, 35.8 and 33.7 percent, respectively. Although twinning rates varied somewhat among years, in most groups of ewes the percentage of twin births

increased as the ewes became older. Smallest percentages were found in ewes lambing at two and three years of age.

The average number of lambs raised per ewe bred for the various breeding groups was: Northwestern, 1.14; Southwestern, 1.08; California, 1.04; Mixed Native, 0.95; and Native, 0.91. The Northwestern ewes had the highest percentage of ewes lambing and a higher percentage of twin births than any other group of ewes.

The pounds of lambs weaned and marketed per ewe bred reflects not only the number of lambs raised per ewe in the flock but also the growth rate and consequent weaning and market weight of lambs produced. The average daily gains of lambs by source and breeding of ewes were: Northwestern, 0.54 pound; California, 0.52 pound; Native, 0.48 pound; Southwestern, 0.59 pound; and Mixed Native, 0.55 pound. As the number of lambs raised per ewe was greater for Northwestern ewes, the pound of lamb marketed per ewe ranked first in comparison to Native and California ewes. The averages by source and breeding of ewes for pounds of lamb marketed per ewe bred were: 93.2 pounds for Northwestern, 68.6 pounds for Native, 63.2 pounds for California, 94.0 pounds for Southwestern, and 72.2 pounds for Mixed Native.

The condition scores of the lambs at market time for the different kinds of ewes were: Northwestern, 12.3; California, 12.1; Mixed Native, 11.4; Native, 11.7; and Southwestern, 11.2.

The Southwestern ewes of grade Rambouillet breeding sheared the heaviest fleeces. The crossbred Northwestern and California ewes with 50 percent Rambouillet breeding produced about one pound less wool than

the grade Rambouillet ewes but 1.63 to 2.10 pounds more than Native ewes. Native and Mixed Native ewes with a high percentage of mutton breeding sheared the lightest fleeces.

Birth weight was significantly influenced by breeding of dam, type of birth, sex of lamb and month of birth. Least squares constants showed that lambs from Northwestern ewes were 0.891 pound heavier at birth than the lambs from Native ewes and 0.696 pound heavier than the lambs from California ewes. Month of birth significantly influenced birth weights of lambs and considerable differences were obtained among months of birth during the lambing season. Lambs born during December, January and February had similar birth weights and were significantly heavier than lambs born during March and April. Deviations from the overall adjusted mean (least squares constants) were: 0.649, 0.522, 0.432, -.092 and -1.511 pounds for lambs born in December, January, February, March and April, respectively.

Lambs out of Northwestern ewes were heavier at weaning than lambs out of California and Native ewes. Average adjusted weaning weights for lambs were: Northwestern, 81.0 pounds; California, 77.4 pounds; and Native, 75.2 pounds. Males were heavier than females with a difference of 3.89 pounds in weaning weight. Lambs born as singles and raised as singles were heavier than those born as twins but raised either as a single or twin. Lambs born and raised as singles, born twin and raised as a single, and born twin and raised as a twin were 4.717, -3.249 and -1.468 pounds above or below the adjusted mean, respectively.

Lambs born in December, January and February were significantly

heavier than those born in March and April. Least squares constants for lambs born in December, January, February, March and April were 13.764, 10.094, 1.592, -7.326 and -18.128 pounds, respectively.

Lambs out of Northwestern ewes gained at a faster rate than lambs out of California or Native ewes. Deviations from the overall adjusted mean were 0.019, -.003 and -.016 pound for lambs from Northwestern, California and Native ewes, respectively. Male lambs gained 0.024 pound more per day than female lambs. Lambs born and raised as singles were 0.027 pound above the adjusted average while lambs born as twins and raised as singles, and those born and raised as twins were -.018 and -.009 pound below the average, respectively.

Lambs born early in the season (December and January) had similar average daily gains from birth to weaning and gained faster than lambs born in other months. February born lambs gained significantly faster than lambs born in March and April.

Lambs born and raised as singles had higher condition scores at weaning than lambs born and raised as twins. They graded about one grade unit or one-third of a full grade higher at weaning than lambs born and raised as twins. The condition scores of lambs born during December and January were similar but significantly higher ($P < .05$) than those of lambs born during February, March and April. The deviations from the overall adjusted mean score were 1.665, 1.404, 0.363, -.770 and -2.662 units for December, January, February, March and April lambs, respectively.

At a standard age of 120-days lambs from Northwestern ewes were

3.179 and 5.011 pounds heavier than lambs from California and Native ewes, respectively ($P < .05$). At this age, males were 3.30 pounds heavier than females. Month of birth effects on 120-day weight were highly significant. Lambs born in the months of December and January were heavier than lambs born in February, March and April. In the analysis of 135-day weights, the effects of breeding of dam, sex of lamb, type of birth and rearing, and month of birth were similar to those obtained in the analysis of 120-day weights. Weight at 135 days was significantly correlated with 120-day weight ($r = 0.998$). Thus, in these data 99.6 percent of variation in 135-day weights was associated with the variation in 120-day weights. This indicates that a comparison of lamb weights at a standard age of 120-days would be as reliable as a comparison at 135 days.

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APPENDIX

TABLE XVII
PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1952

	Breeding of ewes		
	Northwestern	Native	California
No. of ewes bred	21	21	35
Age of ewes, years	2	2	2
No. of ewes lambing	19	18	23
Percent of ewes lambing	90.5	85.7	65.7
Av. lambing date of ewes	2/18/52	2/11/52	2/23/52
Percent lamb crop (to ewes bred)	133.3	128.5	74.3
Lamb raised per ewe bred	0.62	1.09	0.60
No. of lambs born	28	27	26
No. of sets of twins (multiple births)	10	8	3
No. of lambs raised to weaning	13	23	21
Percent of lambs raised to weaning	46.4	85.2	80.8
Av. birth weight of lambs, lb.	7.38	7.34	7.93
Av. weaning weight, lb.	62.5	64.5	58.3
Av. weaning age, days	130	139	131
Av. 135-day weight, lb.	65.4	63.1	60.6
Av. daily gain, lb.	0.43	0.41	0.39
Av. condition score	9.23	8.74	8.40
Pounds of lambs marketed per ewe bred	38.7	70.6	35.0

TABLE XVIII
PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1953

	Breeding of ewes		
	Northwestern	Native	California
No. of ewes bred	18	21	31
Age of ewes, years	3	3	3
No. of ewes lambing	17	17	29
Percent of ewes lambing	94.4	81.0	93.5
Av. lambing date of ewes	2/3/53	1/31/53	2/5/53
Percent lamb crop (to ewes bred)	150	128.5	119.4
Lamb raised per ewe bred	1.39	1.00	1.06
No. of lambs born	27	27	37
No. of sets of twins (multiple births)	10	9	8
No. of lambs raised to weaning	25	21	33
Percent of lambs raised to weaning	92.6	77.8	89.2
Av. birth weight of lambs, lb.	8.77	7.80	9.05
Av. weaning weight, lb.	80.0	74.8	79.0
Av. weaning age, days	133	132	129
Av. 135-day weight, lb.	82.8	77.4	81.9
Av. daily gain, lb.	0.53	0.50	0.53
Av. condition score	12.72	12.48	13.06
Pounds of lambs marketed per ewe bred	111.1	74.8	84.1

TABLE XIX
PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1954

	Breeding of ewes		
	Northwestern	Native	California
No. of ewes bred	17	19	29
Age of ewes, years	4	4	4
No. of ewes lambing	15	13	25
Percent of ewes lambing	88.2	68.4	86.2
Av. lambing date of ewes	2/14/54	2/6/54	2/3/54
Percent lamb crop (to ewes bred)	152.9	105.3	141.4
Lamb raised per ewe bred	1.29	0.90	1.10
No. of lambs born	26	20	41
No. of sets of twins (multiple births)	10	6	15
No. of lambs raised to weaning	22	17	32
Percent of lambs raised to weaning	85.4	85.0	78.0
Av. birth weight of lambs, lb.	8.65	7.75	7.76
Av. weaning weight, lb.	82.0	81.9	82.4
Av. weaning age, days	135	143	138
Av. 135-day weight, lb.	82.4	78.4	80.6
Av. daily gain, lb.	0.54	0.51	0.53
Av. condition score	14.0	14.3	14.31
Pounds of lambs marketed per ewe bred	106.1	72.3	90.9

TABLE XX
PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1955

	Breeding of ewes			
	Northwestern	Native	California	Southwestern
No. of ewes bred	14	9	22	26
Age of ewes, years	5	5	5	2
No. of ewes lambing	13	6	20	24
Percent of ewes lambing	92.9	66.7	90.9	92.3
Av. lambing date of ewes	1/29/55	1/24/55	1/31/55	2/4/55
Percent lamb crop (to ewes bred)	164.3	66.7	159.1	111.5
Lamb raised per ewe bred	1.14	0.44	1.32	0.89
No. of lambs born	23	6	35	29
No. of sets of twins (multiple births)	8	0	14	5
No. of lambs raised to weaning	16	4	29	23
Percent of lambs raised to weaning	69.6	66.7	82.9	79.3
Av. birth weight of lambs, lb.	10.10	11.40	9.40	9.90
Av. weaning weight, lb.	85.1	82.5	81.0	79.0
Av. weaning age, days	151	152	144	144
Av. 135-day weight, lb.	78.4	77.0	77.7	77.4
Av. daily gain, lb.	0.51	0.46	0.50	0.48
Av. condition score	12.40	12.60	11.60	11.40
Pounds of lambs marketed per ewe bred	97.0	36.3	106.9	70.3

TABLE XXI

PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1956

	Breeding of ewes				
	North- western	Native	Cali- fornia	South- western	Mixed Native
No. of ewes bred	12	8	16	25	20
Age of ewes, years	6	6	6	3	2
No. of ewes lambing	11	7	15	25	16
Percent of ewes lambing	91.7	87.5	93.8	100.0	80.0
Av. lambing date of ewes	2/7/56	2/23/56	2/7/56	2/15/56	2/22/56
Percent lamb crop (to ewes bred)	166.7	150.0	162.2	140.0	115.0
Lamb raised per ewe bred	1.42	1.00	1.38	1.12	1.15
No. of lambs born	20	12	26	35	23
No. of sets of twins (multiple births)	9	5	11	10	7
No. of lambs raised to weaning	17	8	22	28	17
Percent of lambs raised to weaning	85.0	66.7	85.4	80.0	73.9
Av. birth weight of lambs, lb.	8.50	7.88	8.35	8.28	6.85
Av. weaning weight, lb.	81.7	73.0	80.7	79.6	72.5
Av. weaning age, days	154	159	156	148	158
Av. 135-day weight, lb.	73.4	63.5	71.4	76.6	63.8
Av. daily gain, lb	0.48	0.41	0.47	0.50	0.42
Av. condition score	11.3	11.2	11.7	11.2	11.9
Pounds of lambs marketed per ewe bred	116.0	73.0	111.4	89.2	61.6

TABLE XXII
PERFORMANCE OF EWE FLOCKS AT THE PLATEAU EXPERIMENT STATION, 1957

	Breeding of ewes				
	North- western	Native	Cali- fornia	South- western	Mixed Native
No. of ewes bred	8	8	10	24	19
Age of ewes, years	7	7	7	4	3
No. of ewes lambing	8	7	8	22	16
Percent of ewes lambing	100.0	87.5	80.0	91.7	84.2
Av. lambing date of ewes	1/6/57	1/4/57	1/2/57	1/10/57	1/18/57
Percent lamb crop (to ewes bred)	137.5	100.0	150.0	145.8	121.0
Lamb raised per ewe bred	1.25	0.62	1.20	1.25	1.05
No. of lambs born	11	8	15	35	23
No. of sets of twins (multiple births)	3	1	7	13	7
No. of lambs raised to weaning	10	5	12	30	20
Percent of lambs raised to weaning	90.9	62.5	80.0	85.7	86.9
Av. birth weight of lambs, lb.	10.00	9.30	8.60	9.70	7.00
Av. weaning weight, lb.	91.3	82.6	87.2	90.0	79.1
Av. weaning age, days	127	154	135	134	133
Av. 135-day weight, lb.	100.1	74.8	88.4	92.1	82.2
Av. daily gain, lb.	0.67	0.49	0.59	0.62	0.56
Av. condition score	13.0	12.3	12.1	11.9	12.0
Pounds of lambs marketed per ewe bred	114.2	51.2	104.6	112.5	83.1