November 30, 1966

To the Graduate Council:

I am submitting herewith a thesis written by G. Srinivasan entitled "Evaluation of Factors Affecting the Performance of Spring Lambs." 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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EVALUATION OF FACTORS AFFECTING THE PERFORMANCE OF SPRING LAMBS

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

G. Srinivasan

December 1966

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CHAPTER I

INTRODUCTION

The predominant system of commercial sheep production in Tennessee is the production of milk-fat spring lambs. Spring lamb is the term applied to the new crop of lambs arriving at the market in the spring, generally born in the early winter and winter months, and marketed directly off their dams. Spring pasture, favorable climate, breeding, care and management have contributed to the excellence of spring lamb production in Tennessee.

The objective of the breeder in spring lamb production is to produce lambs with a fast rate of growth from birth to slaughter and a sufficient amount of fat to bring highest prices at the market. An understanding of the factors which influence the development and growth of sheep will suggest changes in the breeding and management system to improve productivity. Performance records and an effective selection program provides an important tool to the breeder to choose genetically superior animals for breeding purposes.

Many non-genetic or environmental factors as well as genetic factors are known to influence the performance of sheep. Non-genetic factors hinder the breeder's effort to

to select those animals having the greatest breeding value and reduce the progress which might be accomplished by selection. However, adjustments can be made where the effects of various environmental factors are known in order to evaluate and place the records of animals on a more comparable basis.

The objectives of this study were to determine the productivity of ewes of different breeding and to evaluate the effect of various factors including breeding of dam, age of dam, month of birth, sex of lamb, type of birth and type of rearing on various lamb performance traits.

CHAPTER II

REVIEW OF LITERATURE

The weaning performance of lambs is influenced by various factors including birth weight of lamb, sex of lamb, type of birth, type of rearing, season of birth, breed of dam and breed of sire. Considerable research has been conducted to estimate the effects of various factors on lamb traits from birth to weaning.

Miller (1935), in a study of spring lamb production in California, reported that sires of larger breeds, namely Hampshire and Suffolk, produced lambs weighing 6 to 8 pounds more at three and a half to four months of age than sires of smaller breeds such as the Shropshire and Southdown. He found that lambs sired by Hampshire and Suffolk rams averaged approximately 10.5 pounds at birth, whereas those sired by Shropshire and Southdown rams averaged 9.5 pounds at birth.

Phillips and Dawson (1937) observed, in a study involving the effect of factors on lamb traits from birth to weaning of 835 Southdown lambs, that single lambs were heavier at birth than twins, early lambs were heavier at three months of age than late lambs, and lambs heavier at birth tended to be heavier at three months of age. They

showed that, on the average, one would expect an increase of 4.3 pounds in weight at three months of age for each increase of one pound in birth weight of a single, male lamb. They also stated there would be a loss of 0.14 pound at three months of age for each day's increase in birth date of a single, male lamb. Phillips and Dawson (1940), in another study of 508 Hampshire, 521 Shropshire and 835 Southdown lambs born from 1921 to 1934, found that male lambs were significantly heavier than females at birth and single lambs were heavier than twins at three and six months of age. The concluded that in general there was a tendency for differences in weight due type of birth to disappear as the animals matured.

Kincaid (1943), in a study involving Virginia native ewes mated to Hampshire and Southdown rams, found an average increase of 0.63 pound in birth weight of lambs as the ewes increased in age from two to six years of age. There was a significant difference between the average birth weights of lambs sired by Hampshire and Southdown rams of 1.05 pounds. He also reported that lambs at birth from the same ewes were 1.15 pounds heavier at the third lambing than at the first lambing.

Hazel and Terrill (1945) observed that ram lambs were 8.3 pounds heavier than ewe lambs and lambs from mature ewes were 6.1 pounds heavier at weaning than lambs from

two-year-old Rambouillet ewes. In another study of Columbia, Corriedale and Targhee lambs at Dubois, Idaho, Hazel and Terrill (1946) reported that ram lambs averaged 10.8 pounds heavier at weaning than ewe lambs, lambs from mature dams were 8.7 pounds heavier than those from two-year-old dams, lambs born and raised as singles weighed 11.7 pounds more than lambs born and raised as twins and 5.1 pounds more than lambs born as twins but raised as singles.

Leveck (1947), in a study involving Corriedale, Hampshire and Southdown rams crossed with Mississippi native ewes, found that lambs from the Corriedale and Hampshire crosses were equal in growth rate and gained faster than lambs from the Southdown cross.

Henning and Kean (1949) analyzed records of 822 lambs from three mutton breeds, namely, Dorset, Hampshire and Southdown. They found that the average daily gain of male and female lambs was 0.54 and 0.51 pound, respectively. Twins gained 0.45 pound per day whereas singles gained 0.60 pound per day.

Karam, Chapman and Pope (1949), in a study of 437 lambs from farm flocks in Wisconsin, observed that single lambs gained 0.02 pound faster and were 6.2 pounds heavier at 25 weeks than twin lambs. Wether lambs gained 0.02 pound faster and were 3.5 pounds heavier than ewe lambs at the same age. The differences were significant.

Nelson and Venkatachalam (1949) in Michigan showed that birth weights of male lambs were 5 per cent heavier than females, lambs from mature ewes were 10 per cent heavier than lambs from two-year-old ewes and single lambs were 22 per cent heavier than twins.

Sidwell and Grandstaff (1949), in a study of 1509 lambs from 414 Navajo ewes at New Mexico, found that two-year-old ewes weaned the smallest lambs and four to seven-year-old ewes the heaviest, while the three-year-old and eight to eleven-year-old ewes weaned lambs that were intermediate in size. Single lambs were 11.2 pounds heavier than twins raised as singles at weaning time and ewe lambs weighed 4.4 pounds less at weaning than ram lambs.

Blackwell and Henderson (1955) observed that single lambs were heavier at birth than twins and males were heavier at birth and at weaning than ewe lambs in the Corriedale, Dorset, Hampshire and Shropshire breeds. Single lambs were heavier at weaning than twins raised as singles or as twins. They found that age of dam significantly affected the birth weight of lambs except in the Dorset lambs. Their study in Dorset lambs indicated that lambs born in the spring were 0.40 pound heavier at birth than lambs born in the fall and they were 2.85 pounds heavier at weaning. They reported that these differences were significant.

Bogart and Hedrick (1955) in Oregon found that type of birth constituted the most consistent effect on birth weight of lambs. Single lambs were from 1.92 ± 0.68 to 2.40 ± 0.60 pounds heavier at birth than twins.

Botkin, Stratton and Faulkner (1956) observed in purebred Rambouillets that ram lambs were 9 pounds heavier than ewe lambs at 129 days weaning age, and 15 pounds heavier than ewe lambs at 202 days weaning age. Early weaned, single lambs were 14 pounds heavier than twins as compared with 8 pounds for the late group. Single lambs weighed about the same as twins raised as singles.

Cassard and Weir (1956) found in the Suffolk breed in California that early lambs had an advantage in weight and growth from 70 to 120 days but this advantage decreased by 240 days. Singles were heavier than twins and males were larger than females at birth.

DeBaca et al. (1956), in a study involving 280 cross-bred lambs, found that Suffolk rams tended to sire lambs which were heavier at weaning than Southdown rams. Hampshire cross ewes produced the fastest growing lambs as compared to the Cheviot and Romney breed crosses. They found that birth weight had a significant effect on weaning weight and the range in increase in weaning weight varied from 2.50 ± 0.65 to 5.96 ± 0.76 pounds for each pound of

increase in birth weight of the lambs. Single lambs were 17 pounds heavier at weaning than twins.

Harrington, Whiteman and Morrison (1958) analyzed records of 300 crossbred lambs. They found that male lambs were heavier than females at all ages, and birth weight was the most important source of variation in the lambs at different ages. They also found that the effects due to type of birth and type of rearing were less important as the lambs grew older. There was also a significant effect due to the year in which the lambs were born.

Nambiar (1959), in a study of different breed types, found that the average daily gain for male and female lambs was 0.542 $\pm$ 0.004 and 0.491 $\pm$ 0.004 pound, respectively. The average daily gain for singles and twins was 0.560 $\pm$ 0.004 and 0.500 $\pm$ 0.001 pounds, respectively. The differences were significant and indicated that singles grow faster than twins. He found that the growth rate of lambs born as twins but raised as singles was very similar to that of lambs born and raised as singles.

Rempel *et al.* (1959) observed, in crossbred lambs in Minnesota, that the advantage in birth weight for lambs born as singles as compared with twins was 1.62 pounds. Males averaged 0.55 pound heavier than females. At 100 days, the advantage for singles as compared with twins was 8.61 pounds.

Givens, Carter and Gaines (1960) estimated, in crossbred lambs, that wether lambs were 4.7 ± 0.9 pounds heavier than ewe lambs and singles were 10.7 ± 0.09 pounds heavier than twins at 120 days of age with a mean of 82.7 ± 1.1 pounds. Wether lambs gained 0.037 ± 0.007 pound more per day than ewe lambs and single lambs gained 0.077 ± 0.008 pound faster per day than twin lambs with a mean of 0.572 ± 0.008 pounds.

Bailey, Chapman and Pope (1961), in a study involving 1228 lambs, found that singles weighed about 9 pounds more than twins at weaning while wethers averaged 4.5 pounds heavier than ewe lambs. Brown, Baugus and Sabin (1961) observed, in crossbred and inbred lambs at Arkansas, there was not a significant difference in birth weight between male and female lambs. At 120 days of age, the inbred males were 2 pounds heavier than females. This difference was significant. Lambs born and raised as singles were about one pound heavier than lambs born and raised as twins, and about one-half pound heavier than lambs born as twins but raised as singles. Inbred single lambs were 8 pounds heavier than twins raised as twins at 120 days of age and crossbred singles were 7 pounds heavier than twins raised as twins. Lambs born as twins but raised as singles were 3 pounds heavier than singles raised as singles at 120 days age. Lambs from young ewes (two and three-year-old) were 5

pounds lighter in the case of inbreds and 8 pounds heavier in the case of crossbreds at 120 days than lambs from mature ewes (four, five, and six-year-old). However, the lambs from aged ewes (over seven years) did not differ significantly in weight from those of mature ewes.

Campbell (1962) reported that in Rambouillet ewes twinning rate increased up to four years of age and production of pounds of lambs per ewe increased up to five years of age and then decreased. He found that gross returns from ewes were constant from three to six years of age. Sabin and Brown (1962), in a study of 291 inbred Hampshire lambs, found that late born lambs were heavier at birth and grew at a slightly faster rate than early lambs. Age of ewe had no effect on birth weight of lambs but the effect was significant when sale weight of lambs were considered. Single lambs were 8 pounds heavier at 120 days age than twins, male lambs were 0.15 pound heavier at birth than ewe lambs and wethers were 3.26 pounds heavier at 120 days age than ewe lambs.

Fernandes (1964), in a study involving grade and crossbred ewes, reported that lambs born as singles were 1.60 pounds heavier than twins, males were 0.60 pounds heavier at birth than females and birth weights of lambs increased with age of dam through four years of age. Single lambs were 5.28 pounds heavier than twins at weaning and

male lambs were 3.98 pounds heavier than females at weaning. Single lambs gained 0.026 pound faster than twins and male lambs gained 0.023 pound more per day than females. He also observed that lambs born and raised as singles gained 0.041 pound per day faster than lambs born and raised as twins. Lambs from four-year-old ewes grew faster than lambs from one to three-year-old ewes. He found a significant difference in birth weight due to year effects.

Botkin (1964), in a study involving 707 lambs from Corriedale, Columbia and grade Columbia ewes, found that ram lambs gained faster than ewe lambs regardless of other variables. Twins and singles gained essentially the same. Shelton (1964) reported that twin lambs weighed less than singles at birth and death losses were greater in lambs born as twins than in singles. Type of birth and systems of breeding significantly affected both birth weight and death loss.

Sidwell (1964), in a study involving purebred Hampshire, Shropshire, Merino and Southdown sheep, found that single lambs were 2.00 pounds heavier than twins and ram lambs were 0.51 pound heavier than ewe lambs. Single lambs were 10.9 pounds heavier at weaning than lambs born and raised as twins and 4.7 pounds heavier than lambs born as twins but raised as singles. Lambs from four-year-old dams were heavier at birth than those from two and

three-year-old ewes. Lambs from three to six-year-old ewes were significantly heavier at weaning than lambs from other age ewes. The birth and weaning weights of lambs were ranked in the following order: Hampshire; Shropshire; Merino; and Southdown.

Smith and Lidvall (1964) in a study of Hampshire lambs over a period of 13 years from 1950 to 1962, found that single lambs were 1.58 pounds heavier at birth, gained 0.06 pound faster per day and were 8.19 pounds heavier at 120 days of age than twins. Male lambs were 0.41 pound heavier at birth, gained 0.05 pound faster per day and were 6.18 pounds heavier at 120 days of age when compared with ewe lambs. These differences were significant. Lambs born during January, February and March were significantly heavier at birth than lambs born during other months. Lambs born and reared as singles were 2.60 pounds heavier at weaning than lambs born twin but reared as singles. Birth weight of lambs increased with age of dam up to five years and then remained constant to ten years of age. At 120 days of age, weights of lambs from ewes of three to six years of age were similar but heavier than lambs from ewes seven to ten years of age and two-year-old ewes. They found that year effects were highly significant for all traits in the Hampshire breed.

Ray and Smith (1966) found, in spring-born range

lambs in New Mexico, that age of dam did not significantly influence the weight of lambs at birth but two and seven-year-old ewes weaned lighter lambs than ewes of other ages. Single lambs were heavier at birth and at weaning than twin lambs. They reported that the body weight of ewes markedly affected weaning weight of lambs and, to a lesser degree, birth weight of lambs. Lighter ewes produced less pounds of lamb at weaning and fewer twins than the heaviest ewes.

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 Middle Tennessee Experiment Station, Spring Hill, Tennessee. The data were obtained over a 6-year period from 1952 to 1957, inclusive, and complete data on 833 lambs were available.

Experimental Ewe Flocks

During the period included in this study, eight flocks of ewes from different sources and of different breeding were maintained at the station. Three of these flocks were established in 1951 and lambed for the first time during the winter of 1951-52. One flock was purchased as ewe lambs in 1951 and then grown out and bred as yearlings to lamb in the winter of 1952-53. Two flocks were established in the summer of 1954 and lambed for the first time in the winter of 1954-55. Two other flocks were established in the summer of 1955 and lambed for the first time during the winter of 1955-56 and 1956-57.

The source, designation and breeding of ewes in each of the flocks were:

1. S1 - Native (Grade Hampshire).
2. S2 - California (Columbia, Corriedale or Hampshire x Rambouillet).
3. S3 - Northwestern (Hampshire x Rambouillet).
4. S4 - Northwestern (Hampshire x Rambouillet).
5. S5 - Mixed Native (Hampshire, Southdown or Suffolk x Northwestern).
6. S6 - Southwestern (Grade Rambouillet).
7. S7 - Mixed Native (Hampshire, Southdown or Suffolk x Northwestern, California, Native, and Southwestern).
8. S8 - Southwestern (Suffolk x Rambouillet).

S1-Native ewe flock. The ewes in this flock consisted primarily of black-faced ewes of Hampshire breeding. These ewes were purchased as large, early, growthy ewe lambs in the spring of 1951 at the Nashville stockyards and bred in late summer as ewe lambs.

S2-California ewe flock. Ewes in this flock were largely white, brown or mottled-faced ewes of Columbia, Corriedale or Hampshire x Ramboillet breeding. They were purchased as yearlings in the spring of 1951, bred in the fall and lambed for the first time in the winter of 1951-52. These ewes originated in California.

S3-Northwestern ewe flock. This ewe flock consisted of black-faced ewes of Hampshire x Rambouillet breeding, originating in Montana. These ewes were purchased as yearlings and bred in the summer and fall of 1951 to lamb first in the winter of 1951-52.

S4-Northwestern ewe flock. Ewes in this flock were purchased as ewe lambs in 1951 but grown out and bred for the first time as yearlings in 1952. They were largely black-faced ewes of Hampshire x Rambouillet breeding obtained from shipments originating in Montana.

S5-Mixed Native ewe flock. Ewes in this flock were large, early native ewe lambs selected from the 1954 spring lamb crop raised at the station. These ewes consisted of an assortment of breeding since they represented the progeny of ewes in the Native (S1), Northwestern (S3 and S4) and California (S2) flocks which were bred to Hampshire and Southdown rams.

S6-Southwestern ewe flock. These ewes were purchased as yearlings in 1954 and bred to lamb during the winter of 1954-55. They were obtained from shipments of ewes originating in Texas and were grade Rambouillet.

S7-Mixed Native ewe flock. Ewes in this flock consisted of ewe lambs selected from the 1955 spring lamb crop.

These ewes were grown out and bred as yearlings to lamb for the first time in the winter of 1955-56. These ewes were an assortment of different kinds of breeding since they represented the progeny of the various kinds of ewes bred to Hampshire and Southdown rams.

S8-Southwestern ewe flock. Ewes in this flock were purchased as yearlings in 1956 and were bred to lamb during the winter of 1956-57. These ewes originated in Texas and were Suffolk x Rambouillet crossbreds.

Initially, the S1, S2, S3, S4, S5, S6, S7, and S8 flocks of ewes consisted of 48, 48, 48, 48, 24, 36, 30 and 40 ewes, respectively.

Breeding and Management

In most years, the breeding season at this station began about July 1 to July 15 and extended over a period of about 90 days. During the first three breeding seasons (1951 through 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 in 1951 and 1952. In 1953 single rams were used in individual ewe groups for about 50 days and then all ewes and rams were run together for the remainder of the breeding season.

Beginning with the 1954 breeding season, all sources

of ewes were divided into six sire breeding groups on the basis of type, weight, breeding and previous performance. Two rams of different breeds were then used in each breeding group during the 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. During 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. Permanent pastures consisted of either Bluegrass or a Bluegrass-bermuda grass mixture. In some years it was necessary to make use of Fescue pastures. Temporary or winter pasture consisted of either a rye grass and crimson clover mixture or small grain. When winter grazing was not available, legume hay supplemented with concentrates, if needed, provided winter feed.

Ewes were "flushed" for about two weeks on good pasture before the beginning of the breeding season and then maintained on pasture during the breeding season. At the end of the breeding season, all ewes were pastured or fed together until they lambed. Ewes were fed concentrates (about one-half to one pound per head daily) beginning three to four weeks prior to lambing and continued until ewes and lambs were placed on good pastures.

The ewes were lambed in a shed type lambing barn. Ewes and lambs were placed in temporary lambing pens immediately after lambing. Heat lamps were provided as needed. Ewes and lambs remained in the lambing pens for two to five days. Lambs were docked and castrated at 7 to 14 days of age.

Lambs were born in December, January, February and weaned in late May, June and early July. They were weaned at weights of 80 to 100 pounds and marketed directly off their dams. The lambs were weighed at 28-day intervals from birth to weaning. After weaning of lambs, ewes were placed on short pastures to aid in drying them up before the beginning of the breeding season.

Ewes were culled only if they fail to lamb in two consecutive years or two out of three years.

Records Obtained

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

The following records were obtained for 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. Weights at 28-day intervals from birth to weaning.
6. Weaning date.
7. Weaning weight.
8. Weaning condition score.

Lambs were marketed when they weighed between 80 and 100 pounds. The weaning weights of lambs were adjusted to standard ages of 120 and 135 days for comparative study purposes.

Method of Analysis

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

$$\text{Average daily gain (ADG)} = \frac{\text{Weaning weight—birth weight}}{\text{Weaning age in days}}$$

The 120-day weight was calculated:

120-day weight = (ADG x 120) + birth weight

The 135-day weight was calculated:

135-day weight = (ADG x 135) + birth weight

Estimates of the effects of year-age of dam, breed of dam, type of birth, sex of lamb, month of birth and type of birth and weaning on various performance traits of lambs including birth weight, weaning weight, total gain, average

daily gain, 120-day weight and 135-day weight were made by the least squares method described by Harvey (1960) for the data from 1952 through 1957.

Two mathematical models were used to obtain least square constants. The analysis for birth weight was based on the model:

$$Y_{ijklmn} = \mu + y_i + b_j + t_k + s_l + c_m + e_{ijklmn}.$$

Where:

Y_{ijklmn} is observed value of a given trait for ijklmn-th individual,

μ is the effect common to all observations and is the mean of population when equal numbers exist in the subclasses (absorbed),

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,

t_k is the effect of the k-th type of birth,

s_l is the effect of the l-th sex of lamb,

c_m is the effect of the m-th month of birth,

e_{ijklmn} is the random error associated with the ijklmn-th individual.

In the second 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, namely, type of birth and rearing and weaning age.

$$Y_{ijklmn} = \mu + y_i + b_j + r_k + s_l + c_m + b(x-\bar{x}) + e_{ijklmn}$$

Where:

r_k if the effect of k-th type of birth and rearing,

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

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.

In these data, year and age of dam were confounded and estimates of their effects could not be made separately.

CHAPTER IV

RESULTS AND DISCUSSION

The data collected for the various breeding groups of ewes were summarized and studied in two categories: (1) productivity of the ewes and (2) the performance of the lambs. Data on the number of ewes exposed and lambing, percentage of ewes lambing, percentage of twin births, lamb survival rates, and lambs raised per ewe bred, were included in the study of the productivity of ewes. In the study of the productivity of ewes from 1952-1957, all the ewes in the respective ewe groups were considered except those which died during the experiment. Ewes were culled only if they fail to lamb in two consequetive years or two out of three years. Data on birth weight, average daily gain, weaning weight, 120-day weight and 135-day weight were included in the study of lamb performance. Complete data for breeding groups by years for ewe and lamb performance are given in Appendix, Tables XIX through XXIV.

I. PRODUCTIVITY OF EWES

Fertility of Ewes

Table I shows the number of ewes exposed and number of ewes lambing during 1952 through 1957. The total number

TABLE I

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

Breeding of ewes	Year						Total
	1952	1953	1954	1955	1956	1957	
Native (S1)[b]	48/26[a]	48/23	45/36	29/29	28/22	24/22	222/158
California (S2)[b]	48/25	47/26	46/33	30/25	29/21	22/18	222/148
Northwestern (S3)[b]	48/38	46/21	45/35	33/30	30/22	30/25	232/171
Northwestern S4)[c]	-	48/15	47/29	34/26	25/16	23/17	177/103
Mixed Native (S5)[d]	-	-	-	24/12	24/7	15/9	63/28
Southwestern (S6)[e]	-	-	-	36/31	36/27	34/27	106/85
Mixed Native (S7)[f]	-	-	-	-	30/18	28/20	58/38
Southwestern (S8)[g]	-	-	-	-	-	40/30	40/30

[a]Number of ewes exposed to rams during the breeding season and number of ewes lambing, respectively.

[b]Ewes bred first as yearlings in 1951.

[c]Ewes bred first as yearlings in 1952.

[d]Ewes bred first as ewe lambs in 1954.

[e]Ewes bred first as yearlings in 1954.

[f]Ewes bred first as yearlings in 1955.

[g]Ewes bred first as yearlings in 1956.

of ewes exposed to rams and the total number of ewes lambed for the six-year period were 1120 and 761, respectively. The overall lambing percentage was 67.9 per cent. Twenty-four Mixed Native (S5) ewes were bred as ewe lambs and 12 of them lambed as yearlings for a lambing percentage of 50 per cent. The remainder of the ewes were bred as yearlings and older and 749 lambed for a lambing percentage of 68.3 per cent. There were 1038 lambs born during the six-year period and 833 lambs were raised (80.3 per cent).

The average percentage of ewes lambing by source and breeding of ewes as given in Table II were: Native (S1), 71.56 per cent; Mixed Native (S5), 44.46 per cent; Mixed Native (S7), 65.50 per cent; California (S2), 66.66 per cent; Northwestern (S3), 73.69 per cent; Northwestern (S4), 58.16 per per cent; Southwestern (S6), 80.18 per cent; and Southwestern (S8), 75.00 per cent.

The average percentage lamb crop (to ewes bred) by breeding of ewes is presented in Table III. This figure reflects the percentage of ewes lambing as well as the percentage of multiple births. The percentage lamb crop in the different ewe groups were: Native (S1), 100.89 per cent; Mixed Native (S5), 47.65 per cent; Mixed Native (S7), 79.33 per cent; California (S2), 91.44 per cent; Northwestern (S3), 108.18 per cent; Northwestern (S4), 81.36 per cent; Southwestern (S6), 99.79 per cent; and Southwestern (S8), 90.00 per

TABLE II

PERCENTAGE OF EWES LAMBING BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						Av.[g]
	1952	1953	1954	1955	1956	1957	
Native (S1)[a]	54.16	47.91	80.00	100.00	78.60	91.70	71.56
California (S2)[a]	52.10	55.31	71.73	83.30	72.40	81.80	66.66
Northwestern (S3)[a]	79.16	45.65	77.80	90.90	73.30	83.30	73.69
Northwestern (S4)[b]	-	31.25	61.70	76.50	64.00	73.90	58.16
Mixed Native (S5)[c]	-	-	-	50.00	29.20	60.00	44.46
Southwestern (S6)[d]	-	-	-	86.10	75.00	79.40	80.18
Mixed Native (S7)[e]	-	-	-	-	60.00	71.40	65.50
Southwestern (S8)[f]	-	-	-	-	-	75.00	75.00

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

TABLE III

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

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	58.33	72.91	108.88	155.20	125.00	133.30	100.89
California (S2)[a]	60.41	70.21	100.00	120.00	113.80	118.20	91.44
Northwestern (S3)[a]	106.25	71.73	117.70	118.20	126.70	123.30	108.18
Northwestern (S4)[b]	-	37.50	87.23	120.60	84.00	100.00	81.36
Mixed Native (S5)[c]	-	-	-	54.20	29.20	66.70	47.65
Southwestern (S6)[d]	-	-	-	88.90	83.30	123.50	99.79
Mixed Native (S7)[e]	-	-	-	-	70.00	89.30	79.33
Southwestern (S8)[f]	-	-	-	-	-	90.00	90.00

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

cent. The relatively low lambing percentages for the Mixed groups of ewes (S5 and S7) may be explained primarily by the fact that these groups of ewes had the lowest percentages of ewes lambing (Table II, page 26) and the smallest percentages of twin births (Table IV). Groups of ewes with the highest percentage lamb crops were Native (S1), California (S2), and Northwestern (S3) and these were also the groups of ewes with the greatest percentages of ewes lambing and the largest percentages of twin births. In most ewe groups maximum productivity in terms of lambing percentage was reached at five years of age and then remained relatively constant.

The percentage of twin births by breeding of ewes (Table IV) were: Native (S1), 29.47 per cent; Mixed Native (S5), 8.69 per cent; Mixed Native (S7), 17.39 per cent; California (S2), 26.11 per cent; Northwestern (S3), 29.88 per cent; Northwestern (S4), 27.78 per cent; Southwestern (S6), 18.27 per cent; and Southwestern (S8), 16.67 per cent. Northwestern (S3) and Native (S1) ewes had the highest percentage of twin births among the groups and the Mixed Native (S5) ewes had the lowest percentage of twin births. The percentage of twin births among the ewes lambing as yearlings was 7.69 per cent. The percentage of twin births in the different ewe groups increased with age of the ewes, reaching a peak at about five years of age in most groups.

TABLE IV

PERCENTAGE OF TWIN BIRTHS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	7.14	34.29	28.57	35.56	37.14	28.13	29.47
California (S2)[a]	13.79	18.18	28.26	30.56	36.36	26.92	26.11
Northwestern (S3)[a]	25.49	33.33	30.18	23.07	36.84	32.43	29.88
Northwestern (S4)[b]	-	16.67	26.83	36.59	23.81	26.08	27.78
Mixed Native (S5)[c]	-	-	-	7.69	00.00	10.00	8.69
Southwestern (S6)[d]	-	-	-	3.13	10.00	35.71	18.27
Mixed Native (S7)[e]	-	-	-	-	14.29	20.00	17.39
Southwestern (S8)[f]	-	-	-	-	-	16.67	16.67

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

Survival of Lambs

Livability of lambs is an important factor affecting returns to flock owners. Livability of lambs reflects on the productivity of ewes bred. The percentage of lambs raised by breeding of ewes is given in Table V. The percentage of lambs raised was 80.3 per cent for all ages of ewes, 84.6 per cent for yearling ewes and 80.2 per cent for ewes two years of age and older. The average percentage of lambs raised to weaning was 77.22 per cent for Native (S1) ewes; 73.22 per cent for Mixed Native (S5) ewes; 93.46 per cent of Mixed Native (S7) ewes; 76.93 per cent for California (S2) ewes; 78.48 per cent for Northwestern (S3) ewes; 86.12 per cent for Northwestern (S4) ewes; 87.49 per cent for Southwestern (S6) ewes; and 72.22 per cent for Southwestern (S8) ewes.

Lambs Raised Per Ewe Bred

The number of lambs raised per ewe bred by breeding of ewes is shown in Table VI. This figure provides the flock owner with a good index of ewe productivity since it takes into account the percentage of ewes lambing, the twinning rate of ewes and the livability of the lambs.

The average number of lambs raised per ewe bred in the different ewe groups was: Native (S1), 0.779; Mixed Native (S5), 0.354; Mixed Native (S7), 0.742; California (S2), 0.707; Northwestern (S3), 0.712; Northwestern (S4),

TABLE V

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

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	57.14	82.85	83.63	86.70	82.80	59.38	77.22
California (S2)[a]	68.96	66.66	82.97	66.70	90.90	84.62	76.93
Northwestern (S3)[a]	70.58	72.72	83.01	74.40	76.30	94.59	78.48
Northwestern (S4)[b]	-	83.33	90.24	85.40	90.50	78.26	86.12
Mixed Native (S5)[c]	-	-	-	84.60	71.40	60.00	73.22
Southwestern (S6)[d]	-	-	-	81.20	96.70	85.71	87.49
Mixed Native (S7)[e]	-	-	-	-	95.20	92.00	93.46
Southwestern (S8)[f]	-	-	-	-	-	72.22	72.22

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

TABLE VI

LAMBS RAISED TO WEANING PER EWE BRED AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	0.333	0.604	0.911	1.340	1.040	0.790	0.779
California (S2)[a]	0.417	0.468	0.848	0.800	1.030	1.000	0.707
Northwestern (S3)[a]	0.106	0.522	0.978	0.880	0.970	1.170	0.712
Northwestern (S4)[b]	-	0.313	0.787	1.030	0.760	0.780	0.700
Mixed Native (S5)[c]	-	-	-	0.460	0.210	0.400	0.354
Southwestern (S6)[d]	-	-	-	0.720	0.800	1.060	0.856
Mixed Native (S7)[e]	-	-	-	-	0.670	0.820	0.742
Southwestern (S8)[f]	-	-	-	-	-	0.650	0.650

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

0.700; Southwestern (S6), 0.856 and Southwestern (S8), 0.650. The differences in the number of lambs raised per ewe bred among the various groups were not great except for comparisons of Native (S5) ewes with other groups. Native (S5) ewes had the lowest twinning percentage, the lowest lambing percentage and the least number of lambs raised per ewe bred when compared with all other ewe groups.

Pounds of Lamb Marketed Per Ewe Bred

Pounds of lamb marketed per ewe bred, along with quality of the product as evaluated by condition score, has considerable influence on net returns to the flock owner. Performance in this trait depends upon the number of lambs raised per ewe bred and the average daily gain of the lambs. The average pounds of lamb marketed per ewe bred were: 57.28 pounds for Native (S1) ewes; 20.85 pounds for Mixed Native (S5) ewes; 48.30 pounds for Mixed Native (S7) ewes; 55.43 pounds for California (S2) ewes; 55.31 pounds for Northwestern (S3) ewes; 55.64 pounds for Northwestern (4) ewes; 65.04 pounds for Southwestern (S6) ewes; and 48.81 pounds for Southwestern (S8) ewes (Table VII). There were less pounds of lamb marketed per ewe bred from ewes lambing as yearling, 2-year-olds and 3-year-olds when compared to the ewes lambing from 5 to 7 years of age. This indicates that there is an increase in productivity of ewes as they mature.

TABLE VII

POUNDS OF LAMB MARKETED PER EWE BRED BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	21.48	39.97	63.23	110.42	73.94	68.73	57.28
California (S2)[a]	25.88	37.23	62.12	72.08	80.13	89.50	55.43
Northwestern (S3)[a]	7.36	43.94	74.30	70.93	66.93	92.20	55.31
Northwestern (S4)[b]	-	24.57	57.00	76.53	57.61	69.26	53.64
Mixed Native (S5)[c]	-	-	-	22.63	12.94	30.68	20.85
Southwestern (S6)[d]	-	-	-	56.16	53.76	86.39	65.04
Mixed Native (S7)[e]	-	-	-	-	37.05	60.35	48.30
Southwestern (S8)[f]	-	-	-	-	-	48.81	48.81

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

Condition Score of Lambs

The average condition score of the lambs by breeding of ewes is given in Table VIII. Condition score of the lambs is an indication of the milking ability of the dams as well as the average daily gain of the lambs. The average condition scores of lambs by breeding of ewes were: Native (S1), 12.1 (low Choice+); Mixed Native (S5), 9.4 (low Good+); Mixed Native (S7), 10.4 (Good+); California (S2), 11.8 (low Choice-); Northwestern (S3), 12.1 (low Choice+); Northwestern (S4), 10.9 (high Good-); Southwestern (S6), 10.9 (high Good-) and Southwestern (S8), 10.2 (Good+). The difference in the average condition scores of lambs from 2-year-old and older ewes was not great. Ewes lambing as yearlings produced lambs which had the lowest condition scores (8.6 high Utility+).

II. PERFORMANCE OF LAMBS

In the study on performance of lambs, birth weight, weaning weight, total gain, average daily gain, 120-day weight, 135-day weight and weaning age were considered. Least squares analyses were made of data from 782 lambs born during 1952 through 1957 to determine the effects of year-age of dam, breeding of dam, type of birth, sex of lamb and month of birth on the performance traits of the lambs.

TABLE VIII

AVERAGE CONDITION SCORE[a] OF LAMBS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956[h]	1957	Av.[i]
Native (S1)[b]	10.8	13.7	12.3	11.5	-	11.3	12.1
California (S2)[b]	11.0	12.2	12.5	11.7	-	11.8	11.8
Northwestern (S3)[b]	11.6	13.7	13.2	11.8	-	10.4	12.1
Northwestern (S4)[c]	-	13.7	12.3	10.6	-	12.4	10.9
Mixed Native (S5)[d]	-	-	-	8.6	-	10.8	9.4
Southwestern (S6)[e]	-	-	-	11.0	-	10.9	10.9
Mixed Native (S7)[f]	-	-	-	-	-	10.4	10.4
Southwestern (S8)[g]	-	-	-	-	-	10.2	10.2

[a]7-av. Utility; 8-high Utility; 9-low Good; 10-av. Good; 11-high Good; 12-low Choice; 13-av. Choice; and 14-high Choice.

[b]Ewes bred first as yearlings in 1951.

[c]Ewes bred first as yearlings in 1952.

[d]Ewes bred first as ewe lambs in 1954.

[e]Ewes bred first as yearlings in 1954.

[f]Ewes bred first as yearlings in 1955.

[g]Ewes bred first as yearlings in 1956.

[h]Condition score of lambs not recorded in 1956.

[i]Weighted average over all years.

Lambs born as triplets and those born in the month of April were not included in the present study because only limited number were available.

Birth Weight

The average unadjusted birth weights of lambs by breeding of ewes are shown in Table IX. The overall means and standard errors for the performance traits of the lambs are presented in Table X. The least squares constants and the analysis of variance for birth weight are given in Tables XI and XII, respectively. The correlations among lamb traits are shown in Table XIII.

The overall adjusted birth weight of lambs was 8.26 pounds. Differences in birth weights of lambs among years were highly significant. The lambs born in 1957 weighed 9.10 pounds (the highest birth weight), whereas the lambs born in 1954 weighed 7.77 pounds (the lowest birth weight). Management, feeding and health condition of the ewes may account for the differences in birth weight of lambs among the years. Similar results were reported by Blackwell and Henderson (1955), Harrington, Whiteman and Morrison (1958), Fernandes (1964) and Smith and Lidvall (1964).

Breed of dam had a significant influence on the birth weight of lambs. The least squares constants show that the lambs from Northwestern ewes (S3) were 0.495 pound above the

TABLE IX

AVERAGE BIRTH WEIGHT OF LAMBS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	8.30[h]	7.35	7.58	8.00	8.30	8.40	7.95
California (S2)[a]	8.06	7.68	7.53	7.80	8.00	8.50	7.88
Northwestern (S3)[a]	8.40	7.86	7.79	8.10	8.20	8.70	8.17
Northwestern (S4)[b]	-	7.56	7.22	7.60	8.60	9.00	7.86
Mixed Native (S5)[c]	-	-	-	8.00	9.30	7.80	8.24
Southwestern (S6)[d]	-	-	-	8.20	8.20	8.70	8.40
Mixed Native (S7)[e]	-	-	-	-	7.20	8.00	7.63
Southwestern (S8)[f]	-	-	-	-	-	8.20	8.20

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

[h]Weight in pounds.

TABLE X

OVERALL MEANS AND STANDARD ERRORS OF LAMB TRAITS FOR THE YEARS 1952 THROUGH 1957[a]

Trait	Mean	Standard error
Birth weight, lb.	8.26	0.062
Weaning weight, lb.	75.96	0.627
Total gain - birth to weaning, lb.	67.65	0.606
Average daily gain - birth to weaning, lb.	0.514	0.004
120-day weight, lb.	69.91	0.508
135-day weight, lb.	77.86	0.620
Weaning age, days	133.83	1.035

[a]Includes lambs from the 8 ewe groups for a total of 792 lambs.

TABLE XI

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

	No. of lambs	Birth weight (lb.)	Weaning weight (lb.)	Total gain (lb.)	Average daily gain (lb.)	120-day weight (lb.)	135-day weight (lb.)
Year							
1952	72	-.221	1.154	0.975	-.009	-.890	-.811
1953	85	-.480	1.402	1.962	0.008	0.488	0.308
1954	155	-.489	-5,877	-5.127	-.039	-5.446	-6.728
1955	134	-.074	3.440	3.449	0.029	3.355	3.485
1956	158	0.422	-3.728	-3.626	-.010	-1.138	-1.875
1957	178	0.842	3.599	2.367	0.021	3.631	5.621
Breed of dam							
Native (S1)	164	0.153^{ab}	$-.325^{bc}$	$-.373^{b}$	0.000^{c}	0.036^{bcd}	0.302^{cd}
California (S2)	150	0.136^{ab}	1.866^{ab}	1.770^{ab}	0.016^{b}	2.063^{ab}	3.695^{ab}
Northwestern (S3)	186	0.495^{a}	1.484^{abc}	0.937^{ab}	0.013^{b}	1.988^{abcd}	2.208^{abc}
Northwestern (S4)	114	0.157^{ab}	3.766^{a}	3.633^{a}	0.027^{a}	3.380^{a}	3.868^{a}
Mixed Native (S5)	11	$-.240^{ab}$	-3.341^{abc}	-3.034^{b}	$-.025^{e}$	-3.315^{abcd}	-3.905^{abcd}
Southwestern (S6)	88	$-.009^{b}$	$-.818^{bc}$	$-.862^{b}$	$-.007^{d}$	$-.772^{bcd}$	-1.028^{cd}
Mixed Native (S7)	43	$-.770^{c}$	-2.536^{c}	-1.866^{b}	$-.014^{d}$	-2.287^{d}	-2.900^{d}

TABLE XI (continued)

	No. of lambs	Birth weight (lb.)	Weaning weight (lb.)	Total gain (lb.)	Average daily gain (lb.)	120-day weight (lb.)	135-day weight (lb.)
Southwestern (S8)	26	0.078^{ab}	-.096^{abc}	-.205^{ab}	-.010^{d}	-1.093^{abcd}	-2.240^{bcd}
Type of birth							
Single	388	0.563^{a}	-	-	-	-	-
Twin	394	-.563^{b}	-	-	-	-	-
Sex of lamb							
Male	395	0.306^{a}	2.993^{a}	2.710^{a}	0.020^{a}	2.757^{a}	2.785^{a}
Female	387	-.306^{b}	-2.993^{b}	-2.710^{b}	-.020^{b}	-2.757^{b}	-2.785^{b}
Type of birth and rearing							
Born single, raised single	391	-	2.900^{a}	2.214^{a}	0.018^{a}	2.806^{a}	2.886^{a}
Born twin, raised single	54	-	1.551^{a}	1.909^{a}	0.016^{a}	1.557^{a}	1.522^{a}
Born twin, raised twin	337	-	-4.451^{b}	-4.123^{b}	-.034^{b}	-4.363^{b}	-4.408^{b}
Month of birth							
December	322	-.223^{a}	18.713^{a}	18.066^{a}	0.121^{a}	15.009^{a}	17.684^{a}

TABLE XI (continued)

	No. of lambs	Birth weight (lb.)	Weaning weight (lb.)	Total gain (lb.)	Average daily gain (lb.)	120-day weight (lb.)	135-day weight (lb.)
January	179	0.277[b]	8.063[b]	7.440[b]	0.056[b]	7.232[b]	8.138[b]
February	165	0.019[ab]	-6.618[c]	-6.385[c]	-.046[c]	-5.712[c]	-6.677[c]
March	116	-.073[ab]	-20.158[d]	-19.121[d]	-.131[d]	-16.529[d]	-19.145[d]
Regression*	782	-	-.112	-.083	-.004	-.510	-.593

[a,b,c,d]Least squares constants within column and effect do not differ significantly. All others differ significantly ($P < .05$).

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

TABLE XII

ANALYSIS OF VARIANCE FOR BIRTH WEIGHTS OF LAMBS

Source of variation	Degrees of freedom	Mean square
Total	781	-
Reduction	17	27.764
Year - age of dam	5	28.605**
Breed of dam	7	7.237**
Type of birth	1	224.272**
Sex of lamb	1	71.693**
Month of birth	3	9.315**
Error	764	2.406

**$P < .01$.

TABLE XIII

CORRELATIONS AMONG LAMB PERFORMANCE TRAITS

	Birth weight	Weaning weight	Total gain	Average daily gain	120-day weight	135-day weight	Weaning age
Birth weight	1.000	0.390**	0.304**	0.423**	0.519**	0.466**	-.063
Weaning weight		1.000	0.995**	0.590**	0.603**	0.559**	0.510**
Total gain			1.000	0.566**	0.571**	0.531**	0.535**
Average daily gain				1.000	0.993**	0.905**	-.360**
120-day weight					1.000	0.911**	-.348**
135-day weight						1.000	-.306**
Weaning age							1.000

**$P < .01$.

adjusted mean and were heavier when compared to lambs from ewes of other groups. Lambs from Mixed Native ewes (S7) had the lowest birth weights and were 0.770 pound below the adjusted mean. Miller (1935) observed that lambs sired by Hampshire and Suffolk rams were heavier at birth than lambs by rams of other breeds. Kincaid (1943) found that ewes mated to Hampshire rams produced lambs which were heavier at birth than lambs sired by Southdown rams. Sidwell (1964) ranked birth weights of purebred lambs in the following order: Hampshire, Shropshire, Merino and Southdown. Fernandes (1964) showed that crossbred lambs were heavier at birth than grade Hampshire lambs.

The effects of type of birth and sex of lamb on birth weight were highly significant. Lambs born as singles were 1.126 pounds heavier than those born as twins. Males averaged 0.612 pound heavier at birth than females. Brown, Baugus and Sabin (1961) reported that the difference in birth weight between male and female lambs was not significant.

Month of birth had a significant effect on birth weight of lambs. Lambs born in January and in February were 0.277 and 0.019 pound above, respectively, the adjusted mean while those born in December and in March were below the mean. Smith and Lidvall (1964) reported that lambs born in January, February and in March were significantly heavier at

birth than those born in other months. However, the differences in birth weights of lambs depend upon the feeding level during the latter stages of pregnancy in the ewes.

Significant correlations were found between birth weight and the following characteristics: weaning weight (r = 0.390); total gain (r = 0.304); average daily gain (r = 0.423); 120-day weight (r = 0.519); and 135-day weight (r = 0.466). These correlations show that birth weight was related to other performance traits of lambs. However, in most cases, the variation in birth weight does not account for a very high percentage of the variation in other traits.

Weaning Weight

Average unadjusted weaning weights of lambs by years are given in Table XIV, the analysis of variance for weaning weight in Table XV and the least squares constants for weaning weight of lambs in Table XI (page 40). The correlation between weaning weight and other performance traits of lambs has been given in Table XIII (page 44).

The weaning weights of lambs were significantly influenced by year of birth. The lambs born in 1957 and in 1955 had the highest weaning weights. They were 3.599 and 3.440 pounds, respectively, above the overall adjusted mean while the lambs born in 1956 and in 1954 had the lowest

TABLE XIV

AVERAGE WEANING WEIGHT OF LAMBS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	64.50[h]	66.17	69.41	82.40	71.10	87.00	73.56
California (S2)[a]	62.07	79.55	73.25	90.10	77.80	89.50	78.43
Northwestern (S3)[a]	69.40	84.17	75.97	80.60	69.00	78.80	75.93
Northwestern (S4)[b]	-	78.50	72.43	74.30	75.80	88.80	76.58
Mixed Native (S5)[c]	-	-	-	49.20	61.60	76.70	59.52
Southwestern (S6)[d]	-	-	-	78.00	67.20	81.50	75.94
Mixed Native (S7)[e]	-	-	-	-	55.30	73.60	65.09
Southwestern (S8)[f]	-	-	-	-	-	75.10	75.10

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

[h]Weight in pounds.

TABLE XV

ANALYSIS OF VARIANCE

Source of variation	Degrees of freedom	Mean square				
		Weaning weight	Total gain	Average daily gain	120-day weight	135-day weight
Total	781	-	-	-	-	-
Reduction	19	7,597.12	7,248.24	0.27	4,308.84	5,320.29
Year - age of dam	5	1,546.30**	1,290.49**	0.07**	1,235.95**	1,917.09**
Breed of dam	7	292.06*	254.05*	0.01*	254.83*	421.82*
Sex of lamb	1	6,770.85**	5,550.24**	0.33**	5,746.73**	5,861.58**
Type of birth and rearing	2	4,322.02**	3,303.64**	0.22**	4,115.77**	4,252.43**
Month of birth	3	13,280.98**	12,165.72**	0.57**	8,976.39**	12,188.84**
Regression	1	1,694.51**	927.99**	2.24**	35,490.91**	48,034.51**
Error	762	126.11	113.56	0.006	99.76	175.67

*$P < .05$.

**$P < .01$.

weaning weights being 3.728 and 5.877 pounds, respectively, below the overall adjusted mean.

Breed of dam had a significant influence ($P < .05$) on the weaning weight of lambs. Lambs out of Northwestern (S4) ewes were heavier at weaning (3.766 pounds above the overall adjusted mean) when compared with lambs from other ewes. Miller (1935) observed that sires of larger breeds, namely Hampshire and Suffolk, produced heavier lambs at weaning than sires of smaller breeds such as the Shropshire and Southdown.

The effect of sex of lamb on weaning weight was highly significant. Males were 5.986 pounds heavier than females at weaning. The results obtained are in agreement with work by Hazel and Terrill (1946), Karam, Chapman and Pope (1949), Fernandes (1964) and Smith and Lidvall (1964).

Type of birth and rearing showed a highly significant effect on weaning weights of lambs. Lambs born and raised as singles were heavier at weaning than those born as twins but raised either as singles or twins. Least squares means show that lambs born and raised as singles weighed 78.86 pounds at weaning while lambs born as twins but raised as singles or as twins weighed 77.51 and 71.51 pounds, respectively. Sidwell and Grandstaff (1949), Blackwell and Henderson (1955), Bailey, Chapman and Pope (1961), and Smith and Lidvall (1964) also found significant differences due to

type of birth and rearing of lambs on weaning weight. Harrington, Whiteman and Morrison (1958) found that the effects due to type of birth and type of rearing were less important as the lambs grew older.

Highly significant correlations were obtained between weaning weight and the following traits: total gain ($r = 0.995$); average daily gain ($r = 0.590$); 120-day weight ($r = 0.603$); and 135-day weight ($r = 0.559$).

Average Daily Gain

The average unadjusted average daily gain of lambs by years, analysis of variance of average daily gain, least squares constants for average daily gain, and correlations between average daily gain and other performance traits are shown in Tables XVI, XV (page 48), XI (page 40), and XIII (page 44), respectively.

Highly significant differences in average daily gain were found among years. The lambs born in 1955 had the highest average daily gain of 0.543 pound. The differences for year effects may be due to varying environmental and nutritional conditions.

Breed of dam had a significant influence on average daily gain of the lambs. The lambs from Northwestern (S4) ewes gained 0.541 pound per day and this was greater ($P<.05$) than those from other ewes. Mixed Native (S5) ewes had

TABLE XVI

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

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	0.473[h]	0.470	0.500	0.550	0.560	0.490	0.513
California (S2)[a]	0.421	0.490	0.518	0.570	0.530	0.490	0.508
Northwestern (S3)[a]	0.471	0.520	0.526	0.570	0.520	0.430	0.555
Northwestern (S4)[b]	-	0.549	0.533	0.570	0.550	0.510	0.545
Mixed Native (S5)[c]	-	-	-	0.526	0.520	0.470	0.513
Southwestern (S6)[d]	-	-	-	0.530	0.530	0.450	0.498
Mixed Native (S7)[e]	-	-	-	-	0.480	0.430	0.453
Southwestern (S8)[f]	-	-	-	-	-	0.440	0.440

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

[h]Average daily gain in pounds.

lambs which gained less per day (0.489 pound) when compared with other lambs.

Average daily gain was significantly affected by sex of lambs. Male lambs gained 0.040 pound more per day than female lambs. These results agree with those of Kean and Henning (1949), Karam, Chapman and Pope (1949), Nambiar (1959), and Givens, Carter and Gaines (1960), Fernandes (1964), and Smith and Lidvall (1964) who reported that males gained faster than females.

The differences in average daily gain due to type of birth and rearing were highly significant. Lambs born and raised as singles were 0.018 pound above the overall adjusted mean while lambs born as twins and raised as singles or as twins were 0.016 pounds above and 0.034 below the overall adjusted mean, respectively. Botkin, Stratton and Faulkner (1956) observed that single lambs made gains about the same as twins raised as singles. Smith and Lidvall (1964) found that singles gained 0.06 pound faster per day than twins.

The effect of month of birth on average daily gain was highly singificant. Lambs born in December gain 0.065 faster per day than those born in January. The lease square constants for average daily gain of the lambs born in February and March were 0.046 and 0.131 pound below the overall adjusted mean.

Significant correlations were obtained between average daily gain and the following characteristics: birth weight ($r = 0.423$); weaning weight ($r = 0.590$); total gain ($r = 0.566$); 120-day weight ($r = 0.993$) and 135-day weight ($r = 0.905$).

120-Day Weight

Table XV (page 48) shows the analysis of variance for 120-day weight and Table XI (page 40) the least squares constants for 120-day weight. Unadjusted 120-day weights of lambs by years are presented in Table XVII.

There were highly significant differences in the effects of years on 120-day weight of lambs. Lambs born in 1957 had the heaviest weight (73.54 pounds) at 120 days and lambs born in 1954 had the lowest average weight (64.46 pounds) at 120 days.

Differences in 120-day weight of lambs due to breed of dam were significant ($P < .05$). Lambs from Northwestern (S4) ewes were heavier at 120-days than the lambs from other groups.

Sex of lamb significantly affected 120-day weight. Males were 5.514 pounds heavier at 120 days than females.

Lamb weight at 120 days was highly affected by type of birth and rearing. Lambs born and raised as singles were

TABLE XVII

AVERAGE 120-DAY WEIGHT OF LAMBS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	65.06[h]	63.75	67.58	74.00	75.50	67.20	69.44
California (S2)[a]	58.58	66.48	69.69	76.20	71.60	67.30	68.85
Northwestern (S3)[a]	64.92	70.26	70.79	76.50	70.60	60.30	68.60
Northwestern (S4)[b]	-	73.44	71.18	76.00	74.60	70.20	73.18
Mixed Native (S5)[c]	-	-	-	71.12	71.70	64.20	69.36
Southwestern (S6)[d]	-	-	-	71.80	71.80	62.70	68.05
Mixed Native (S7)[e]	-	-	-	-	64.80	59.60	62.02
Southwestern (S8)[f]	-	-	-	-	-	61.00	61.00

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

[h]Weight in pounds.

1.249 and 7.169 pounds heavier than lambs born as twins but raised as singles and twins, respectively.

The effect of month of birth on 120-day weight was highly significant. The lambs born in December and in January were heavier at 120 days being 15.009 and 7.232 pounds above the overall adjusted mean, respectively. The lambs born in February and in March were lighter at 120 days than December and January lambs being 5.712 and 16.529 pounds below the overall adjusted mean, respectively.

Weight at 120 days was significantly correlated with the following traits (Table XIII, page 44): birth weight ($r = 0.519$); weaning weight ($r = 0.603$); total gain ($r = 0.571$); average daily gain ($r = 0.993$) and 135-day weight ($r = 0.911$).

135-Day Weight

The unadjusted 135-day weights by years and breeding groups are given in Table XVIII. Effects of various factors on 135-day weight and analysis of variance were similar to that of 120-day weight (Table XI and XV, pages 40 and 48). Lambs out of Northwestern (S4) were heavier than those from other ewe groups and 3.868 pounds above the overall adjusted mean at 135 days of age than those from other lamb groups. Males were 5.570 pounds heavier than females.

Lambs born and raised as singles were 1.364 pounds

TABLE XVIII

AVERAGE 135-DAY WEIGHT OF LAMBS BY BREEDING OF EWES AT THE MIDDLE TENNESSEE EXPERIMENT STATION DURING THE YEARS 1952-1957

Breeding of ewes	Year						
	1952	1953	1954	1955	1956	1957	Av.[g]
Native (S1)[a]	72.23[h]	72.79	75.82	83.60	83.90	74.55	77.95
California (S2)[a]	66.81	79.34	79.38	86.20	79.55	74.65	78.19
Northwestern (S3)[a]	73.97	82.86	78.88	87.40	78.40	66.75	77.55
Northwestern (S4)[b]	-	82.92	79.75	84.80	82.85	77.85	81.76
Mixed Native (S5)[c]	-	-	-	79.50	79.50	71.25	77.25
Southwestern (S6)[d]	-	-	-	80.50	79.75	69.45	75.89
Mixed Native (S7)[e]	-	-	-	-	72.00	66.05	68.82
Southwestern (S8)[f]	-	-	-	-	-	67.60	67.60

[a]Ewes bred first as yearlings in 1951.

[b]Ewes bred first as yearlings in 1952.

[c]Ewes bred first as ewe lambs in 1954.

[d]Ewes bred first as yearlings in 1954.

[e]Ewes bred first as yearlings in 1955.

[f]Ewes bred first as yearlings in 1956.

[g]Weighted average over all years.

[h]Weight in pounds.

heavier than lambs born as twins, and raised as singles. Lambs born as twins but raised as singles were 5.930 pounds heavier at 135 days than those born as twins and raised as twins.

Lambs born in December and January were heavier at 135 days than lambs born in February and March. Least squares constants for December, January, February and March were 17.684, 8.138, -6.677 and -19.145 pounds, respectively.

There was a high significant correlation between 135-day weight and 120-day weight (r = 0.911).

CHAPTER V

SUMMARY AND CONCLUSIONS

Data were collected on 1120 ewes bred and 761 ewes lambing during the period from 1952 through 1957 at the Middle Tennessee Experiment Station, Spring Hill. To study the productivity of ewes, data were analyzed for the following traits: number of ewes exposed and lambing, percentage of ewes lambing, percentage of twin births, lamb survival rates, lambs raised per ewe bred and pounds of lamb marketed per ewe bred were included. Least squares methods were used to determine the effects of various factors on lamb performance traits including birth weight, weaning weight, total gain, average daily gain, 120-day weight and 135-day weight. Effects included in the least squares models were year, breed of dam, type of birth, sex of lamb, type of birth and rearing and month of birth.

The average percentage of ewes lambing for all breeding groups of ewes was 67.9 per cent. Lambing percentages were highest in the Southwestern (S6), Southwestern (S8), Northwestern (S3) and Native (S1) groups of ewes with 80.2, 75.0, 73.7, and 71.6 per cent of ewes lambing respectively. Lambing percentages were lowest in the California (S2), Mixed Native (S7), Northwestern (S4) and Mixed Native (S5)

with lambing percentages of 66.7, 65.5, 58.2 and 44.5 per cent, respectively.

The percentage of twin births among the ewes lambing as yearlings was 7.69 per cent. Although the twinning rates varied among years, in most breeding groups of ewes the percentage of twin births increased as the ewes become older, reaching a peak at about five years of age. Northwestern (S3 and S4), Native (S1) and California (S2) ewes had the highest percentages of twin births while Mixed Native (S5 and S7) and Southwestern (S6 and S8) ewes had the lowest percentages among the groups.

The overall percentage of lambs raised was 80.3 per cent. The percentage of lambs raised was 84.6 per cent for yearling ewes and 80.3 per cent for ewes two years of age and older. Mixed Native (S7) ewes had the highest percentage of lambs raised to weaning of 93.5 per cent and Southwestern (S8) ewes had the lowest percentage of 72.2. The differences in the number of lambs raised per ewe bred among the different groups of ewes was not great except for comparisons of Mixed Native (S5) ewes with other groups. This group of ewes had the lowest lambing percentage and the lowest twinning percentage and hence the lowest number of lambs raised per ewe bred.

The pounds of lamb weaned and marketed per ewe bred in Southwestern (S6) ewes were 65.05 pounds, the highest

among the group. There were less pounds of lamb marketed per ewe bred from the ewes lambing as yearlings, 2-year olds and 3-year olds when compared with 5 to 7-year old ewes. This indicates there is an increase in productivity of ewes as they mature.

The differences in the average condition scores of lambs from 2-year old ewes and older ewes were not great and the degree of finish varied from 10.2 to 13.7. The condition score of lambs from Mixed Native (S5) ewes lambing as yearlings was 8.6, the lowest among the groups.

Highly significant differences due to breed of dam, type of birth, sex of lamb and month of birth on birth weight of lambs were observed. Lambs from Northwestern (S3) ewes were heavier at birth than the lambs from other ewe groups. Lambs born as singles were 1.126 pounds heavier than those born as twins and male lambs were 0.612 pound heavier than females. Lambs born during January were heavier at birth and the deviations from the overall adjusted mean were 0.277, 0.019, -0.223 and -0.073 pound for lambs born in January, February, March and December, respectively.

Lambs out of Northwestern (S4) ewes were heavier at weaning than the lambs from other ewe groups. Males were 5.986 pounds heavier than females at weaning time. Lambs born as singles and raised as singles were 1.349 and 7.351

pounds heavier than those born as twins but raised either as singles or as twins, respectively. Lambs born in December were significantly heavier than those born in January, February and March.

Lambs from the Northwestern (S4) ewes gained faster than the lambs from ewes of other breeding groups. Males gained 0.042 pound faster per day than females. Lambs born as singles and raised as singles gained faster than those born as twins but raised as singles or as twins. Least squares constants for daily gain for lambs born and raised as singles, born as twins and raised as singles, and born as twins and raised as twins were 0.018, 0.016 and -0.034 pound, respectively.

Early lambs gained faster than the late lambs. Lambs born in December and in January gained at a faster rate than those born in February and in March.

Lamb weights at 120 and at 135 days were significantly influenced by breed of dam, sex of lamb, type of birth and rearing and month of birth. At these standard ages, lambs from Northwestern (S4) ewes were heavier than the lambs from other ewe groups. Males were 5.514 pounds and 5.570 pounds heavier than females at 120 and 135 days of age, respectively. Lambs born and raised as singles were heavier than those born as twins but raised as either singles or twins. Lambs born in December and in January

were significantly heavier at 120 and 135 days of age as compared with lambs born in other months.

There was a highly significant correlation between 135-day weight and 120-day weight of lambs ($r = 0.911$). This indicates that 83 per cent of variation in 135-day weights was explained by the variation in 120-day weights.

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APPENDIX

TABLE XIX

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1952

	Breeding of ewes		
	Native (S1)	California (S2)	North-western (S3)
No. of ewes bred	48	48	48
Age of ewes, years	2	2	2
No. of ewes lambing	26	25	38
Per cent of ewes lambing	54.2	52.1	79.2
Av. lambing date of ewes	2/18/52	2/20/52	2/12/52
Per cent lamb crop (to ewes bred)	58.3	60.4	106.2
Lambs raised per ewe bred	0.33	0.42	0.11
No. of lambs born	28	29	51
No. of sets of twins (multiple births)	2	4	13
No. of lambs raised to weaning	16	20	36
Per cent of lambs raised to weaning	57.1	69.0	70.6
Av. birth weight of lambs, lb.	8.3	8.1	8.4
Av. weaning age, days	118.8	128.3	129.5
Av. weaning weight, lb.	64.5	62.1	69.4
Av. 120-day weight, lb.	65.1	58.2	64.9
Av. 135-day weight, lb.	72.2	66.8	74.0
Av. daily gain, lb.	0.47	0.42	0.47
Av. condition score	10.8	11.0	11.6
Pounds of lamb marketed per ewe bred	21.5	25.9	7.4

TABLE XX

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1953

	Breeding of ewes			
	Native (S1)	California (S2)	Northwestern (S3)	Northwestern (S4)
No. of ewes bred	48	47	46	48
Age of ewes, years	3	3	3	2
No. of ewes lambing	23	26	21	15
Per cent of ewes lambing	47.9	55.3	45.7	31.3
Av. lambing date of ewes	2/3/53	1/14/53	1/17/53	2/3/53
Per cent lamb crop (to ewes bred)	72.9	70.2	71.7	37.5
Lambs raised per ewe bred	0.60	0.47	0.52	0.31
No. of lambs born	35	33	33	18
No. of sets of twins (multiple births)	12	6	11	3
No. of lambs raised to weaning	29	22	24	15
Per cent of lambs raised to weaning	82.9	66.7	72.7	83.3
Av. birth weight of lambs, lb.	7.4	7.7	7.9	7.6
Av. weaning age, days	125.2	146.7	146.8	129.2
Av. weaning weight, lb.	66.2	79.6	84.2	78.5
Av. 120-day weight, lb.	63.8	66.5	70.3	73.4
Av. 135-day weight, lb.	72.8	79.3	82.9	82.9
Av. daily gain, lb.	0.47	0.49	0.52	0.55
Av. condition score	13.7	12.2	13.7	13.7
Pounds of lamb marketed per ewe bred	40.00	37.2	43.9	24.6

TABLE XXI

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1954

	Breeding of ewes			
	Native (S1)	Cali-fornia (S2)	North-western (S3)	North-western (S4)
No. of ewes bred	45	46	45	47
Age of ewes, years	4	4	4	3
No. of ewes lambing	36	33	35	29
Per cent of ewes lambing	80.0	71.7	77.8	61.7
Av. lambing date of ewes	1/9/54	1/5/54	1/3/54	1/5/54
Per cent lamb crop (to ewes bred)	108.9	100.0	117.7	87.2
Lambs raised per ewe bred	0.91	0.85	0.98	0.79
No. of lambs born	49	46	53	41
No. of sets of twins (multiple births)	14	13	16	11
No. of lambs raised to weaning	41	39	44	37
Per cent of lambs raised to weaning	83.6	83.0	83.0	90.2
Av. birth weight of lambs, lb.	7.6	7.5	7.8	7.2
Av. weaning age, days	123.7	126.9	129.6	122.4
Av. weaning weight, lb.	69.4	73.3	76.0	72.4
Av. 120-day weight, lb.	67.6	69.7	70.8	71.2
Av. 135-day weight, lb.	75.8	79.4	78.9	79.8
Av. daily gain, lb.	0.50	0.52	0.53	0.53
Av. condition score	12.3	12.5	13.2	12.3
Pounds of lamb marketed per ewe bred	63.2	62.1	74.3	57.0

TABLE XXII

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1955

	Breeding of ewes		
	Native (S1)	California (S2)	North-western (S3)
No. of ewes bred	29	30	33
Age of ewes, years	5	5	5
No. of ewes lambing	29	25	30
Per cent of ewes lambing	100.0	83.3	90.9
Av. lambing date of ewes	1/13/55	12/22/54	1/12/55
Per cent lamb crop (to ewes bred)	155.2	120.0	118.2
Lambs raised per ewe bred	1.34	0.80	0.88
No. of lambs born	45	36	39
No. of sets of twins (multiple births)	16	11	9
No. of lambs raised to weaning	39	24	29
Per cent of lambs raised to weaning	86.7	66.7	74.4
Av. birth weight of lambs, lb.	8.0	7.8	8.1
Av. weaning age, days	135.3	144.4	127.2
Av. weaning weight, lb.	82.4	90.1	80.6
Av. 120-day weight, lb.	74.0	76.2	76.5
Av. 135-day weight, lb.	83.6	86.2	87.4
Av. daily gain, lb.	0.55	0.57	0.57
Av. condition score	11.5	11.7	11.8
Pounds of lamb marketed per ewe bred	110.4	72.1	70.9

TABLE XXII (continued)

	Breeding of ewes		
	Northwestern (S4)	Mixed Native (S5)	Southwestern (S6)
No. of ewes bred	34	24	36
Age of ewes, years	4	1	2
No. of ewes lambing	26	12	31
Per cent of ewes lambing	76.5	50.0	86.1
Av. lambing date of ewes	1/26/55	3/28/55	1/26/55
Per cent lamb crop (to ewes bred)	120.6	54.2	88.9
Lambs raised per ewe bred	1.03	0.46	0.72
No. of lambs born	41	13	32
No. of sets of twins (multiple births)	15	1	1
No. of lambs raised to weaning	35	11	26
Per cent of lambs raised to weaning	85.4	84.6	81.2
Av. birth weight of lamb, lb.	7.6	8.0	8.2
Av. weaning age, days	113.5	78.3	131.7
Av. weaning weight, lb.	74.3	49.2	78.0
Av. 120-day weight, lb.	76.0	71.1	71.8
Av. 135-day weight, lb.	84.8	79.5	80.5
Av. daily gain, lb.	0.57	0.53	0.53
Av. condition score	10.6	8.6	11.0
Pounds of lamb marketed per ewe bred	76.5	22.6	56.2

TABLE XXIII

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1956

	Breeding of ewes			
	Native (S1)	California (S2)	Northwestern (S3)	Northwestern (S4)
No. of ewes bred	28	29	30	25
Age of ewes, years	6	6	6	5
No. of ewes lambing	22	21	22	16
Per cent of ewes lambing	78.6	72.4	73.3	64.0
Av. lambing date of ewes	1/27/56	1/7/56	1/24/56	1/9/56
Per cent lamb crop (to ewes bred)	125.0	113.8	126.7	84.0
Lambs raised per ewe bred	1.04	1.03	0.97	0.76
No. of lambs born	35	33	38	21
No. of sets of twins (multiple births)	13	12	14	5
No. of lambs raised to weaning	29	30	29	19
Per cent of lambs raised to weaning	82.8	90.9	76.3	90.5
Av. birth weight of lambs, lb.	8.3	8.0	8.2	8.6
Av. weaning age, days	111.0	130.9	117.4	121.3
Av. weaning weight, lb.	71.1	77.8	69.0	75.8
Av. 120-day weight, lb.	75.5	71.6	70.6	74.6
Av. 135-day weight, lb.	83.9	79.6	78.4	82.9
Av. daily gain, lb.	0.56	0.53	0.52	0.55
Pounds of lamb marketed per ewe bred	73.9	80.1	66.9	57.6

TABLE XXIII (continued)

	Breeding of ewes		
	Mixed Native (S5)	South-western (S6)	Mixed Native (S7)
No. of ewes bred	24	36	30
Age of ewes, years	2	3	2
No. of ewes lambing	7	27	18
Per cent of ewes lambing	29.2	75.0	60.0
Av. lambing date of ewes	1/28/56	1/27/56	2/18/56
Per cent lamb crop (to ewes bred)	29.2	83.3	70.0
Lambs raised per ewe bred	0.21	0.80	0.67
No. of lambs born	7	30	21
No. of sets of twins (multiple births)	0	3	3
No. of lambs raised to weaning	5	29	20
Per cent of lambs raised to weaning	71.4	96.7	95.2
Av. birth weight of lamb, lb.	9.3	8.2	7.2
Av. weaning age, days	100.0	100.8	99.2
Av. weaning weight, lb.	61.6	67.2	55.3
Av. 120-day weight, lb.	71.7	71.8	64.8
Av. 135-day weight, lb.	79.5	79.8	72.0
Av. daily gain, lb.	0.52	0.53	0.48
Pounds of lamb marketed per ewe bred	12.9	53.8	37.1

TABLE XXIV

PERFORMANCE OF EWE FLOCKS AT THE MIDDLE TENNESSEE EXPERIMENT STATION
1957

	Breeding of ewes			
	Native (S1)	Cali-fornia (S2)	North-western (S3)	North-western (S4)
No. of ewes bred	24	22	30	23
Age of ewes, years	7	7	7	6
No. of ewes lambing	22	18	25	17
Per cent of ewes lambing	91.7	81.8	83.3	73.9
Av. lambing date of ewes	1/5/57	12/23/56	1/3/57	12/29/56
Per cent lamb crop (to ewes bred)	133.3	118.2	123.3	100.0
Lambs raised per ewe bred	0.79	1.00	1.17	0.78
No. of lambs born	32	26	37	23
No. of sets of twins (multiple births)	9	7	12	6
No. of lambs raised to weaning	19	22	35	18
Per cent of lambs raised to weaning	59.4	84.6	94.6	78.3
Av. birth weight of lamb, lb.	8.4	8.5	8.7	9.0
Av. weaning age, days	160	165	163	156
Av. weaning weight, lb.	87.0	89.5	78.8	88.8
Av. 120-day weight, lb.	67.2	67.3	60.3	70.2
Av. 135-day weight, lb.	74.6	74.7	66.8	77.9
Av. daily gain, lb.	0.49	0.49	0.43	0.51
Av. condition score	11.3	11.8	10.4	12.4
Pounds of lamb marketed per ewe bred	68.7	89.5	92.2	69.3

TABLE XXIV (continued)

	Breeding of ewes			
	Mixed Native (S5)	South-western (S6)	Mixed Native (S7)	South-western (S8)
No. of ewes bred	15	34	28	40
Age of ewes, years	3	4	3	2
No. of ewes lambing	9	27	20	30
Per cent of ewes lambing	60.0	79.4	71.4	75.0
Av. lambing date of ewes	1/9/57	12/30/56	1/20/57	1/14/57
Per cent lamb crop (to ewes bred)	66.7	123.5	89.3	90.0
Lambs raised per ewe bred	0.40	1.06	0.82	0.65
No. of lambs born	10	42	25	36
No. of sets of twins (multiple births)	1	15	5	6
No. of lambs raised to weaning	6	36	23	26
Per cent of lambs raised to weaning	60.0	85.7	92.0	72.2
Av. birth weight of lamb, lb.	7.8	8.7	8.0	8.2
Av. weaning age, days	147	162	152	152
Av. weaning weight, lb.	76.7	81.5	73.6	75.1
Av. 120-day weight, lb.	64.2	62.7	59.6	61.0
Av. 135-day weight, lb.	71.3	69.5	66.1	67.6
Av. daily gain, lb.	0.47	0.45	0.43	0.44
Av. condition score	10.8	10.9	10.4	10.2
Pounds of lamb marketed per ewe bred	30.7	86.4	60.4	48.8