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A Comparison of Type of Birth, Breed of Sire, Postweaning Nutrition, and Age of First Breeding on Lifetime Lamb and Wool Production in Range Ewes

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A COMPARISON OF TYPE OF BIRTH, BREED OF SIRE, POSTWEANING NUTRITION, AND AGE OF FIRST BREEDING ON LIFETIME LAMB AND WOOL PRODUCTION IN RANGE EWES

BY

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

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INTRODUCTION

Due to present economic pressures, sheep producers must utilize every management tool in the most profitable manner. Therefore, many traditional practices must be reevaluated. Research has indicated that some possible areas to improve lamb and wool production are in the use of crossbred ewes, breeding ewes to lamb at 1 yr of age, feeding a high level of postweaning nutrition, and selection for twins, lamb production, wool production, longevity, and lifetime production.

Research is usually performed at experiment stations where the conditions are not typical of those found for commercial operations and therefore may affect the application of the results. By conducting an experiment at several commercial operations, the results should be more applicable to the commercial producer.

This investigation was initiated to determine which factors would be most beneficial to implement on a range operation. This study involved five groups of ewes that were maintained for 5 or 6 yr of production on several commercial range operations in western South Dakota.

REVIEW OF LITERATURE

Certain traits are utilized to evaluate sheep production such as birth weight, weaning weight, postweaning ewe size, annual ewe size, lifetime production, and annual wool weight. These traits are affected by many environmental and genetic factors that can be modified or regulated to increase production with minimal additional cost. The following review will discuss the influence of several genetic and environmental factors on birth weight, weaning weight, postweaning growth, age of first breeding, lamb production, wool production, and longevity.

Birth Weight

Many researchers consider birth weight as a selection criterion since it is indicative of subsequent growth and survival (Kincaid, 1943; deBaca et al., 1956; Harrington et al., 1958; Purser and Young, 1964; Hight and Jury, 1970; Elliot et al., 1974; Smith, 1977; Farid and Makarechian, 1978; Hinkelman et al., 1979). Birth weight is influenced by manageable factors such as breed of sire and dam, prenatal nutrition, ewe size, and ewe age (Blackwell and Henderson, 1955; Bennet et al., 1963; Sidwell et al., 1964; Lambe et al., 1965; Singh et al., 1967; Vesely et al., 1970; Sidwell and Miller, 1971b; El Kouni et al., 1974; Hohenboken et al., 1976a; Smith, 1977; Rastogi et al., 1982). These authors also observed that lamb year of birth, type of birth, and sex affected birth weight.

Campbell and Nel (1967) defined birth weight as the weight of a newborn lamb immediately after the naval cord and any placental membranes have been removed but prior to nursing. This initial weight has been positively correlated with lamb growth (deBaca et al., 1956; Harrington et al., 1958), weaning weight, and postweaning gain (Kincaid, 1943; Farid and Makarechian, 1978). Bush and Lewis (1977) reported that birth weight accounted for 20% of the variation in rate of gain in lambs. Elliot et al. (1974) observed a small, positive relationship between birth weight of lambs born to yearling ewes and the ewes' subsequent production.

Birth weights exceeding 3.5 kg have been associated with a higher lamb survival rate from birth to weaning (Kincaid, 1943; Guyer and Dyer, 1954; Hoversland et al., 1957; Lax and Brown, 1968; Hight and Jury, 1970; Smith, 1977; Hinkelman et al., 1979). Several researchers have recommended selection for high birth weights, since birth weight is a moderately heritable trait (Carter and Henning, 1951; Blackwell and Henderson, 1955; Dickerson and Laster, 1975; Scott, 1977; Smith, 1977). Purser and Young (1964) also recommended selection for lambs with high birth weights but not exceeding 4.5 kg. This recommendation was based on their conclusions that a higher percentage of dystocia occurs with lambs weighing over 4.5 kg at birth. This problem is more prevalent in single-born lambs, since they usually are heavier at birth. Smith (1977) reported similar results with lambs weighing in excess of 5.5 kg at birth. According to several researchers, lambs weighing less than 2.0 kg at birth are more frequently found as stillbirths than heavier born lambs (Kincaid, 1943; Purser and Young, 1964; Smith, 1977; Hinkelman et al., 1979). Purser and Young (1964) stated that multiple-born lambs are weaker at birth and are more commonly found dead at birth. They perceived this lowered viability to be explained by the lower birth weights found with the multiple-born lambs.

Birth weights vary from lamb to lamb and some of this variation is due to the breed of sire and the breed of dam (Blackwell and Henderson, 1955; Jamison et al., 1961; Bennet et al., 1963; Lambe et al., 1965; Vesely et al., 1970; Wiener and Hayter, 1975; Wright et al., 1975; Hohenboken et al., 1976a; Smith, 1977). Laster et al. (1972) suggested that some of the variation that is due to breed can be accounted for by the varying frequencies of multiple births for the different breeds. Rastogi et al. (1982) reported the Suffolk ewes gave birth to heavier lambs and more single-born lambs than Targhee ewes. Oltenacu and Boylan (1981b) did not observe any breed effect on birth weight with 122 Suffolk and Targhee ewes in 3 yr of lambing. Forbes (1967) suggested that some of this breed variation may be attributed to the different gestation lengths of various breeds. Hunter (1956) stated that the smaller-sized breeds have longer gestation periods. Levine and Hohenboken (1978) reported that Suffolk ewes, which were 13.8 kg heavier than the Columbia ewes in their study, produced lambs that weighed .3 kg more at birth.

Many investigators have observed crossbred lambs to be .11 to 1.2 kg heavier than straightbred lambs at birth (Starke et al., 1958;

Sidwell et al., 1964; Singh et al., 1967; Sidwell and Miller, 1971a,b; Matthews et al., 1977; McGuirk et al., 1978). Lasley (1972) and Hight and Jury (1970) accredited the higher birth weights to heterosis and observed an increase in birth weight with each added cross. However, heterosis is not always evident in birth weight. Such is the case when the crossbred lamb's birth weight is less than the mean of the parent breed's birth weight (Carter and Henning, 1951; Bradford et al., 1963; Sidwell and Miller, 1971b; El Kouni et al., 1974). Lamb birth weight increases with an increase in the age of the ewe, with the maximum birth weights occurring between 4 and 6 yr of age and then decreasing with further advancement in age (Kincaid, 1943; Blackwell and Henderson, 1955; Hunter, 1956; Bennet et al., 1963; Sidwell et al., 1964; Smith and Lidvall, 1964; Vesely and Peters, 1964; Lambe et al., 1965, Vesely et al., 1966, 1970; Singh et al., 1967; El Tawil et al., 1970; Sidwell and Miller, 1971b; El Kouni et al., 1974; Hohenboken et al., 1976a,b; McCall and Hight, 1981). Lambe et al. (1965) reported that 4.4% of the variation in birth weight was due to age of the dam. Starke et al. (1958) concluded that the birth weight of a lamb was approximately 7.5% of the average weight of the parents. Slyter (1968) and Hinkelman et al. (1979) reported that heavier ewes gave birth to heavier lambs.

Investigators have suggested that type of birth causes the greatest variation in birth weight (deBaca et al., 1956; Bogart et al., 1957; Vesely and Peters, 1964). Other researchers also have found that type of birth affects birth weight, with the single-born lambs being heavier (Hazel and Terrill, 1945; Blackwell and Henderson, 1955; Cassard and Weir, 1956; Bennet et al., 1963; Purser and Young, 1964; Sidwell et al., 1964; Lambe et al., 1965; Singh et al., 1967; El Tawil et al., 1970; Vesely et al., 1970; Sidwell and Miller, 1971b; Dyrmundsson, 1973; Wright et al., 1975; Hohenboken et al., 1976a,b; Smith, 1977; McCall and Hight, 1981; Rastogi et al., 1982). Single-born lambs have been found to be 1.4 to .7 kg heavier than twin-born lambs (Bogart et al., 1957; Starke et al., 1958; Smith and Lidvall, 1964; Hight and Jury, 1970; Bush and Lewis, 1977; Levine and Hohenboken, 1978). It is well accepted that single-born lambs have a longer gestation period than multiple-born lambs and therefore higher birth weights (Forbes, 1967; Glimp, 1971; Thrift and Dutt, 1972; Hinkelman et al., 1979). Gould and Whiteman (1974) summarized that single-reared ewes produced heavier lambs at birth. Russel et al. (1981) reported that a ewe's nutrition during her pregnancy has a direct effect on her lamb's birth weight.

Many researchers have reported that male lambs are .02 to .61 kg heavier at birth than ewe lambs (Starke et al., 1958; Bennet et al., 1963; Smith and Lidvall, 1964; Hight and Jury, 1970; Baharin and Beilharz, 1977; Bush and Lewis, 1977; Levine and Hohenboken, 1978). Thrift and Dutt (1972) accounted the heavier male birth weights to a longer gestation period for the male lambs. However, Cassard and Weir (1956) and Forbes (1967) reported that sex of lamb did not affect birth weight. Bush and Lewis (1977) concluded that single-born male lambs were the heaviest at birth followed by single-born ewe lambs, while the twin-born ewe lambs were the lightest.

Weaning Weight

Weighing lambs at weaning time is one of the most common practices performed to measure a ewe's lamb production. Basuthakur et al. (1973) and Barlow and Hodges (1976) reported that a ewe's weaning weight is positively correlated with her total lamb and wool production. Hulet et al. (1969) stated that ewes with heavier weaning weights tend to exhibit estrus sooner than ewes that are lighter at weaning time. Weaning weight is influenced by many phenotypic and genotypic factors such as birth weight, breed of sire and dam, maternal milk production, type of birth and rearing of lamb, type of birth of dam, sex of lamb, age of ewe, size of ewe, and year of lamb birth (Terrill et al., 1947, 1948; Sidwell and Grandstaff, 1949; Blackwell and Henderson, 1955; deBaca et al., 1956; Warwick and Cartwright, 1957; Bennet et al., 1963; Sidwell et al., 1964; Vesely and Peters, 1964, 1972; Lambe et al., 1965; Vesely et al., 1966, 1970; Singh et al., 1967; El Tawil et al., 1970; Sidwell and Miller, 1971b; Lasley, 1972; El Kouni et al., 1974; Dickerson and Laster, 1975; Hohenboken et al., 1976a,b; Matthews et al., 1977; Bhat et al., 1981; McCall and Hight, 1981; Rastogi et al., 1982).

deBaca et al. (1956) reported that weaning weights range from 2.5 to 5.96 times the birth weight and that birth weights have the greatest influence on preweaning gain of any of the factors observed. Other researchers also stated that birth weights influence weaning weight (Guyer and Dyer, 1954; El Tawil et al., 1970; Farid and Makarechian, 1978). Smith and Lidvall (1964) suggested that date of birth may affect weaning weight, since seasons affect preweaning gain and therefore weaning weight.

Breed of sire and dam has been proven to affect weaning weight (deBaca et al., 1956; Botkin and Paules, 1965; Vesely et al., 1966; Sidwell and Miller, 1971b; Bradley et al., 1972; Fogarty, 1972; Vesely and Peters, 1972; El Kowni et al., 1974; Hohenboken et al., 1976b; Levine and Hohenboken, 1978; Lloyd et al., 1980; Blackburn et al., 1981; Crouse et al., 1981; Leymaster and Smith, 1981; Rastogi et al., 1982). Oltenacu and Boylan (1981b) reported that Suffolk lambs weighed 5.3 kg more at weaning than Targhee lambs. Similarly, Sidwell and Miller (1971b) observed weaning weights for Suffolk lambs to be 5.7 kg higher than weaning weights for Targhee lambs. According to numerous reports, crossbred lambs appear to be 4.4 to 8.2% heavier at weaning time than straightbred lambs (Fox et al., 1964; Sidwell and Miller, 1971b; Lasley, 1972; Vesely and Peters, 1972; McGuirk et al., 1978). However, Sidwell et al. (1964) and Bradley et al. (1972) stated that single-cross lambs don't exhibit any heterosis. Sidwell and Miller (1971b) and Bradley et al. (1972) provided evidence for this statement, reporting that Suffolk x Targhee lambs had weaning weights that were lower than the mean of the weaning weights for Suffolk and Targhee lambs. Sidwell et al. (1964) and Bradley et al. (1972) declared that, as the number of crosses increase over a two-way cross, so does the amount of heterosis. Numerous investigators suggested selection for high weaning weights, since weaning weight is 6 to 56% heritable (Blackwell and Henderson, 1955; Shelton and Campbell, 1962; Vesely et al., 1970; Hohenboken et al., 1976b; Scott, 1977; Mavrogenis et al., 1980).

Some of the breed effect on weaning weight can be attributed to the breed effect on birth weight and to the variation in milk production of the different breeds. Doney et al. (1981) reported that breed of ewe affected a lamb's weaning weight by the milk producing ability of the ewe. According to Guyer and Dyer (1954) and Scott (1977), weaning weight is a measure of the dam's ability to produce milk and the lamb's ability to gain. Wilson et al. (1970) observed Southdown ewes to produce more milk than Hampshire ewes and to produce lambs that gained faster from birth to weaning. Gardner and Hogue (1966) reported that Hampshire ewes produced more milk and heavier lambs at weaning than Corriedale ewes. Crossbred ewes have been noted to produce more milk and have lambs with faster preweaning gains than straightbred ewes (Holtman and Bernard, 1969). Orr et al. (1977) and Doney et al. (1981) reported that the amount a lamb nurses is positively correlated to the lamb's first 4-wk growth. Wallace (1948) and Burris and Baugus (1955) found this correlation to be .90 and stated that this correlation decreased as age increased over 4 wk. Slen et al. (1963) claimed that milk production of a ewe is a major factor that influences her lamb's weaning weight. A ewe's milk production is affected by many factors other than breed. Some of these factors are preweaning nutrition of the ewe (Gould and Whiteman, 1975), size of the ewe, birth weight of the lamb (Burris and Baugus, 1955), type of lamb birth and type of lamb rearing (Guyer and Dyer, 1954; Alexander and Davies, 1959; Slen et al., 1963; Gardner and Hogue, 1966; Peart et al., 1975; Torres-Hernandez and Hohenboken, 1979). Larger ewes and ewes that give birth to heavier lambs were positively correlated to higher milk production by 50 and 74%, respectively, by Burris and Baugus (1955). Ewes that give birth to and raise multiple lambs also tend to produce more milk (Guyer and Dyer, 1954; Peart et al., 1975; Doney et al., 1981). Slen et al. (1963) and Torres-Hernandez and Hohenboken (1979) suggested that this added milk production is 18 to 41% more than the milk production of ewes with single lambs. Alexander and Davies (1959) reported that milk yield is mainly dependent on number of lambs reared and not on the number of lambs born. Slen et al. (1963) suggested that milk production for ewes rearing multiple lambs is limited by the ewes' capabilities, whereas milk production for ewes rearing a single lamb is limited by the lamb's consumption.

Dun and Grewal (1963) stated that multiple-raised lambs have a postnatal handicap, since they don't receive as much milk as a single-raised lamb. Therefore, multiple-raised lambs will gain slower from birth to weaning and weigh less at weaning time (Guyer and Dyer, 1954; Cassard and Weir, 1956; Shelton and Campbell, 1962; Slen et al., 1963; Hohenboken et al., 1976b; Mavrogenis and Louca, 1979; Bhat et al., 1981). According to numerous reports, lambs born and raised as singles will weigh 4.0 to 7.7 kg more at weaning than multiple-born and raised lambs (Hazel and Terrill, 1945, 1946a; Sidwell and Grandstaff, 1949; deBaca et al., 1956; Ch'ang and Rae, 1970; Dickerson and Laster, 1975; Gould and Whiteman, 1975; Bush and Lewis, 1977). Some researchers report the type of birth effect and the type of rearing effect on weaning weight only as a type of birth effect (Terrill et al., 1947; Sidwell et al., 1964; Singh et al., 1967; Vesely et al., 1970; El Kouni et al., 1974; Hohenboken et al., 1976a; Rastogi et al., 1982). Other investigators report these effects separately (Blackwell and Henderson, 1955; Harrington et al., 1958; Vesely and Peters, 1964; Lambe et al., 1965; El Tawil et al., 1970; Sidwell and Miller, 1971b), while other researchers consider the type of rearing effect to be much greater on weaning weight than the type of birth effect (Warwick and Cartwright, 1957; Vesely et al., 1966; Vesely and Peters, 1972). Bennet et al. (1963) observed that lambs born and raised as singles were 6.2 kg heavier than lambs born and raised as twins, while lambs born as twins and raised as singles were 2.7 kg heavier than twin-born and raised lambs. Smith and Lidvall (1964) and Bush and Lewis (1977) pointed out that single-born and raised lambs not only are heavier at birth but also have higher preweaning gains and therefore are heavier at weaning time. Type of ewe birth has been reported to affect lamb weaning weight, with the single-born ewes weaning heavier lambs (McCall and Hight, 1981).

Sex of lamb has been well documented to affect weaning weight (Blackwell and Henderson, 1955; Cassard and Weir, 1956; Warwick and Cartwright, 1957; Bennet et al., 1963; Sidwell et al., 1964; Vesely et al., 1966, 1970; Singh et al., 1967; Sidwell and Miller, 1971b; Vesely and Peters, 1972; El Kouni et al., 1974; Hohenboken et al., 1976a) with ram lambs being heavier at weaning time (Harrington et al., 1958; Wiener and Hayter, 1975; Rastogi et al., 1982). Ram lambs have been reported to be .6 to 4.9 kg heavier than ewe lambs at weaning time (Hazel and Terrill, 1945, 1946a; Sidwell and Grandstaff, 1949; Bush and Lewis, 1977; Levine and Hohenboken, 1978). Numerous researchers account the higher weaning weights for male lambs to their higher birth weights and faster preweaning gains (Guyer and Dyer, 1954; Shelton and Campbell, 1962; Smith and Lidvall, 1964; Baharin and Beilharz, 1977; Bush and Lewis, 1977; Mavrogenis and Louca, 1979; Bhat et al., 1981).

According to many researchers, the age of the ewe has a significant effect on the lamb's weaning weight (Terrill et al., 1947; Blackwell and Henderson, 1955; Bennet et al., 1963; Sidwell et al., 1964; Lambe et al., 1965; Singh et al., 1967; El Tawil et al., 1970; Vesely et al., 1970; Sidwell and Miller, 1971b; El Kouni et al., 1974; Vesely and Peters, 1974, 1979; Dickerson and Laster, 1975; Hohenboken et al., 1976a; Matthews et al., 1977; McCall and Hight, 1981). Numerous investigators reported that ewes will wean the most kilograms of lamb per year when they are 3 to 5 yr old (Sidwell and Grandstaff, 1949; Vesely and Peters, 1964, 1972; Vesely et al., 1966; Lax and Brown, 1967; Lasley, 1972; Hohenboken, 1976b; Mavrogenis and Louca, 1979), while others state that this high level of production is maintained until 7 yr of age (Hazel and Terrill, 1945; Shelton and Campbell, 1962; Olson et al., 1978). However, Bhat et al. (1981)

indicated that the age of dam effect on weaning weight was not significant for Awassi lambs. Dickerson and Laster (1975) and Doney et al. (1981) claimed that of all the factors analyzed, age of dam had the largest influence on weaning weight. Starke (1953) stated that a ewe's milk production will peak at 3 to 5 yr of age and accounted for the high level of lamb production, which occurred at the same time, to the milk production.

Size of ewe also is considered to affect lamb weaning weight. Thrift and Whiteman (1969a) contended that the dam's body size affects the rate of gain of the lamb to 70 d of age. Holtman and Bernard (1969) observed Suffolk ewes to wean more kilograms of lamb than the Cheviot ewes, which were smaller in size. Sidwell and Miller (1971b) and Levine and Hohenboken (1978) reported that Suffolk ewes which weighed 13.8 kg more than the Columbia ewes weaned lambs that averaged 3.2 kg more than lambs from Columbia ewes. Lasley (1972) reported that mature ewes tend to wean 12.6% heavier lambs than immature ewes. Larger ewes have been positively correlated to higher milk yields (Starke, 1953). However, the effect of size of ewe and milk production on lamb weaning weight are confounded with the breed of ewe.

According to numerous studies, year of lamb birth has a very significant effect on lamb weaning weight (Terrill et al., 1947; Sidwell and Grandstaff, 1949; Blackwell and Henderson, 1955; Warwick and Cartwright, 1957; Bennet et al., 1963; Sidwell et al., 1964; Vesely and Peters, 1964; Lambe et al., 1965; Vesely et al., 1966, 1970; Singh et al., 1967; Ch'ang and Rae, 1970; El Tawil et al., 1970; Bradley et al., 1982). This effect can be attributed to the variation in the weather and nutrition from year to year.

Postweaning Growth

Postweaning growth is measured by yearling weight and weight at 2 yr of age. Ewes that have heavier yearling weights tend to produce more lambs and wool in their lifetime (Kincaid, 1943; Reeve and Robertson, 1953; Guyer and Dyer, 1954; Nichols and Whiteman, 1966; Jordan et al., 1970; Suiter and Fels, 1971; Drymundsson, 1973). Several researchers stated that a higher lamb production from ewes that were heavier at a year of age can be attributed to the increased frequency of multiple births and not to higher lamb weaning weights (Kincaid, 1943; Reeve and Robertson, 1953; Suiter and Fels, 1971). Hulet et al. (1969) reported that ewes that were heavier at yearling time tended to show first estrus earlier than the lighter weight yearling ewes. Guyer and Dyer (1954) also observed larger yearling ewes to be more productive than smaller yearling ewes. This difference due to size decreased as the ewes advanced in age, due to the added strain of higher production on the larger ewes. Hight and Jury (1976) did not observe any relationship between size and weight of yearling ewes and subsequent production.

Yearling and subsequent weights are affected by many factors such as breed, type of birth and rearing, age of dam, year of birth, birth weight, postweaning gain, and age of first breeding (Terrill et al., 1947; Nichols and Whiteman, 1966; Singh et al., 1967; El Tawil et al., 1970; Vesely and Peters, 1972; El Kouni et al., 1974; Bhat et al., 1981). Breed of the ewe has been reported to have a definite effect on the ewe's mature size (Terrill et al., 1947; Cassard and Weir, 1956; Singh et al., 1967; El Tawil et al., 1970; Vesely and Peters, 1972, 1979; Dickerson and Laster, 1975). Suffolk ewes have been reported to excel over Targhee ewes in mature weight (Dickerson and Glimp, 1975), weight at puberty (Laster et al., 1972), and postweaning average daily gain (Sidwell and Miller, 1971b). However, Rastogi et al. (1982) observed Targhee ewes to have higher postweaning gains than Suffolk and Columbia ewes. This higher level of gain for the Targhee ewes was explained as compensatory gain, since the Targhee ewes were the lowest in weaning weights. Suffolk ewes have also been reported to have better growth traits than Columbia ewes (Blackburn et al., 1981) and to be heavier at mature weight than Cheviot, Columbia, and Romnlet ewes (Vesely and Peters, 1972). Wilson et al. (1970) observed Southdown lambs to have higher preweaning gains and Hampshire lambs to have higher postweaning gains. The Southdown's higher preweaning gains were attributed to the higher milk production of the Southdown ewes. Therefore, the Hampshire's higher postweaning gains were assumed to be compensatory gains. The maternal influence, which includes milk production, on lamb's growth is quite large up to weaning time. Thereafter, this influence fades rapidly (Hunter, 1956; Dun and Grewal, 1963).

Crossbred ewes have been found to be 4.5 to 12.6% heavier at mature size than straightbred ewes (Price et al., 1953, Fox et al., 1964; Singh et al., 1967; Holtman and Bernard, 1969; Lasley, 1972).

Crossbred ewes have also been shown to have 6 to 8% higher postweaning gains than straightbred ewes (Vesely and Peters, 1972, 1979; Rastogi et al., 1982). Lasley (1972) and Vesely and Peters (1979) indicated that crossbred lambs that are more than a two-breed cross have higher mature weights and higher postweaning gains. Vesely and Peters (1972) observed three-breed crossbred lambs to have 10% higher postweaning gains than the two-breed crossbred lambs. These authors explained these higher gains by maternal heterosis, which was only found with the dams of the three-breed crossbred lambs. Lloyd et al. (1980) observed Suffolk x Targhee lambs to have faster postweaning gains than Targhee lambs. Leymaster and Smith (1981) reported that Suffolk crossbred lambs excelled in growth traits over Columbia crossbred lambs.

Heterosis is not evident in all crosses, especially in a two-breed cross (Bradford et al., 1963; Holtman and Bernard, 1969). Mature body weight has been reported to be 40% heritable (Terrill and Hazel, 1943; Scott, 1977)and postweaning gain was reported to be 60% heritable (Mavrogenis et al., 1980). Lasley (1972) concluded that postweaning gain is a highly heritable trait and therefore will be very slightly affected by heterosis.

Postweaning gains are generally higher for multiple-born and raised lambs because they have lower weaning weights and equivalent genetic potential (Cassard and Weir, 1956; Dun and Grewal, 1963; Olson et al., 1978). Dickerson and Laster (1975) agreed with this statement by reporting that multiple-born and raised lambs are 4 to 5 kg lighter at weaning time and only 3 kg lighter at a year of age than single-born at weaning time and only 3 kg lighter at a year of age than single-born and raised lambs. The effect of type of birth and rearing on lamb weight decreases after weaning time (Terrill et al., 1947; Harrington et al., 1958; El Kouni et al., 1974). Many investigators stated that single-born lambs are 1.7 to 3.0 kg heavier at a year of age (Terrill et al., 1948; Price et al., 1953; El Tawil et al., 1970; Burfening et al., 1971; Fogarty, 1972; Elliot et al., 1978). However, Ch'ang and Rae (1970) and McCall and Hight (1981) reported that multiple-born lambs which were 4.1 kg lighter than single-born lambs at weaning time had equivalent yearling weights. Several other researchers observed single-born lambs to have heavier mature body weights (Hazel and Terrill, 1946b; Lax and Brown, 1967; Vesely and Peters, 1972; Bhat et al., 1981). Dun and Grewal (1963) concluded that type of birth effect on lamb weight was not evident after 18 mo of age.

Age of dam has been reported to affect yearling weight (Terrill et al., 1947; El Tawil et al., 1970; Vesely and Peters, 1972). Price et al. (1953) observed lambs from mature ewes to be 1.4 kg heavier at a year of age than lambs from 2- and 7-yr-old ewes. Olson et al. (1978) reported that lambs from 2- and 7-yr-old ewes have higher postweaning gains than lambs from mature ewes. Olson et al. (1978) suggested that this higher postweaning gain can be explained as compensatory gain since weaning weights of the lambs from 2- and 7-yr-old ewes were lower than their contemporaries. However, El Kouni et al. (1974) reported that the age of dam effect on lamb weight declined after weaning time and was not evident at a year of age. Dickerson and Laster (1975) concluded that the effect of age of dam on lamb weight was insignificant at puberty.

Many researchers have stated that year of lamb birth affects yearling weight (Terrill et al., 1947; El Tawil et al., 1970; El Kouni et al., 1974) and mature body weight (Terrill et al., 1948). Terrill et al. (1947) concluded that year of lamb birth was the largest factor that influenced yearling weight. Birth weight has also been shown to affect yearling weight (El Tawil et al., 1970). Harrington et al. (1958) claimed that birth weight accounted for 34 to 44% of the total variation in mature weight.

Postweaning nutrition levels have been indicated to affect postweaning gain and yearling weights, with the higher postweaning nutrition groups having higher postweaning gains (Jordan et al., 1970; Burfening et al., 1971; Quirke, 1979) and higher yearling weights (Bradford et al., 1961; Burfening et al., 1971). Burfening et al. (1971) supported this statement by reporting that the high postweaning nutrition group gained 10.5 kg more from weaning time to a year of age and maintained this added weight to 18 mo of age. The high postweaning nutrition groups have been observed to be heavier at puberty (Quirke, 1979), reach puberty at an earlier age (Younis et al., 1978; Quirke, 1979), and produce more wool and lamb as yearlings (Jordan et al., 1970). This increased lamb production may be explained by a higher ovulation rate found with lambs that were fed the higher postweaning nutrition level (El Sheikh et al., 1955). Foote et al. (1959) reported that the prepubertal nutrition level had a larger effect on the number of ova shed than did prebreeding weight. However, Burfening et al. (1972) reported that the level of postweaning nutrition had no effect on any subsequent production. Nichols and Whiteman (1966) stated that postweaning gains and weaning weights had an effect on mature body weight.

Age of first breeding also affects postweaning growth. When a ewe is bred at 7 mo of age, there is an added strain on the ewe's postweaning growth. This pregnancy puts a short-term check on growth but is overcome by the weaning of the second lamb (Briggs, 1936; Drymundsson, 1973; Tyrrell, 1976). Therefore, the postweaning gain is just delayed.

<u>Age of First Breeding</u>

Shelton and Klindt (1976) reported that increasing a ewe's reproductive rate is one of the best methods to increase her lifetime efficiency of lamb production. Dyrmundsson (1973) defined puberty as the first time that a ewe lamb is capable of reproduction. He also concluded that, if a ewe lamb reaches puberty at 7 to 8 mo of age and conceives, she will increase her lifetime production capabilities. Breeding ewes to lamb at 12 mo of age has been shown to suppress postweaning growth (Bowstead, 1930; Ensminger, 1970) but has no effect on the ewe's mature weight (Briggs, 1936; Dyrmundsson, 1973). Tyrrell (1976) observed ewes that displayed estrus at 7 to 8 mo of age to be heavier at weaning time than ewes that did not display estrus until they were older. Hight and Jury (1976) reported that ewes that exhibited estrus their first fall have heavier yearling weights than those that exhibited their first estrus later. Ponzoni et al. (1979) stated that ewes that don't display estrus by 8 mo of age have lower reproductive performances and are lighter in weight at prebreeding time. Ewes that reach puberty early tend to have more teeth problems than ewes that reach puberty after 8 mo of age (Briggs, 1936). Dyrmundsson (1973) attributed the teeth problem to delayed eruption of the first two incisor teeth, which occurs more frequently in ewes that reach puberty early. Levine et al. (1978) observed Columbia ewes that conceived at 7 mo of age to live longer than Columbia ewes that could not conceive at 7 mo of age.

The first lamb crop from ewes bred to lamb at a year of age tend to be lighter in birth weight (Ensminger, 1970; Dyrmundsson, 1973), cause more lambing problems (Ensminger, 1970), and have a higher mortality rate (Dyrmundsson, 1973) than the first lamb crop from ewes bred to lamb first at 2 yr of age. Dyrmundsson (1973) suggested that the lower birth weights for lambs born to 12-mo-old ewes may be explained by a shorter gestation period found in these young ewes. Bowstead (1930) revealed that lambs born to 12-mo-old ewes had lower fertility than lambs born to older ewes. This author also reported that 2-yr-old and older ewes that had a lamb at 12 mo of age had heavier and stronger lambs than lambs from equivalent aged ewes that did not lamb at 12 mo of age. He attributed the heavier weights and more strength to the increased mammary development with the ewes that had lambs at 12 mo of age. Dyrmundsson (1973) and McCall and Hight (1981) observed a very low rate of multiple births (3.7%) with

12-mo-old ewes. Dyrmundsson (1973) explained this low rate of multiple births by the shortened breeding season, since most ewe lambs haven't reached puberty at the onset of the breeding season. Scott (1977) went on to state that matings from the first half of the breeding season tend to produce the majority of the multiple births. Hohenboken et al. (1977) found a lowered conception rate with the breeding of 7-mo-old ewes. This can be somewhat accounted for by the ewe lambs' shortened breeding season.

Burfening et al. (1972) reported that ewes bred as lambs at 24 mo of age gave birth to .17 more lambs and weaned 5.5 kg more lamb per ewe bred than ewes bred to first lamb as 2-yr-olds. Hohenboken et al. (1977) and McCall and Hight (1981) also reported that ewes that lambed at 12 mo of age were more productive at 24 mo of age than ewes that didn't lamb until 24 mo of age. However, Hohenboken et al. (1977) did state that this increased lamb production was not significantly higher. McCall and Hight (1981) claimed that the higher lamb production was indicative of higher fertility in the lamb-bred ewes. Briggs (1936) reported that ewes that displayed estrus their first fall produced .6% more lambs and weaned 14.04 more kg of lamb at 24 and 36 mo of age than equivalent aged ewes that did not exhibit estrus until their first winter and thereafter. In a 6-yr study, Burfening et al. (1972) concluded that lamb-bred ewes gave birth to 7.1 lambs and weaned 216 kg of lamb per ewe bred, whereas the yearling bred ewes only gave birth to 6.3 lambs and weaned 144 kg of lamb per ewe bred. In a 8-yr study, the lamb-bred ewes gave birth to .68 more lamb and weaned

13.9 kg more lamb per ewe bred than yearling-bred ewes (Spencer et al., 1942).

Many researchers have stated that lamb-bred ewes have higher lifetime production than yearling-bred ewes (Hulet et al., 1969; Ensminger, 1970; Southham et al., 1971; Hohenboken et al., 1977; Scott, 1977; Ponzoni et al., 1979). Hulet et al. (1969) and Laster et al. (1972) stated that ewes that exhibit estrus at 7 to 8 mo of age have higher lifetime production than ewes that don't exhibit estrus by 8 mo, even if they aren't bred until 20 mo of age. Ponzoni et al. (1979) suggested that breeding ewes to lamb at 12 mo of age may enhance subsequent fertility. Dyrmundsson (1973) stated that the capability of lambing at a year of age may indicate a high level of fertility. Ch'ang and Rae (1970) and Dyrmundsson (1973) stated that age of puberty is positively correlated to subsequent lamb production.

Dyrmundsson (1973) observed lamb bred ewes to have lower wool production than yearling bred ewes. Briggs (1936) and Ensminger (1970) claimed that breeding ewes to lamb at 12 mo of age had no effect on accumulative wool production. However, Hohenboken et al. (1977) observed lower accumulative wool production for lamb bred ewes than yearling bred ewes. McCall and Hight (1981) summarized the advantages of breeding ewes to lamb at 12 mo of age as early recognition of fertility as a selection tool, more rapid genetic turnover and genetic gain, and an increase in lamb production.

Age of puberty is affected by many factors such as age of dam, breed of ewe, postweaning nutrition level, postweaning body weight, type of ewe birth, and year of birth (Hulet et al., 1969; Burfening et al., 1971; Southham et al., 1971; Laster et al., 1972; Dickerson and Laster, 1975; Scott, 1977). Several investigators reported that age of dam affects their offspring's age of puberty (Hulet et al., 1969; Southham et al., 1971; Wright et al., 1975; McCall and Hight, 1981). Hulet et al. (1969) and Southham et al. (1971) stated that 2- and 7-yr-old ewes produce lambs that have lower weaning weights and reach puberty at a later age than lambs from 3- to 6-yr-old ewes. Glimp (1971) and Dickerson and Laster (1975) observed age of dam to have no effect on age of first estrus.

Breed has been shown to affect age of puberty in the ewe lamb (Hulet et al., 1969; Southham et al., 1971; Dyrmundsson, 1973; Dickerson and Laster, 1975; Scott, 1977). Laster et al. (1972) and Dickerson and Glimp (1975) observed Suffolk ewe lambs to reach puberty at a younger age than Targhee ewe lambs. Laster et al. (1972) also found Suffolk ewe lambs to be heavier at 8 mo of age than Targhee ewe lambs and concluded that body weight affected age of puberty. Levine et al. (1978) reported that a higher percentage of Columbia ewes were more fertile their first fall than Targhee ewe lambs. Cedillo et al. (1977) stated that Suffolk ewe lambs had a greater tendency to exhibit estrus by 8 mo of age than Columbia ewe lambs. However, this difference was insignificant. Crossbred lambs have been shown to reach puberty at an earlier age than straightbred lambs (Dyrmundsson, 1973). Hight and Jury (1976) only found crossbred lambs from their first and third crosses to reach puberty earlier than straightbred lambs.

Sidwell and Miller (1971b) stated that heterosis was not evident in every cross.

Southham et al. (1971) reported that the postweaning nutrition level affects age of puberty. He observed 88% conception in the higher energy level group, whereas the low energy level group only had 17% conception. Burfening et al. (1971) observed the same effects but with only a difference of 5.4%. Similarly, Younis et al. (1978) and Quirke (1979) reported that their higher nutrition level group reached puberty at a younger age than their low level group. Dyrmundsson (1973) and Gunn and Doney (1975) stated that ewe lambs in poor condition will exhibit their first estrus later than they would if they had adequate nutrition. Evans et al. (1975) reported that accelerated fed ewe lambs that were exposed to a ram at 8 mo of age were much more productive in their lifetime than normal fed ewe lambs that were exposed at 20 mo of age. Body weight of a ewe lamb is said to have a direct effect on age of first estrus (Burfening et al., 1971; Southham et al., 1971; Laster et al., 1972; Scott, 1977; Younis et al., 1978). Hulet et al. (1969) stated that body weight is a very large function of age of puberty. Age of first breeding has been found to be positively correlated to weaning weight (Barlow and Hodges, 1976), premating weight (Ponzoni et al., 1979), and mature weight (Bowstead, 1930). McCall and Hight (1981) observed ewe lambs that reach puberty their first fall have the highest yearling weights of the flock.

Percentage conception of ewe lambs exposed at 7 to 8 mo of age ranges from 12 to 88% (Bowstead, 1930; Briggs, 1936; Hulet et al., 1969; Burfening et al., 1971; Southham et al., 1971; Dickerson and Glimp, 1975; Tyrrell, 1976; Cedillo et al., 1977; Levine et al., 1978; McCall and Hight, 1981). Dyrmundsson (1973) stated that the lower than average conception rate was affected by the percentage of ewe lambs that reached puberty that fall as well as the shortened breeding season that was found with the ewe lambs reaching puberty late. The large variation in conception rates for ewe lambs can also be attributed to postweaning nutrition (Southham et al., 1971), size and weight of ewe lamb (Hulet et al., 1969), and breed of ewe lamb (Levine et al., 1978).

Dyrmundsson (1973) and Dickerson and Laster (1975) reported that multiple-born lambs reach puberty at an older age because they are smaller in size and weight than single-born lambs. Gould and Whiteman (1974) observed twin-born lambs to be more productive in their lifetime than single-born lambs when all of the lambs were exposed to a ram at 8 mo of age. Year of lamb birth has been proven to have a definite effect on age of puberty (Hulet et al., 1969; Southham et al., 1971; Laster et al., 1972; Cedillo et al., 1977). Dyrmundsson (1973) reported that birth date has a very large effect on age of first estrus, since sheep are seasonal breeders.

Lamb Production

Lamb production is a major concern in the sheep industry since most of the income that is acquired is from the lambs produced. Humes et al. (1978) reported that poor reproductive rates and high preweaning mortality were two obstacles that limit profitability in sheep production. Lamb production from 2-yr-old ewes was found to be positively correlated with the ewe's subsequent lamb production (Hulet et al., 1969). Terrill and Stoehr (1942) and Pajl (1978) observed larger ewes to have greater lamb production than smaller ewes. Crossbred ewes were reported to be 9 to 23% better than purebred ewes in reproductive performance (Fox et al., 1964; Dyrmundsson, 1973; Vesely and Peters, 1974). Miller and Dailey (1951) and Sidwell and Miller (1971b) were more specific by stating that crossbred ewes were more productive in producing lambs than purebred ewes. Bradley et al. (1972) stated that heterosis for reproductive performance is quite low. However, Scott (1977) reported that heterosis for reproductive performance was high enough to consider in a crossbreeding program.

Vesely and Peters (1974) reported that crossbred ewes have a higher percentage conception rate than purebred ewes, even though both groups were mated a similar number of times. Sidwell et al. (1962) and Vesely and Peters (1974) reported that, when a purebred ram was bred to a purebred ewe of a different breed, then a lower than average conception rate was observed. They attributed this to a lowered compatability that was found between the egg and sperm of the two different breeds.

Lamberson and Thomas (1982) found Finnsheep ewes to have a shorter anestrous period and gave birth to more lambs than Cheviot, Dorset, Romney, and Suffolk ewes. Thrift and Dutt (1976) reported that Suffolk ewes came out of anestrus 10 d earlier than Columbia ewes. Glimp (1971) observed Targhee ewes to display estrus earlier in the breeding season than Suffolk ewes. However, Oltenacu and Boylan

(1981a) observed Suffolk ewes to display estrus earlier in the breeding season and give birth to more lambs than Targhee ewes. It has been suggested that most multiple births come from matings that occur early in the breeding season (Reeve and Robertson, 1953; Scott, 1977). Reeve and Robertson (1953) suggested that this may be attributed to the fact that the best ewes exhibit estrus earlier in the breeding season and the pasture is usually in its best nutritional state at the onset of the breeding season. Therefore, a flushing effect was observed. Flushing causes an increase in ovulation rate (Foote et al., 1959; Slyter, 1968; Dyrmundsson, 1973; Gunn and Doney, 1975) and also increases the number of lambs born per ewe (Slyter, 1968).

Ovulation rate, fertility, and embryonic mortality increased in ewe lambs fed a high postweaning level (El Sheikh et al., 1955). This author also stated that flushing was most beneficial with thin ewes. Flushing and body condition of a ewe are negatively correlated to embryonic survival (Gunn and Doney, 1975), while body size and weight are positively correlated to ovulation rate (Foote et al., 1959; Gunn and Doney, 1975). Dyrmundsson (1973) reported that crossbred ewes have a higher ovulation rate than purebred ewes. Lamberson and Thomas (1982) observed Finnsheep ewes to have a higher ovulation rate than Cheviot, Dorset, Romney, and Suffolk ewes. Hight and Jury (1976) stated that a young ewe's ovulation rate is indicative of her subsequent ovulation rates but not of her subsequent fertility.

Sidwell and Miller (1971) reported that fertility (percentage ewes lambing of those bred), prolificacy (number of lambs born per ewe lambing), livability (percentage lambs weaned of those born), and weight of lambs weaned are all methods of measuring lamb production. Numerous investigators reported fertility to range from 71 to 93.5% (Laster et al., 1972; Hohenboken et al., 1976a; Levine and Hohenboken, 1978; Pajl, 1978; Clarke and Hohenboken, 1983). However, Fox et al. (1964) observed fertility rates as low as 58.5%.

Fertility has been reported to be affected by breed, age of ewe, type of ewe birth, size of ewe, year of production, nutrition, and environment (Botkin and Paules, 1965; Sidwell et al., 1962; Purser and Young, 1964; Lamond et al., 1973; Dickerson and Glimp, 1975; Barlow and Hodges, 1976; Baharin and Beilharz, 1977; Vesely and Peters, 1981). Several researchers suggested that fertility was affected by breed of ewe (Sidwell et al., 1962; Laster et al., 1972; Dickerson and Glimp, 1975; Vesely and Peters, 1981). Vesely et al. (1966) and Cedillo et al. (1977) found Targhee ewes to be more fertile than Suffolk ewes. Glimp (1971) and Bradley et al. (1972) reported similar results with the differences in fertility between these two breeds of 4.5 and 7.0%, respectively. Clarke and Hohenboken (1983) reported Columbia ewes to have 96% fertility, while Suffolk ewes had 93% fertility. However, it has been stated that breed of ewe has no effect on fertility (Wiener and Hayter, 1975; Levine and Hohenboken, 1978).

Crossbred ewes have been shown to have higher fertility than straightbred ewes (Sidwell et al., 1962; Sidwell and Miller, 1971a; Lasley, 1972; Scott, 1977; Vesely and Peters, 1981). Vesely and Peters (1974) reported that the percentage of ewes mating was equivalent for crossbred and straightbred ewes, but the percentage conception was higher for crossbred ewes. Fox et al. (1964) found crossbred ewes to be 7.0% more fertile than purebred ewes. Matthews et al. (1977) observed Suffolk x Targhee ewes to be more fertile than Targhee ewes. However, Bradley et al. (1972) reported that 98% of the Targhee ewes were fertile, while 96% of the Suffolk x Targhee ewes were fertile. McGuirk et al. (1978) found fertility in crossbred ewes to be slightly higher than fertility in purebred ewes. Investigators have stated that fertility is 7 to 13% heritable (Purser and Young, 1964; Lasley, 1972) and is highly affected by heterosis (Lasley, 1972). Others have reported that fertility is hardly affected by heterosis (Hohenboken et al., 1976a; Hohenboken and Cochran, 1976).

Age of ewe has been proven to affect fertility (Sidwell et al., 1962; Vesely et al., 1965; McCall and Hight, 1981; Vesely and Peters, 1981), with 3- through 6-yr-old ewes having the highest fertility (Karam, 1957; Vesely and Peters, 1974). Vesely and Peters (1974) also stated that the effect of age of ewe on fertility was greater than any other factor. Dickerson and Glimp (1975) reported fertility for 1-, 5-, and 7-yr-old ewes to be 60, 90, and 70%, respectively. Type of ewe birth also has an effect on fertility (McCall and Hight, 1981), with twins being more fertile than single-born ewes (Mullaney and Brown, 1969). Purser and Young (1964) reported twin-born ewes to be more fertile their first and subsequent lambings. Reeve and Robertson (1953) reported that twin ewes declined in fertility after 6 yr of age. Baharin and Beilharz (1977) observed twin-born ewes to be less fertile their first lambing and then increase in fertility rapidly. However, twin-born ewes would decline in fertility earlier in breeding life than single-born ewes.

Barlow and Hodges (1976) found that ewes with above average weaning weights would also be above average in fertility. Year of production also has been shown to affect fertility (Sidwell et al., 1962; Vesely et al., 1965; Vesely and Peters, 1974, 1981; Dickerson and Glimp, 1975; Wright et al., 1975). Fertility can be reduced by having a ewe in an over or under nutritional condition (Lamond et al., 1973). Environment can also play a role in fertility as seen by Bradford et al. (1961), with range-reared ewes more fertile than the farm-reared ewes fed a supplemental feed.

Prolificacy, number of lambs born per ewe lambing, ranges from 100 to 164% for domestic breeds (Karam, 1957; Dickerson and Glimp, 1975; Hohenboken et al., 1976a; Pajl, 1978). The number of lambs born can also be based on per ewe exposed, and this ranges from 93 to 142% (Laster et al., 1972; Pajl, 1978). The variations in proficiency can be attributed to the effects of breed, age, size, and type of birth of ewe, year of production, environment, and nutrition (Sidwell et al., 1962; Fahmy and Bernard, 1973).

The breed of a ewe has been reported to affect her prolificacy (Reeve and Robertson, 1953; Sidwell et al., 1962; Vakil et al., 1968; Wiener and Hayter, 1975; Matthews et al., 1977). Suffolk ewes have been observed to be more prolific than Targhee ewes (Vesely et al., 1966; Glimp, 1971; Bradley et al., 1972; Laster et al., 1972; Dickerson and Glimp, 1975; Oltenacu and Boylan, 1981a). Levine and Hohenboken (1978) observed Suffolk ewes gave birth to .08 more lamb per ewe exposed than Columbia ewes. Clarke and Hohenboken (1983) observed Columbia ewes gave birth to .12 more lamb per ewe lambing than Suffolk ewes. When Dorset, Suffolk, and Targhee ewes were compared in prolificacy, Dickerson and Glimp (1975) found the Suffolk ewes to be the most prolific during the first 5 yr of their life and the Dorset ewes were the most prolific during the last 5 yr of their life. Levine et al. (1978) observed Targhee ewes to be more prolific than Columbia ewes. Reeve and Robertson (1953) concluded that the late maturing breeds tend to have more multiple births. Vesley et al. (1965) reported that breed of ewe doesn't affect the ewe's prolificacy.

Crossbred ewes generally give birth to more lambs per ewe than purebred ewes (Botkin and Paules, 1965; Parker, 1971a,b; Sidwell and Miller, 1971a; Scott, 1977; Vesely and Peters, 1981), with the exception of a two-breed crossbred ewe (Vesely and Peters, 1974). This was explained by the low compatability of the egg and sperm from two purebred animals of different breeds (Vesely and Peters, 1974). Crossbred ewes have been said to give birth to 3 to 9% more lambs (Miller and Dailey, 1951; Fox et al., 1964; McGuirk et al., 1978). Suffolk x Targhee ewes were found to be more prolific than Targhee ewes (Sidwell and Miller, 1971a; Matthews et al., 1977). Matthews et al. (1977) reported the twinning rate for Targhee and Suffolk x Targhee ewes to be 41.8 and 58.9%, respectively. Gorman et al. (1942) stated that crossbred ewes are less prolific than straightbred ewes. Bradley et al. (1972) observed Targhee ewes to be 10.4% more prolific than Suffolk x Targhee ewes. Sidwell (1956) found purebred Navajo ewes to have a higher twinning rate than crossbred Navajo ewes. Heterosis for prolificacy has been reported to be from 1.3 to 10.0% (Hohenboken et al., 1976a; Hohenboken and Cochran, 1976). Heritability for prolificacy and multiple birth was reported to be 20% (Kennedy, 1967) and 15 to 21% (Vakil et al., 1968; Fahmy and Bernard, 1973; Scott, 1977), respectively.

Age of ewe affects the number of lambs born per ewe (Sidwell et al., 1962; Vesely et al., 1965; Lax and Brown, 1968; Vakil et al., 1968; Basuthakur et al., 1973; Hohenboken et al., 1976a; Thrift and Dutt, 1976; Matthews et al., 1977). Vesley and Peters (1974) stated that age of ewe has the largest effect on prolificacy of any of the factors observed. Prolificacy increases as age of ewe advances to 6 yr of age (Parker, 1971b; Dyrmundsson, 1973; Wright et al., 1975; Pajl, 1978). Glimp (1971) stated that 3- to 6-yr-old ewes were the most prolific. Dickerson and Glimp (1975) reported prolificacy levels for 1-, 6-, and 9-yr-old ewes to be 100, 160, and 135%, respectively. Older ewes have been observed to produce more multiple births than younger ewes (Bowstead, 1930; Reeve and Robertson, 1953; Scott, 1977). Mullaney and Brown (1969) suggested that 2-yr-old ewes were the most prolific and as the ewe's age increased her prolificacy decreased.

The size of ewe has been shown to affect number of lambs born per ewe (Reeve and Robertson, 1953; Fahmy and Bernard, 1973), with the larger ewes giving birth to more lambs (Suiter and Fels, 1971;

Dyrmundsson, 1973). Suiter and Fels (1971) went on to say that, with each 4.5-kg increase in mature body weight, there was a 2.9 to 6.4% increase in number of lambs born. Yearling weight has been positively correlated to number of lambs born (Nichols and Whiteman, 1966) and to potential for multiple births (Scott, 1977). Ewe type of birth affects ewe prolificacy, with twin-born ewes giving birth to more lambs than single-born ewes (Karam, 1957; Lax and Brown, 1968; Vakil et al., 1968; Fahmy and Bernard, 1973). Thrift and Dutt (1976) observed single-born ewes gave birth to more lambs per ewe than multiple-born ewes but acknowledged that this number of lambs was insignificant and the reverse of most recommendations and studies. Dzakuma et al. (1982) reported that the number of lambs born to a ewe in her first year of production was indicative of her subsequent prolificacy.

Year of production has a definite effect on prolificacy (Karam, 1957; Sidwell et al., 1962; Vesely et al., 1965; Vakil et al., 1968; Wright et al., 1975; Thrift and Dutt, 1976). Hohenboken and Clarke (1981) reported that Columbia ewes were more prolific on hill pastures but less prolific on irrigated pastures than Suffolk ewes. Range ewes have been shown to give birth to more lambs per ewe than farm flock ewes (Bradford et al., 1961). Ewes that are mated during the early part of the breeding season tend to give birth to more lambs. This has been attributed to the best ewes displaying estrus earlier in the breeding season and the pasture is in its most nutritious state of the breeding season (Reeve and Robertson, 1953; Scott, 1977). Fahmy and Bernard (1973) stated that nutrition has an effect on prolificacy and

Slyter (1968) stated that flushing increased the number of lambs born per ewe.

Number of lambs weaned has a very large effect on the overall lamb production of a ewe. Survival of the lambs born determines the number of lambs weaned (Sidwell and Miller, 1971a). Lamb survival ranges from 76.8 to 93.0% (Bradley et al., 1972; Hohenboken et al., 1976a; McCall and Hight, 1981; Oltenacu and Boylan, 1981a). The variation in lamb survival is due to breed and age of ewe, year of production, nutrition, lamb birth weight, and lamb type of birth (Sidwell et al., 1962; Gould and Whiteman, 1974; Hight and Jury, 1976; Khalaf et al., 1979).

Breed of ewe has an effect on lamb survival (Sidwell et al., 1962). Lambs from Suffolk ewes have been observed to have a lower survival rate than lambs from Columbia ewes (Leymaster and Smith, 1981) and Targhee ewes (Dickerson and Glimp, 1975). Oltenacu and Boylan (1981a) reported that Suffolk ewes gave birth to lambs that had a 76.8% survival rate, while lambs from Targhee ewes had a 85.2% survival rate. Vesely et al. (1966) observed lambs from Suffolk and Targhee ewes to have the same survival rate. It has been well documented that lambs from crossbred ewes have a higher survival rate than lambs from straightbred ewes (Sidwell et al., 1962; Parker, 1971a,b; Lasley, 1972; Scott, 1977; Vesely and Peters, 1981). McGuirk et al. (1978) reported that lambs reared by crossbred ewes have 10% higher survival rates than lambs reared by straightbred ewes. Dickerson and Laster (1975) observed that lambs from Suffolk x Targhee ewes had a higher survival rate than lambs from Targhee ewes. However, Bradley et al. (1972) found Suffolk x Targhee and Targhee ewes had lamb survival rates of 81.7 and 90.9%, respectively. Hohenboken et al. (1976a) stated that heterosis for lamb survival was very low at 3.2%.

Age of ewe affects lamb survival (Sidwell et al., 1962; Vesely and Peters, 1981), with 4- to 5-yr-old ewes having the highest lamb survival rates (Mullaney and Brown, 1969). McCall and Hight (1981) reported that 12-mo-old ewes only had 77.6% lamb survival rates. On the contrary, Lax and Brown (1968) stated that age of ewe had no effect on lamb survival. Year of production also affects lamb survival (Sidwell et al., 1962; Vesely and Peters, 1971). Khalaf et al. (1979) reported that in the last 8 wk of gestation nutrition plays a vital role in lamb survival. Birth weight of lambs has been related to lamb survival, with the heavier lambs having higher survival rates (Guyer and Dyer, 1954; Hight and Jury, 1970). Type of lamb birth also has been correlated with lamb survival, with single-born lambs having the higher survival rate (Sidwell et al., 1962; Vesely and Peters, 1981).

Actual number of lambs weaned ranged from .85 to 1.60 lambs per ewe exposed (Bradley et al., 1972; Laster et al., 1972; Pajl, 1978; Clarke and Hohenboken, 1983). Pajl (1978) reported that 1.21 lambs were weaned per ewe lambing. Number of lambs weaned was not only affected by lamb survival but also by breed, age, size and type of birth of ewe, year of production, and environment (Vesely et al., 1965; Dyrmundsson, 1973; Thrift and Dutt, 1976; Hohenboken and Clarke, 1981). Targhee ewes were found to wean more lambs per ewe than Suffolk ewes

(Bradley et al., 1972; Laster et al., 1972; Dickerson and Glimp, 1975; Oltenacu and Boylan, 1981a), Columbia ewes (Bennet et al., 1963; Levine et al., 1978), and Rambouillet ewes (Bennet et al., 1963). Vesley et al. (1966) observed Suffolk ewes to wean more lambs per ewe than Targhee ewes. Clarke and Hohenboken (1983) reported that Columbia ewes weaned 1.32 lambs per ewe and Suffolk ewes weaned 1.20 lambs per ewe. Hohenboken and Clarke (1981) found that Columbia ewes weaned more lambs per ewe in hill pastures than Suffolk ewes and the reverse was true for irrigated pastures. Vesely et al. (1965) reported that breed of ewe has no effect on number of lambs weaned per ewe when comparing Cheviot, Columbia, Romnlet, Targhee, and Suffolk ewes. Crossbred ewes generally wean more lambs per ewe than straightbred ewes (Vesley and Peters, 1981). Miller and Dailey (1951) and Lasley (1972) reported that crossbred ewes weaned 15% more lambs per ewe than straightbred ewes. Bradley et al. (1972) reported the number of lambs weaned per ewe for Suffolk x Targhee and Targhee ewes to be 1.29 and 1.60, respectively. Heritability for number of lambs weaned per ewe ranges from .2 to 13.0% (Kennedy, 1967; Scott, 1977).

Age of ewe definitely affects number of lambs weaned per ewe (Vesely et al., 1965; Basuthakur et al., 1973; Thrift and Dutt, 1976). It has been reported that 4- to 7-yr-old ewes have the highest number of lambs weaned per ewe (Matthews et al., 1977), while the peak of number of lambs weaned per ewe is found in ewes 4 and 5 yr old (Lax and Brown, 1967). Wright et al. (1975) observed 2- and 3-yr-old ewes to have a low number of lambs weaned per ewe.

Nichols and Whiteman (1966), Dyrmundsson (1973) and Elliot et al. (1974) all suggested that yearling weight was positively correlated with number of lambs weaned per ewe. Gould and Whiteman (1974) reported that twin-born ewes were slightly higher (.8 lambs per ewe) in the number of lambs weaned per ewe in a lifetime than single-born ewes. Thrift and Dutt (1976) reported that single-born ewes weaned a nonsignificantly higher number of lambs per ewe than multiple-born ewes. Year of production also affects the number of lambs weaned per ewe (Vesely et al., 1965; Wright et al., 1975). Range ewes weaned more lambs per ewe than farm flock ewes (Bradford et al., 1961).

Weight of lambs weaned per ewe is more dependent on number of lambs weaned per ewe than weaning weight of the lambs. Weight of lambs weaned per ewe is the most accurate method of measuring lamb production since it is dependent upon number of lambs weaned per ewe, prolificacy, and fertility (Sidwell and Miller, 1971a). The variation in weight of lambs weaned per ewe is due to breed, age, type of birth and size of ewe, year of production, and type of lamb birth (Terrill and Stoehr, 1942; Gould and Whiteman, 1974; Dickerson and Laster, 1975; Thrift and Dutt, 1976).

Breed of ewe has been observed to affect the weight of lambs weaned per ewe. Suffolk lambs were found to have heavier weaning weights than Columbia (Leymaster and Smith, 1981) and Targhee lambs (Oltenacu and Boylan, 1981b). It has been reported that Suffolk ewes wean more kilograms of lamb per ewe than Targhee (Vesely et al., 1966), Cheviot (Holtman and Bernard, 1969) and Columbia ewes (Levine and Hohenboken, 1978). However, Clarke and Hohenboken (1983) reported that Suffolk ewes weaned 1.4 kg less lamb per ewe than Columbia ewes. Levine et al. (1978) observed Targhee ewes to wean more kilograms of lambs per ewe than Columbia ewes. Hohenboken and Clarke (1981) observed Columbia ewes to wean more kilograms of lamb per ewe than Suffolk ewes in hill pastures and the reverse was true for irrigated pastures.

Crossbred ewes were found to wean heavier lambs (Sidwell, 1956) and wean 4 to 9% more weight of lamb per ewe than purebred ewes (Miller and Dailey, 1951; Fox et al., 1964; Botkin and Paules, 1965; Wiener and Hayter, 1975). Matthews et al. (1977) observed Suffolk x Targhee ewes to wean 9.3 kg of lamb per ewe more than Targhee ewes. However, Sidwell and Miller (1971c) reported that Targhee ewes weaned 11.4 kg of lamb per ewe more than Suffolk x Targhee ewes. Heterosis for weight of lamb weaned per ewe was stated to be 14% by Hohenboken and Cochran (1976).

Age of ewe also affects the weight of lamb weaned per ewe. Two-yr-old ewes wean the lowest weight of lamb per ewe (Sidwell and Grandstaff, 1949) and mature ewes wean the highest weight of lamb per ewe (Terrill and Stoehr, 1942; Hazel and Terrill, 1945). Hohenboken et al. (1976) stated that the weight of lambs weaned per ewe increased with ewe age. Twin-born ewes weaned heavier lambs (Gould and Whiteman, 1974) and weaned .9 kg more lamb per ewe (Gould and Whiteman, 1975) than single-born ewes until 4 yr of age. Hohenboken et al. (1976a) reported single-born ewes to wean a nonsignificantly higher weight of lamb per ewe than twin-born ewes. Larger ewes have been shown to wean more kilograms of lamb per ewe than smaller ewes (Terrill and Stoehr, 1942). The more kilograms of lamb weaned were due to more lambs weaned per ewe and not lambs with higher weaning weights.

Dickerson and Laster (1975) and Pajl (1978) stated that type of lamb birth affects the weight of lamb weaned per ewe. Sidwell (1956) found that ewes with twin lambs weaned more kilograms of lamb per ewe than ewes with single lambs. Year of production also affects the weight of lamb weaned per ewe (Sidwell and Grandstaff, 1949; Sidwell and Miller, 1971c; Thrift and Dutt, 1976).

Wool Production

Wool production is another source of income in the sheep industry. Ray and Sidwell (1964) reported an average annual wool production of 3.2 kg for six crossbred breeds. Wool production in young ewes can be an excellent selection tool, since it is indicative of subsequent wool production (Hill, 1921; Jones et al., 1944). Several researchers reported that wool production is medium to highly heritable, with values ranging from 24 to 38% heritability (Terrill and Hazel, 1943; Shelton and Menzies, 1968; Vesely et al., 1970; Fahmy and Bernard, 1973; Scott, 1977). Wool production varies largely (Hill, 1921) and is influenced by breed, age and type of birth of ewe, type of birth of lamb, size of ewe, age of first breeding, nutrition, and year of production (Terrill et al., 1947; Burfening et al., 1971; Sidwell et al., 1971; Dyrmundsson, 1973; Fahmy and Bernard, 1973).

Breed of ewe has a very significant effect on wool production (Terrill et al., 1947; Price et al., 1953; Blackwell and Henderson, 1955; Bennet et al., 1963; Vesely et al., 1965; Sidwell et al., 1971; Fahmy and Bernard, 1973; Hohenboken, 1976). Targhee ewes have been reported to produce 1.6 to 3.3 kg of wool per year more than Suffolk ewes (Vesely et al., 1966; Ensminger, 1970; Sidwell and Miller, 1971c; Oltenacu and Boylan, 1981b). Columbia ewes were observed to produce 1.3 to 3.7 kg of wool more than Suffolk ewes (Ensminger, 1970; Cedillo et al., 1977; Levine and Hohenboken, 1978). Columbia ewes were also observed to produce more wool than Targhee ewes (Bennet et al., 1963; Hohenboken et al., 1977). Crossbred ewes have been reported to produce more wool (Gorman et al., 1942; Price et al., 1953; Sidwell et al., 1971; McGuirk et al., 1978), an intermediate amount of wool (Thrift and Whiteman, 1969b; Sidwell et al., 1971; Gunn and Doney, 1975), and less wool than the parent breeds (Botkin and Paules, 1965). However, Sidwell et al. (1971) stated that crossbred ewes generally produce more wool than purebred ewes. Scott (1977) reported that heterosis in wool production is very low.

Age of ewe has a definite effect on wool production. Wool production has been reported to increase from 1 yr of age to 3 yr of age (Lush and Jones, 1923; Oltenacu and Boylan, 1981b). A ewe's wool production usually peaks at 3.0 to 3.5 yr of age (Brown et al., 1966; Wright et al., 1975; Elliott et al., 1978) and then declines at 4% per year (Jones et al., 1944; Vesely et al., 1966; Ryder, 1982). Brown et al. (1966) stated that the increase in wool production to 3 yr of age is due to an increase in the number of fibers. Age of dam also affects a lamb's wool production at 12 mo of age (Terrill et al., 1947; Price et al., 1953; Bennet et al., 1963; McCall and Hight, 1981). Lambs from mature ewes tend to produce more wool than lambs from immature and old ewes (Terrill et al., 1947; Lax and Brown, 1967; Sidwell et al., 1971).

The type of birth of a ewe affects her ability to produce wool (Basuthakur et al., 1973; Fahmy and Bernard, 1973; McCall and Hight, 1981), with single-born ewes producing more wool (Terrill et al., 1947, 1948; Vesely et al., 1965; Lax and Brown, 1967; Basuthakur et al., 1973). Several investigators reported this difference to be .1 to .32 kg (Hazel and Terrill, 1946b; Brown et al., 1966; Sidwell et al., 1971). Brown et al. (1966) explained the lower wool production of twin-born ewes by stating that they have a lower number of fibers. Dunn and Grewal (1963) stated that twin-born ewes produced less wool because they had a lower level of preweaning nutrition.

The number of lambs born and raised affects a ewe's wool production (Price et al., 1953; Thrift and Whiteman, 1969b; Sidwell et al., 1971). Ray and Sidwell (1964) stated that as reproduction rates decrease wool production increases. Ewes raising single lambs produced 14% less wool than a barren ewe (Jones et al., 1944; Seebeck and Tribe, 1963; Ray and Sidwell, 1964; Elliott et al., 1978) and 9 to 14% more than a ewe with twins (Slen and Whiting, 1956; Seebeck and Tribe, 1963; Ray and Sidwell, 1964). Pregnancy causes a 7 to 17.4% decrease in fleece weight, while lactation causes a 2.0 to 7.7%

decrease in fleece weight (Brown et al., 1966; Reid, 1978). Seebeck and Tribe (1963) reported that the longer the lactation period the greater the decline in fleece weight. Ray and Sidwell (1964) reported that pregnancy causes a small decrease in fleece weight and lactation and parturition cause a large decrease in fleece weight.

Size of ewe affects wool production (Thrift and Whiteman, 1969b; Fahmy and Bernard, 1973), with larger ewes having heavier fleeces (Terrill and Stoehr, 1942; Bennet et al., 1963). Nichols and Whiteman (1966) stated that yearling weight and lifetime weight were positively correlated to wool production by .16 and .27, respectively.

Age of first breeding has been reported to have no effect on lifetime wool production (Briggs, 1936; Ensminger, 1970; Burfening et al., 1972). Levine et al. (1978) reported that lamb-bred Columbia ewes produced 3.7 kg more wool than yearling-bred ewes. Twelve-mo wool production has been observed to be 12% lower for lamb-bred ewes than yearling-bred ewes (Tyrrell, 1976). The second year of wool production was equal for the two age of first breeding groups (Hulet et al., 1969; Tyrrell, 1976; Hohenboken et al., 1977). Ponzoni et al. (1979) reported ewes that displayed estrus their first fall but were not mated produced more wool than ewes that didn't reach puberty until later.

Lambs that are fed a high level of nutrition during their postweaning period will produce .8 kg more wool their first year (Bradford et al., 1961; Burfening et al., 1971) and 4.1 kg more wool in their lifetime than lambs fed a low level of nutrition during their postweaning period (Evans et al., 1975). A ewe in poor condition will have a lower fleece weight than normal (Gunn and Doney, 1975). Slen and Whiting (1956) reported that during the first and last trimester of pregnancy and during lactation nutrition has a large effect on wool production. Year of production also influences wool production (Price et al., 1953; Blackwell and Henderson, 1955; Bennet et al., 1963; Vesely et al., 1965; Thrift and Whiteman, 1969b; Sidwell et al., 1971; Wright et al., 1975; Hohenboken, 1976). Terrill et al. (1947) stated that the variation in weather between year of production affected wool production more than any other factor observed.

Longevity

Longevity, or amount of time a ewe remains in the flock, ranges from 4.25 to 6.29 yr for a flock average (Matthews et al., 1977; Hohenboken and Clarke, 1981). Slyter (1968) reported that 57.4% of the original ewes remained in the flock at 5 to 6 yr of age. Pajl (1978) reported that 50.2% of the original ewes remained in the flock at the end of a 5-yr study. Attrition rate or rate of ewes leaving a flock from death or culling ranges from 2 to 13% per year (Thomas and Aitken, 1959; Campbell, 1962; Norman and Hohenboken, 1979). Several researchers stated that death rates increase considerably after 6 yr of age (Campbell, 1962; Slyter, 1968; Matthews et al., 1977).

Matthews et al. (1977) reported several of the larger causes of attrition to be missing ewes, old age, and mastitis, while pneumonia, dystocia, accident, bloat, infertility, unknown causes, and poison are the minor causes. Pajl (1978) reported unknown causes, udder problems, missing ewes, and teeth problems to cause 28.5, 19.2, 15.4, and 13.8%, respectively, of the total attrition for the entire study. Norman and Hohenboken (1979) summarized their causes and found 42, 37, and 16% of attrition to be caused by illness, unknown causes, and accident, respectively, while reproductive failure and udder problems collectively caused 5% of the total attrition. Slyter (1968) reported that after 6 yr of age 79% of the ewes were sold because of old age, 14.6% were sold for other reasons, and 5.8% died. Thomas and Aitken (1959) reported that pregnancy toxemia, which causes attrition, can be caused by inadequate nutrition during the last trimester of pregnancy in ewes carrying twins.

Several factors can affect attrition rate such as breed of ewe, age of first breeding, year of production, and environment. Vesely and Peters (1974) compared Suffolk, Columbia, and Cheviot ewes and found Suffolk ewes lived the longest and Cheviot ewes died the earliest. Hohenboken et al. (1977) found Columbia ewes outlived Targhee ewes. Hohenboken and Clarke (1981) found Columbia ewes lived an average of 7.2 mo longer than Suffolk ewes on a hill pasture, while Suffolk ewes outlived Columbia ewes by an average of .2 mo on an irrigated pasture. In a 10-yr study, Matthews et al. (1977) observed Suffolk x Targhee ewes lived as long as Targhee ewes. They noted that more Suffolk x Targhee ewes were missing than Targhee ewes and suggested that the crossbred ewes may have had a reduced herding instinct. They also noted that Targhee ewes were more frequently culled because of dystocia or reproductive failures.

Age of first breeding affects longevity with more yearling bred ewes being culled (Hulet et al., 1969; Levine et al., 1978). Levine et al. (1978) explained this by stating that unsound ewes and disease-susceptible ewes usually do not conceive as lambs. Briggs (1936) reported that more lamb-bred ewes get culled for teeth problems than yearling-bred ewes. Briggs (1936) and Dyrmundsson (1973) stated that this problem stemmed from delayed eruption of the first two incisor teeth when they were lambs. Norman and Hohenboken (1979) stated that the variation in environmental factors affected attrition rates of a flock. Bradford et al. (1961) reported range ewes survived longer than farm flock ewes. Attrition rates also are affected by management and lactation (Terrill, 1939; Slyter, 1968; Matthews et al., 1977).

In summarizing the aforementioned literature review, intermediate birth weight was found to be associated with higher lamb survival and intermediate growth, while birth weight was affected by breed, size, age and nutritional condition of dam, type of lamb birth, and sex of lamb. A high weaning weight was related to an increase in lamb and wool production and a younger age at puberty. Birth weight, breed, sex, type of birth and rearing of lamb, and type of birth, age, and size of ewe contribute to the variation in weaning weight.

Faster postweaning gains were positively correlated with above-average lamb and wool production and an earlier age of puberty. Postweaning gain was influenced by age of dam, year of production and lamb breed, type of birth and rearing, birth weight, and preweaning gain. Age of first breeding affected rate of postweaning gain and lifetime production, while breed, type and year of birth, postweaning nutrition, size of ewe, and age of dam affected age of puberty.

Lamb production of 2-yr-old ewes indicates subsequent lamb production. Lamb production was controlled by all of the factors previously discussed along with others that affect ovulation, conception, fertility, prolificacy, and lamb survival. Wool production was positively related to subsequent wool production. Wool production was influenced by size, breed, age, age of first breeding and type of birth of ewe, type of lamb birth, nutrition, and environment. Longevity affected the lifetime production of a ewe, while breed of ewe, age of first breeding, nutrition, and environmental elements affected longevity.

MATERIALS AND METHODS

Objectives

This experiment was designed to evaluate lamb and wool production of range ewes while comparing different management practices. Therefore, the following objectives were studied:

1. To determine whether white face range ewes or white face-black face crossbred ewes are more productive.
2. To determine whether single-born or multiple-born ewes are more productive.
3. To determine whether ewes fed a high-energy or moderate-energy postweaning ration are more productive.
4. To determine whether ewes bred at 7 mo of age, ewes not exposed until 19 mo of age, or ewes exposed at 7 mo of age but did not conceive were more productive.

Management

Initially, 261 yearling Targhee ewes were purchased in 1970 and maintained at the Antelope Range Livestock Station for the production of five sets of ewes (1971-75) for this study. These ewes were randomly allotted into two equal groups, with one group being exposed for 35 d each fall to Suffolk rams and the other to Targhee rams. These groups were rotated every year.

The ewes were shed lambed in late February and March and the lambs were weaned at an average age of 70 to 80 d. At weaning, approximately June 1 each year, the female progeny were trucked to the U.S. Irrigation and Dry Land Field Station, Newell, South Dakota (1971), or to the South Dakota State University Sheep Unit, Brookings, South Dakota (1972-75), for their postweaning treatments. At this time, the ewe lambs were randomly assigned within type of birth and breed of sire to a high- or moderate-energy ration group. The moderate-energy ration was designed to meet NRC (1964) requirements for replacement ewe lambs and the high-energy ration was designed to meet NRC (1964) requirements for fattening lambs. All ewe lambs were fed in drylot for approximately 100 d on a 60% cracked corn, 40% alfalfa ration. The moderate-energy level group was hand-fed what they would consume up to 1.14 kg per head per day for the first 70 d of the trial and 1.36 kg per head per day for the remaining 30 d. The high-energy group was self-fed. The ration was fed in ground form for all years except 1972, when it was fed as a pellet.

After the postweaning treatment period, the ewe lambs were randomly allotted within type of birth, breed of sire, and postweaning treatment to be exposed to rams at either 7 or 19 mo of age. Two-thirds of the ewe lambs were exposed for 34 d at 7 mo of age and one-third were exposed for the first time at 19 mo of age. Crossbred Finnsheep ram lambs were utilized during all breeding seasons except 1972, when Columbia ram lambs were used.

Following the breeding season, all ewes were combined and managed as a single flock until lambing season. At this time, all ewes that lambed at 12 mo received supplemental grain prior to and following lambing. These ewes nursed their lambs for approximately 60 d. Following weaning each year in early June, the yearling ewes were sold as a group under a research contract to producers in northwestern South Dakota who agreed to provide lifetime production data to the university. These ewes were maintained under range conditions that were typical of the area. The 1971, 1972, and 1973 ewes were maintained for 6 yr and the 1974 and 1975 ewes were maintained for 5 yr.

During this study, no lambs were culled and mature ewes were only culled for bad udders or teeth or failing to lamb for 2 successive yr. Ram lambs were usually castrated within 10 d of birth. If rams were left intact, it was random across all treatments within location. All lambs were weaned as a group within a location and ewes were shorn as a group prior to lambing. When a ewe gave birth to triplets or quadruplets, then one or two lambs were bummed, respectively.

Data Collected

The data presented are for 586 ewes that were born in 1971 through 1975 and their production data collected through and including 1980. This study included 2,281 matings, 1,927 ewes lambing and 2,127 lambs weaned.

Preweaning data for the ewes included breed of sire, birth weight, birth date, year of birth, type of birth, and weaning weight.

Postweaning data included postweaning treatment level, body weight, wither height, and age of first breeding. Subsequent yearly production data included ewe weight, ewe height, ewe fleece weight, date of lambing, number of lambs born, sex of lambs, lamb birth weight, number of lambs weaned, lamb weaning weight, lamb weaning date, and percent conception. Ages given for annual production (i.e., 12 mo) are approximations.

Those ewes that died at less than 7 mo of age were not considered to be in the experiment. If a ewe had no data reported for 2 consecutive yr, she was considered dead after the last reported data. When wool production, ewe weight, or height data were not reported but lamb production data were reported, then the wool and ewe data were considered missing. When the reverse occurred, then lamb production was considered to be zero. When a lamb's weaning weight was not reported, then the lamb was considered dead.

Statistical Analyses

All statistical procedures were done in accordance with Steele and Torrie (1980). In this manuscript, the levels of probability considered were .05, .01, and .005 for all F-tests. The Tukey and Chi-square tests were performed at the .05 level.

Comparisons of breed of sire, postweaning nutrition, age of first breeding, and type and year of birth were performed using a least-squares analysis of variance with one or two-way classifications. Type of lamb birth and sex of lamb were also included when appropriate. Least-squares analyses were completed by utilizing the general linear model. When the F-tests indicated a significant difference between treatments, the Tukey's w procedure was employed for mean comparisons. One-way Chi-square analyses were used in comparing discrete values as type of lamb birth, ewe lambing percentages, and number of lambs weaned.

Analyses were done on a yearly production and an accumulation basis. The yearly production analyses were completed by per ewe present, while accumulative analyses were completed by per ewe present and per ewe entering. Accumulative per ewe entering analyses were performed including 12-mo production and excluding 12-mo production.

Significant two-way interactions, analysis of variance, and Chi-square analysis of variance are shown in tabular form in the appendix.

RESULTS AND DISCUSSION

Ewe Growth

Several traits were analyzed prior to administration of any treatments to determine if differences existed between treatment groups. These traits were ewe birth date, birth weight, and weaning weight (table 1). Seven-mo and subsequent annual weight and wither height measurements were analyzed to determine treatment effects on ewe size. Factors considered in the analysis were type of birth, ewe breed, postweaning nutrition, age of first breeding, and year.

Birth Date. Birth date differed ($P \leq .005$) by year, somewhat due to the different breeding seasons imposed by management.

Birth Weight. Single ewes were .81 kg heavier ($P \leq .005$) than twin ewes. Other researchers (Hazel and Terrill, 1945; Blackwell and Henderson, 1955; Cassard and Weir, 1956; deBaca et al., 1956; Bogart et al., 1957; Bennet et al., 1963; Purser and Young, 1964; Lambe et al., 1965; Singh et al., 1967; El Twail et al., 1970; Vesely et al., 1970; Sidwell and Miller, 1971b; Dyrmundsson, 1973; Wright et al., 1975; Hohenboken et al., 1976b; Smith, 1977; McCall and Hight, 1981; Rastogi, 1982) found similar results.

Suffolk x Targhee ewes weighed .43 kg more at birth than Targhee ewes ($P \leq .005$). This agreed with work reported by Starke et al., (1958), Sidwell et al., (1964); Singh et al., (1967); Sidwell and Miller (1971a), Matthews et al., (1977), and McGuirk et al. (1978). The ewes were randomly allotted to the postweaning nutrition treatment.

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

Parameter	Birth date[a]	Birth wt, kg	Weaning wt, kg	Wt at 7 mo, kg	Height at 7 mo, cm	Wt:height kg/cm
Overall mean	63.8 (584)[c]	4.88 (586)	27.4 (585)	47.2 (586)	60.91 (586)	.774 (581)
Ewe type of birth		***	***	***	***	***
Single	63.8 (213)	5.29 (214)	30.0 (213)	49.7 (214)	61.86 (214)	.804 (213)
Multiple	63.8 (371)	4.48 (372)	24.9 (372)	44.7 (372)	59.95 (372)	.743 (368)
Ewe breed[b]		***	***	***		***
T	64.2 (296)	4.67 (297)	26.3 (296)	44.8 (297)	60.96 (297)	.733 (294)
S x T	63.4 (288)	5.10 (289)	28.6 (289)	49.6 (289)	60.86 (289)	.814 (287)
Postweaning nutrition		**		***	*	***
High	63.8 (292)	4.80 (293)	27.4 (293)	49.8 (293)	61.56 (293)	.808 (290)
Moderate	63.8 (292)	4.96 (293)	27.5 (292)	44.6 (293)	60.26 (293)	.740 (291)
Age at first breeding						
7 mo	63.6 (231)	4.92 (232)	27.5 (232)	47.9 (232)	61.52 (232)	.777 (230)
19 mo	63.3 (197)	4.81 (198)	27.9 (197)	47.5 (198)	60.75 (198)	.781 (197)
7 mo, open	64.5 (156)	4.92 (156)	26.9 (156)	46.3 (156)	60.45 (156)	.763 (154)
Year of birth	***	***	***	***	***	***
1971	60.0 (110)[d]	4.61 (110)[d]	22.5 (110)[d]	40.6 (110)[d]	57.02 (110)[d]	.711 (108)[d]
1972	63.7 (137)[e]	4.96 (137)[e]	31.4 (136)[e]	49.2 (137)[ef]	63.31 (137)[e]	.776 (137)[e]
1973	68.7 (139)[f]	4.93 (139)[e]	25.3 (139)[f]	51.4 (139)[f]	59.19 (139)[df]	.866 (136)[f]
1974	61.2 (110)[d]	5.01 (110)[e]	31.6 (110)[e]	47.7 (110)[e]	63.49 (110)[e]	.750 (110)[d]
1975	65.2 (88)[e]	4.91 (90)[e]	26.4 (90)[f]	47.1 (90)[e]	61.53 (90)[ef]	.765 (90)[e]
Standard deviation	6.91	.64	3.83	6.98	6.24	.08

[a] Days after January 1.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Values within parentheses represent number of observations.
[d,e,f] Means with different superscripts in the same column and within main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

However, the moderate level ewes were .16 kg heavier at birth ($P \leq .01$) than the high postweaning nutrition level ewes. Year of ewe birth affected birth weights ($P \leq .005$). Weights ranged from 4.61 kg in 1971 to 5.01 kg in 1974. Some of the variation can be accounted for by age of dam (Lambe et al., 1965) and some by environmental differences between years. No difference ($P > .05$) in birth weight was observed among age of first breeding groups.

<u>Weaning Weight</u>. Weaning weight differed ($P \leq .005$) for ewe type of birth, ewe breed, and year of birth. Single ewes weighed 5.1 kg more at weaning than twin ewes. This agreed with results reported by Hazel and Terrill (1946a), Sidwell and Grandstaff (1949), Guyer and Dyer (1954), Cassard and Weir (1956), deBaca et al. (1956), Shelton and Campbell (1962), Slen et al. (1963), Dickerson and Laster (1975), Gould and Whiteman (1975), Hohenboken et al. (1976b), Bush and Lewis (1977), and Bhat et al. (1981). The larger weaning weights for single ewes can be explained by their heavier birth weights (Guyer and Dyer, 1954; El Tawil et al., 1970; Farid and Makarechian, 1978) and an opportunity for more milk consumption (Slen et al., 1963).

Suffolk x Targhee ewes were 2.3 kg heavier at weaning time than Targhee ewes. Fox et al. (1964), Sidwell and Miller (1971b), Lasley (1972), Vesely and Peters (1972), and McGuirk et al. (1978) found similar results with crossbred ewes compared to straightbred ewes. However, Sidwell et al. (1964) and Bradley et al. (1972) reported lower weaning weights for Suffolk x Targhee ewes than the mean weaning weight of the parent breeds. Weaning weights ranged from 22.5 kg in 1971 to

31.6 kg in 1974. This may be the result of the influence of environmental factors and birth weight on weaning weight (Guyer and Dyer, 1954; El Tawil et al., 1970; Farid and Makerechian, 1978).

Postweaning Growth. Weight at 7 mo of age (table 1) differed ($P \leq .005$) in all factors except age of first breeding. Single ewes weighed 5 kg more at 7 mo of age than twin ewes. Most of this difference can be accounted for in the 5.1 kg difference between twin and single ewes at weaning time. Other researchers (Terrill et al., 1947; Cassard and Weir, 1956; Dickerson and Laster, 1975; Olson et al., 1978) found twin ewes to have compensatory postweaning gains. Seven-mo weights were 4.8 kg higher for Suffolk x Targhee ewes than Targhee ewes. Bradford et al. (1963) and Holtman and Bernard (1969) reported that heterosis was not found in two-breed crosses. Sidwell and Miller (1971b) observed Suffolk ewes to have higher postweaning gains than Targhee ewes. Rastogi et al. (1982) reported the reverse.

Postweaning nutrition affected 7-mo weight, with the high level ewes weighing 5.2 kg heavier. Jordan et al. (1970), Burfening et al. (1971), and Quirke (1979) found similar results. Year of birth also affected 7-mo weight, ranging from 40.6 kg for 1971 ewes to 51.4 kg for 1973 ewes. Some of the variation can be accounted for by age of dam and environmental differences between the years.

Height at 7 mo of age (table 1) differed by type of birth ($P \leq .005$), postweaning nutrition ($P \leq .05$), and year of birth ($P \leq .005$). Single ewes were 1.91 cm taller than twin ewes at this age. Ewes fed the high level of nutrition during the postweaning period were 1.30 cm taller than the moderate level ewes. A range of 6.47 cm in 7-mo height was observed between year of birth.

The weight:height ratio at 7 mo of age (table 1) differed ($P \leq .005$) for all factors except age of first breeding. A higher ratio indicated more weight (kg) per unit of height (cm). Single ewes had a higher ratio than twin ewes. Therefore, single ewes were taller and had more weight per centimeter of height. Suffolk x Targhee ewes had a higher ratio than Targhee ewes but were similar in height. This suggested that Suffolk x Targhee ewes were only heavier than Targhee ewes. Ewes fed the high level of postweaning nutrition were taller and heavier per centimeter of height than the low level ewes. In year of birth, differences were found in weight, with 1973-born ewes weighing the heaviest per centimeter of height and 1971 ewes weighing the lightest.

Mature Size. Annual ewe weight analyses were completed on all ewes (table 2) and on ewes lambing (table 3). Ewes reached their mature weight at 36 mo of age. Significance of factors decreased with age, especially after the ewes reached their mature weight. Single ewes were significantly heavier than twin ewes throughout the study except at 48 mo. This difference decreased after 36 mo. Guyer and Dyer (1954) found the difference between large and small ewes to decrease with advancing age. They attributed this to more lamb and wool production by the larger ewes. Some researchers observed single ewes to have heavier mature weights than twin ewes (Hazel and Terrill, 1946; Lax and Brown, 1967; Vesely and Peters, 1972; Bhat et al., 1981).

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

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	51.2 (553)[b]	66.6 (469)	71.4 (422)	71.1 (353)	72.2 (287)	71.5 (158)
Ewe type of birth	***	***	***		*	*
Single	53.0 (208)	67.9 (182)	72.9 (166)	71.7 (137)	73.5 (111)	73.0 (66)
Multiple	49.4 (345)	65.4 (287)	69.9 (256)	70.5 (216)	70.9 (176)	70.0 (92)
Ewe breed[a]	***	***	***	***		*
T	48.7 (282)	65.4 (239)	69.5 (211)	68.9 (177)	71.2 (146)	70.0 (74)
S x T	53.7 (271)	67.9 (230)	73.3 (211)	73.3 (176)	73.2 (141)	73.0 (84)
Postweaning nutrition	***					
High	52.2 (281)	66.9 (241)	71.5 (216)	70.8 (181)	71.6 (147)	70.8 (81)
Moderate	50.2 (272)	66.4 (228)	71.3 (206)	71.4 (172)	72.7 (140)	72.2 (77)
Age of first breeding	***					
7 mo	49.1 (218)[c]	66.7 (179)	71.4 (162)	71.2 (143)	71.8 (116)	71.4 (62)
19 mo	51.7 (192)[d]	66.5 (162)	71.5 (146)	70.9 (130)	72.1 (104)	71.5 (65)
7 mo, open	52.8 (143)[d]	66.7 (128)	71.4 (114)	71.2 (80)	72.6 (67)	71.7 (31)
Year of production	***	***	***	***	***	
1972	42.3 (102)[c]					
1973	55.0 (129)[d]	60.9 (90)[c]				
1974	50.7 (130)[e]	68.8 (113)[de]	64.9 (80)[c]			
1975	51.5 (105)[e]	66.8 (104)[e]	74.2 (106)[d]	67.0 (72)[c]		
1976	56.5 (87)[d]	66.8 (85)[e]	74.2 (95)[d]	77.6 (81)[d]	69.4 (57)[c]	
1977		69.9 (77)[d]	71.9 (73)[d]	76.0 (88)[df]	75.5 (67)[d]	70.3 (50)
1978			72.0 (68)[d]	61.2 (58)[e]	71.7 (77)[c]	73.5 (53)
1979				73.7 (54)[f]	76.3 (40)[d]	70.7 (55)
1980					67.9 (46)[c]	
Standard deviation	5.77	6.38	6.49	6.72	7.40	7.96

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column within main effect differ ($P \leq .05$).
*$P \leq .05$.
***$P \leq .001$.

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

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	48.1 (175)[b]	65.6 (325)	71.0 (334)	70.5 (281)	71.6 (254)	70.6 (138)
Ewe type of birth	***	***	**			
Single	49.7 (62)	67.0 (124)	72.3 (127)	71.2 (106)	72.5 (100)	72.1 (57)
Multiple	46.2 (113)	64.1 (201)	69.7 (207)	69.9 (175)	70.7 (154)	69.2 (81)
Ewe breed[a]	***	***	***	***	*	
T	45.9 (70)	64.4 (155)	69.4 (165)	68.1 (142)	70.3 (127)	69.6 (67)
S x T	50.0 (105)	66.7 (170)	72.6 (169)	73.0 (139)	72.9 (127)	71.7 (71)
Postweaning nutrition						
High	48.7 (104)	66.1 (172)	71.1 (179)	70.4 (143)	71.3 (132)	70.2 (75)
Moderate	47.2 (71)	65.0 (153)	70.8 (155)	70.7 (138)	71.9 (122)	71.0 (63)
Age of first breeding						
7 mo	--	65.2 (117)	71.3 (121)	70.5 (118)	71.2 (99)	70.4 (56)
19 mo	--	65.6 (120)	70.7 (116)	69.9 (103)	71.8 (94)	70.7 (53)
7 mo, open	--	65.9 (88)	70.9 (97)	71.2 (60)	71.8 (61)	70.8 (29)
Year of production	***	***	***	***	***	
1972	38.7 (28)[c]					
1973	56.4 (38)[d]	59.0 (48)[c]				
1974	49.2 (50)[e]	67.6 (88)[de]	64.4 (51)[c]			
1975	45.9 (73)[f]	65.7 (45)[d]	73.8 (79)[d]	65.4 (43)[c]		
1976	49.4 (71)[e]	65.7 (73)[d]	73.2 (85)[d]	77.8 (67)[d]	68.9 (54)[c]	
1977		69.8 (71)[e]	71.7 (54)[d]	75.3 (78)[de]	74.1 (48)[d]	69.2 (39)
1978			71.8 (65)[d]	61.0 (43)[f]	71.5 (71)[cd]	72.3 (45)
1979				73.4 (50)[e]	75.6 (35)[d]	70.4 (54)
1980					67.9 (46)[c]	
Standard deviation	5.11	5.93	6.34	5.93	6.91	7.61

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and within main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .001$.

Others found no difference in mature weight between single and twin ewes (Dunn and Grewal, 1963; Ch'ang and Rae, 1970; McCall and Hight, 1981).

Suffolk x Targhee ewes had heavier annual weights from 12 to 48 mo and 72 mo than Targhee ewes. Dickerson and Glimp (1975) reported similar data. Postweaning nutrition only affected ($P \leq .005$) 12-mo weight. Jordan et al. (1970), Burfening (1971), and Quirke (1979) observed similar results. Age of first breeding was significant ($P \leq .005$) for 12-mo weight. Briggs (1936) and Dyrmundsson (1973) indicated that pregnancy puts a short-term check on postweaning growth, but this was overcome by weaning of the second lamb.

Year of production significantly ($P \leq .005$) affected annual weight at every age except 72 mo. Birth weight (Harrington et al., 1958) and year of birth (Terrill et al., 1948) may account for some of the variation.

When comparing annual weights for those ewes lambing to the entire flock, the same general pattern of significance was exhibited. However, all ewes weaning a lamb were slightly lighter than the average of the entire flock. This can be explained somewhat by the higher maintenance requirements for a pregnant or lactating ewe than a nonproductive ewe. The 48- and 72-mo-old single ewes that weaned a lamb were no heavier than their twin comtemporaries. However, ewes that didn't wean a lamb exhibited some differences in weight at these ages. This may suggest that single ewes that don't wean a lamb become fat easier than twin ewes that don't wean a lamb. Postweaning nutrition didn't have any affect on annual ewe weight contrary to the 12-mo weight for the entire flock. This may be partially explained by the higher percentage of high level ewes weaning a lamb than the moderate level ewes when compared to the percentage of each in the entire flock (table 12).

Annual wither height analyses were completed on all ewes (table 4) and on ewes lambing (table 5). Mature wither height was reached at 36 mo of age. Age of first breeding never affected wither height, whereas year of production significantly affected all ages. Some of these differences can be attributed to year of birth (Terrill et al., 1947; Nichols and Whiteman, 1966; Singh et al., 1967; Vesely and Peters, 1972; Bhat et al., 1981). When type of birth was significant, single ewes were taller. These results agreed with those reported by Guyer and Dyer (1954). Targhee ewes were generally taller than Suffolk x Targhee ewes. Since the Suffolk x Targhee ewes were heavier (table 2), this indicated that Targhee ewes have a lower weight:height ratio than the Suffolk ewes for these significant ages. The high postweaning nutrition level ewes were significantly taller ($P \leq .05$) at 12 mo than the moderate level ewes. Bradford et al. (1961) and Burfening et al. (1971) reported similar results.

Year of production was the only consistent significant factor affecting annual wither height for those ewes weaning a lamb. Single ewes were taller than twin ewes at 72 mo. When ewe breed was significant, Targhee ewes were taller.

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

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	66.0 (552)[b]	66.4 (469)	67.1 (422)	67.2 (347)	65.2 (287)	67.0 (158)
Ewe type of birth	***	*				**
Single	66.4 (207)	66.7 (182)	67.3 (166)	67.4 (133)	65.4 (111)	67.7 (66)
Multiple	65.6 (345)	66.1 (287)	66.9 (256)	67.0 (214)	65.1 (176)	66.3 (92)
Ewe breed[a]	***	***	*		***	
T	66.3 (281)	67.0 (239)	67.5 (211)	67.4 (173)	65.7 (146)	67.3 (74)
S x T	65.6 (271)	65.7 (230)	66.7 (211)	66.9 (174)	64.7 (141)	66.7 (84)
Postweaning nutrition	*					
High	66.2 (281)	66.4 (241)	67.2 (216)	67.2 (177)	65.3 (147)	66.6 (81)
Moderate	65.7 (271)	66.4 (228)	67.0 (206)	67.1 (170)	65.2 (140)	67.4 (77)
Age of first breeding						
7 mo	65.7 (217)	66.4 (179)	67.1 (162)	67.1 (140)	65.4 (116)	66.9 (62)
19 mo	65.9 (192)	66.4 (162)	67.0 (146)	66.7 (128)	64.9 (104)	66.9 (65)
7 mo, open	66.4 (143)	66.4 (128)	67.2 (114)	67.7 (79)	65.3 (67)	67.2 (31)
Year of production	***	***	***	***	***	*
1972	62.3 (102)[c]					
1973	68.3 (128)[d]	68.3 (90)[c]				
1974	65.9 (130)[e]	67.7 (113)[c]	68.3 (80)[c]			
1975	65.9 (105)[e]	65.0 (104)[d]	67.9 (106)[c]	65.9 (72)[c]		
1976	67.5 (87)[d]	65.1 (85)[d]	66.4 (95)[d]	68.9 (81)[d]	66.2 (57)[cd]	
1977		65.6 (77)[d]	66.2 (73)[d]	65.7 (88)[c]	67.0 (67)[c]	66.4 (50)[c]
1978			66.6 (68)[d]	67.7 (52)[d]	65.7 (77)[d]	67.9 (53)[cd]
1979				67.7 (54)[d]	65.0 (40)[d]	66.7 (55)[d]
1980					62.2 (46)[e]	
Standard deviation	2.42	2.58	2.88	2.55	2.41	2.60

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and within main effect differ ($P \leq .05$).
*$P < .05$.
**$P \leq .01$.
***$P \leq .005$.

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

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	65.4 (175)[b]	66.3 (325)	67.0 (334)	67.0 (279)	65.2 (254)	66.8 (138)
Ewe type of birth						**
Single	65.8 (62)	66.5 (124)	67.1 (127)	67.2 (104)	65.3 (100)	67.5 (57)
Multiple	65.0 (113)	66.1 (201)	66.8 (207)	66.8 (175)	65.0 (154)	66.1 (81)
Ewe breed[a]		***			**	
T	65.6 (70)	67.0 (155)	67.3 (165)	67.3 (140)	65.7 (127)	67.2 (67)
S x T	65.2 (105)	65.6 (170)	66.6 (169)	66.8 (139)	64.7 (127)	66.4 (70)
Postweaning nutrition						
High	65.5 (104)	66.4 (172)	67.0 (179)	67.1 (142)	65.3 (132)	66.5 (75)
Moderate	65.3 (71)	66.2 (153)	67.0 (155)	67.0 (137)	65.1 (122)	67.1 (63)
Age of first breeding						
7 mo	--	66.0 (117)	66.9 (121)	67.0 (117)	65.3 (99)	66.8 (56)
19 mo	--	66.5 (120)	66.9 (116)	66.5 (102)	64.9 (94)	66.9 (53)
7 mo, open	--	66.3 (88)	67.1 (97)	67.7 (60)	65.4 (61)	66.7 (29)
Year of production	***	***	***	***	***	
1972	61.3 (28)[c]					
1973	68.8 (38)[d]	68.3 (48)[c]				
1974	65.4 (50)[e]	67.3 (88)[c]	68.1 (51)[c]			
1975	66.0 (42)[e]	65.2 (45)[d]	67.8 (79)[c]	65.6 (43)[c]		
1976	66.6 (17)[e]	65.0 (73)[d]	66.0 (85)[d]	69.0 (67)[d]	66.1 (54)[cd]	
1977		65.5 (71)[d]	66.3 (54)[d]	65.6 (78)[c]	67.0 (48)[c]	66.3 (39)
1978			66.6 (65)[cd]	67.5 (41)[d]	65.6 (71)[d]	67.5 (45)
1979				67.6 (50)[d]	65.1 (35)[d]	66.6 (54)
1980					62.2 (46)[e]	
Standard deviation	2.46	2.51	2.89	2.54	2.37	2.49

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and within main effect differ ($P \leq .05$).
**$P \leq .01$.
***$P \leq .005$.

Ewe Production

A ewe is capable of producing two products every year. The kilograms of lamb and wool produced every year determines her economic value. Also, the number of years a ewe produces these products affects the total lamb and wool production of a ewe. Lamb and wool production has been analyzed in several different ways to evaluate the treatments imposed in this investigation.

Lamb Production. Analyses of lambing date are presented in table 6. Year of production was the only significant factor that affected lambing date for all ages of ewes ($P \leq .005$). This was due in part to the varied breeding seasons imposed by the different managements. Single ewes lambed later than twin ewes at 48 mo of age ($P \leq .05$). Suffolk x Targhee ewes lambed 42 d earlier ($P \leq .005$) than Targhee ewes at 36 mo of age. Postweaning nutrition was significant ($P \leq .05$) at 60 mo and age of first breeding was significant ($P \leq .05$) at 48 mo of age. Single-born lambs were born later than multiple-born lambs for ewes that were 24 and 36 mo old. This may be accounted for by single lambs having a longer gestation period than multiple-born lambs (Forbes, 1967; Glimp, 1971; Thrift and Dutt, 1972; Hinkelman et al., 1979) and to the higher frequency of multiple births reported in the early part of the lambing season (Reeve and Robertson, 1953; Scott, 1977).

The Chi-square analysis of conception data at 7 mo of age is presented in table 7. Ewe breed and year of production significantly affected ($P \leq .005$) conception at 7 mo of age. The Suffolk x Targhee

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The Chi-square analysis of conception data at 7 mo of age is presented in table 7. Ewe breed and year of production significantly affected ($P \leq .005$) conception at 7 mo of age. The Suffolk x Targhee

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

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	72.0 (227)[b]	99.6 (462)	93.2 (411)	77.7 (360)	72.0 (303)	69.6 (164)
Ewe type of birth				*		
Single	71.4 (79)	98.9 (170)	93.3 (147)	80.6 (142)	70.7 (118)	69.1 (66)
Multiple	72.7 (148)	100.3 (292)	93.0 (264)	74.9 (218)	73.3 (185)	70.0 (98)
Ewe breed[a]			***			
T	73.5 (93)	100.0 (230)	95.3 (206)	76.2 (181)	72.5 (149)	70.0 (76)
S x T	70.6 (134)	99.2 (232)	91.1 (205)	79.3 (179)	71.5 (154)	69.1 (88)
Postweaning nutrition					*	
High	70.9 (122)	100.0 (234)	92.9 (215)	78.8 (180)	73.5 (156)	70.6 (84)
Moderate	73.3 (105)	99.3 (228)	93.5 (196)	76.7 (180)	70.4 (147)	68.4 (80)
Age of first breeding				*		
7 mo	--	99.5 (172)	93.6 (158)	75.5 (148)[c]	70.6 (123)	69.5 (64)
19 mo	--	98.8 (168)	92.8 (142)	74.1 (129)[c]	73.1 (111)	70.6 (68)
7 mo, open	--	100.6 (122)	93.2 (111)	83.6 (83)[d]	72.2 (69)	68.5 (32)
Year of production	***	***	***	***	***	***
1972	83.9 (42)[c]					
1973	69.3 (50)[d]	109.8 (63)[c]				
1974	74.1 (62)[d]	66.8 (117)[d]	96.8 (63)[c]			
1975	71.9 (52)[d]	123.8 (105)[e]	77.5 (105)[d]	123.7 (70)[c]		
1976	61.1 (21)[e]	124.6 (92)[e]	85.1 (100)[e]	51.2 (89)[d]	83.7 (67)[c]	
1977		73.0 (85)[f]	127.0 (76)[f]	59.3 (87)[d]	51.8 (67)[d]	57.2 (49)[c]
1978			79.7 (67)[d]	75.1 (57)[e]	78.2 (76)[e]	73.9 (55)[d]
1979				79.3 (57)[e]	71.5 (44)[f]	77.5 (60)[d]
1980					74.8 (49)[ef]	
Lamb type of birth		*	***			
Single	72.5 (164)	100.8 (292)	94.9 (209)	76.5 (134)	72.5 (87)	69.8 (49)
Multiple	71.6 (63)	98.4 (170)	91.5 (202)	79.0 (226)	71.4 (216)	69.3 (115)
Standard deviation	8.99	9.10	9.42	21.14	8.32	10.92

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

[b] Values within parentheses represent number of obsevations.

[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).

*$P \leq .05$.

***$P \leq .005$.

TABLE 7. NUMBER OF EWES CONCEIVING AT 7 MO OF AGE OF THOSE EXPOSED[a]

Main effects	Conceived	Open	Total
Ewe type of birth			
Single	80 (57)[d]	60 (43)	140
Multiple	147 (62)	90 (38)	237
Ewe breed[b]			
T[c]	92 (48)	98 (52)	190
S x T[c]	135 (72)	52 (28)	187
Postweaning nutrition			
High	123 (65)	66 (35)	189
Moderate	104 (55)	84 (45)	188
Year of production[b]			
1972	42 (62)	26 (38)	68
1973	50 (58)	36 (42)	86
1974	62 (75)	21 (25)	83
1975	52 (64)	29 (36)	81
1976	21 (36)	38 (64)	59

[a] Differences between main effects were tested by Chi-square procedures.
[b] Significant main effects ($P \leq .005$).
[c] T = Targhee, S x T = Suffolk x Targhee.
[d] Values within parentheses represent percentage of ewes in each simple effect.

ewes conceived at a much higher rate than the Targhee ewes. Laster et al. (1972) and Dickerson and Glimp (1975) found Suffolk ewes reached puberty at a younger age than Targhee ewes. Conception by year of production ranged from 75% in 1974 to 36% in 1976. This may be explained by age of dam (Hulet et al., 1969; Southham et al., 1971; Wright et al., 1975; McCall and Hight, 1981).

Chi-square analysis for percentage of ewes lambing of those exposed is shown in table 8. Of the 2,269 ewes exposed, 1,927 or 84.93% lambed. Twin ewes conceived at a higher rate than single ewes at 24 and 36 mo of age and over the entire study. These results agree with those reported by Karam (1957), Lax and Brown (1968), Vakil et al. (1968), and Fahmy and Bernard (1973). Suffolk x Targhee ewes had higher conception rates ($P \leq .005$) than Targhee ewes at 12 mo of age and over the entire study. Other studies found Suffolk ewes to have higher conception rates than Targhee ewes (Vesely et al., 1966; Glimp, 1971; Bradley et al., 1972; Laster et al., 1972; Dickerson and Glimp, 1975; Oltenacu and Boylan, 1981a). Postweaning nutrition and age of first breeding didn't affect conception rates. Year of production was significant at 12, 24, and 36 mo of age and overall conception rate ($P \leq .005$). Karam (1957), Sidwell et al. (1962), Vesely et al. (1965), Vakil et al. (1968), Wright et al. (1975) and Thrift and Dutt (1981) reported similar results.

Number of lambs born per ewe exposed (fertility) increased as age of ewe increased (table 9). Twin ewes gave birth to more lambs at 24 and 36 mo of age than single ewes. These results agree with those

TABLE 8. PERCENT EWES LAMBING OF THOSE EXPOSED[a]

Parameter	Age, mo						Total lambing/ total exposed	Overall
	12	24	36	48	60	72		
Ewe type of birth		*	***					***
Single	56.43	84.58	85.58	91.03	90.77	90.41	722/878	82.23
Multiple	62.45	91.82	92.96	91.59	89.81	90.74	1205/1391	86.63
Ewe breed[b]	***							***
T	48.95	87.12	87.66	90.50	89.76	89.41	935/1140	82.02
S x T	71.66	90.98	90.31	92.27	90.58	91.66	992/1129	87.87
Postweaning nutrition								
High	64.55	87.64	90.72	89.55	91.76	94.38	991/1153	85.96
Moderate	55.85	90.48	87.11	93.26	88.55	86.96	936/1116	83.87
Age of first breeding								
7 mo	100.00	87.76	87.29	91.93	90.44	92.75	665/743	89.50[c]
19 mo	--	93.34	88.75	92.80	90.99	90.67	618/676	91.42
7 mo, open	.00	85.31	91.74	88.30	88.47	86.48	417/473	88.16[c]
Year of production	***	***	***					***
1972	61.76							
1973	58.14	63.00						
1974	74.70	94.35	72.41					
1975	64.20	93.75	93.75	90.91				
1976	35.59	96.85	94.34	93.68	95.71			
1977		96.59	93.83	91.58	83.75	89.14	354/457	77.46
1978			88.16	90.47	89.41	87.30	483/560	86.25
1979				87.07	89.80	95.23	490/544	90.07
1980					94.23		321/369	86.99
							279/339	82.30
Overall	60.21	89.02	88.96	91.37	90.18	90.61	1927/2269	84.93

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Excluding 12-mo lambing. Including 12-mo lambing, percentages were 91.96 (892/970) for the 7-mo group and 66.93 (417/623) for the 7 mo, open, group.
*$P \leq .05$.
***$P \leq .005$.

TABLE 9. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR NUMBER OF LAMBS BORN PER EWE EXPOSED[a]

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	.72 (388)[c]	1.22 (519)	1.30 (462)	1.45 (394)	1.53 (336)	1.59 (181)
Ewe type of birth		*	***			
Single	.70 (142)	1.21 (201)	1.23 (178)	1.43 (156)	1.50 (130)	1.54 (73)
Multiple	.75 (246)	1.23 (318)	1.36 (284)	1.48 (238)	1.55 (206)	1.64 (108)
Ewe breed[b]	***	***				
T	.52 (197)	1.13 (264)	1.22 (235)	1.41 (200)	1.48 (166)	1.57 (85)
S x T	.92 (191)	1.31 (255)	1.36 (227)	1.50 (194)	1.57 (170)	1.61 (96)
Postweaning nutrition						
High	.78 (197)	1.19 (267)	1.31 (237)	1.43 (201)	1.56 (170)	1.64 (89)
Moderate	.66 (191)	1.25 (252)	1.28 (225)	1.48 (193)	1.50 (166)	1.54 (92)
Age of first breeding		*				
7 mo	--	1.25 (196)	1.32 (181)	1.52 (161)	1.63 (136)	1.65 (69)
19 mo	--	1.29 (180)	1.27 (160)	1.47 (139)	1.50 (122)	1.49 (75)
7 mo, open	--	1.12 (143)	1.30 (121)	1.38 (94)	1.46 (78)	1.62 (37)
Year of production	***	***	***	***		
1972	.72 (68)					
1973	.83 (87)	.71 (100)				
1974	.92 (83)	1.42 (124)	.96 (87)			
1975	.71 (88)	1.15 (112)	1.47 (112)	1.20 (77)		
1976	.43 (62)	1.45 (95)	1.45 (106)	1.59 (95)	1.65 (70)	
1977		1.38 (88)	1.09 (81)	1.60 (95)	1.34 (80)	1.56 (55)
1978			1.49 (76)	1.36 (63)	1.51 (85)	1.44 (63)
1979				1.54 (64)	1.44 (49)	1.77 (63)
1980					1.69 (52)	
Standard deviation	.67	.55	.62	.64	.67	.61

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Values within parentheses represent number of observations.
*P≤.05.
***P≤.005.

reported by Karam (1957), Lax and Brown (1968), Vakil et al. (1968), and Fahmy and Bernard (1973). Suffolk x Targhee ewes gave birth to more lambs at 12 and 24 mo of age than Targhee ewes ($P \leq .005$). Sidwell and Miller (1971) and Matthews et al. (1977) reported similar observations. Suffolk x Targhee ewes may have been more prolific since they were heavier at a young age. The Targhee ewes' limiting factor may have been nutrition, since they were taller and lighter at this age. Age of first breeding was significant ($P \leq .05$) at 24 mo of age. The ewes that were exposed at 7 mo of age and didn't conceive gave birth to less lambs per ewe exposed than their contemporaries. Briggs (1936), Ponzoni et al. (1979), and McCall and Hight (1981) also found increased fertility of those ewes that conceived at 7 mo of age vs those ewes that didn't conceive at this age. But, these authors found the increased fertility to be more prolonged. Year of production affected ($P \leq .005$) number of lambs born per ewe exposed from 12 to 48 mo of age. Other researchers reported year of production to affect fertility (Purser and Young, 1964; Botkin and Paules, 1965; Sidwell et al., 1965; Dickerson and Glimp, 1975; Barlow and Hodges, 1976; Vesely and Peters, 1981).

Number of lambs born per ewe lambing (table 10) is a measure of prolificacy. Number of lambs born per ewe lambing increased from 1.22 lambs at 12 mo to 1.71 lambs at 72 mo of age. Crossbred ewes were more prolific at 12, 24 ($P \leq .005$), and 36 mo of age ($P \leq .05$). Sidwell and Miller (1971a) and Matthews et al. (1977) found similar results with

TABLE 10. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR NUMBER OF LAMBS BORN PER EWE LAMBING[a]

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	1.22 (227)[c]	1.35 (462)	1.46 (411)	1.61 (360)	1.70 (303)	1.71 (164)
Ewe type of birth						
Single	1.19 (79)	1.35 (170)	1.44 (147)	1.60 (142)	1.67 (118)	1.67 (66)
Multiple	1.25 (184)	1.35 (292)	1.49 (264)	1.62 (218)	1.71 (185)	1.75 (98)
Ewe breed[b]	***	***	*			
T	1.08 (93)	1.29 (230)	1.40 (206)	1.56 (181)	1.66 (149)	1.72 (76)
S x T	1.35 (134)	1.41 (232)	1.52 (205)	1.66 (179)	1.72 (154)	1.71 (88)
Postweaning nutrition						
High	1.26 (122)	1.34 (234)	1.45 (215)	1.61 (180)	1.70 (156)	1.71 (84)
Moderate	1.18 (105)	1.36 (228)	1.47 (196)	1.61 (180)	1.69 (147)	1.72 (80)
Age of first breeding		*				
7 mo	--	1.41 (172)	1.54 (158)	1.62 (148)	1.76 (123)	1.79 (64)
19 mo	--	1.36 (168)	1.44 (142)	1.63 (129)	1.66 (111)	1.61 (68)
7 mo, open	--	1.27 (122)	1.41 (111)	1.58 (83)	1.65 (69)	1.73 (32)
Year of production		***	***	***		
1972	1.16 (42)					
1973	1.36 (50)	1.12 (63)				
1974	1.20 (62)	1.48 (117)	1.30 (63)			
1975	1.16 (52)	1.24 (105)	1.59 (105)	1.82 (70)		
1976	1.20 (21)	1.47 (92)	1.56 (100)	1.71 (89)	1.70 (67)	
1977		1.44 (85)	1.18 (76)	1.76 (87)	1.63 (67)	1.68 (49)
1978			1.69 (67)	1.57 (57)	1.75 (76)	1.62 (55)
1979				1.68 (57)	1.66 (44)	1.84 (60)
1980					1.72 (49)	
Standard deviation	.43	.45	.46	.47	.46	.44

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Values within parentheses represent number of observations.
*$P \leq .05$.
***$P \leq .005$.

Suffolk x Targhee and Targhee ewes. However, Vesely and Peters (1974) stated that two-breed crossbreds are the only crossbreds that aren't more prolific than purebreds. Age of first breeding was significant ($P \leq .05$) at 24 mo of age. Burfening et al. (1972) also reported 7-mo open ewes to give birth to less lambs than 7-mo pregnant ewes. Number of lambs born per ewe lambing was affected by year of production ($P \leq .005$) for 24, 36, and 48 mo of age. Other investigators (Sidwell et al., 1962; Fahmy and Bernard, 1973) also found year of production to be a significant factor in prolificacy.

Number of lambs weaned per ewe lambing (table 11) is a measure of prolificacy and livability and ranged from .93 at 12 mo to 1.20 lambs weaned per ewe lambing at 60 mo of age. Vesely and Peters (1974) found prolificacy to increase until 6 yr of age and Sidwell et al. (1962) and Vesely and Peters (1981) reported greater lamb livability at 4 to 5 yr of age. This table shows similar results, with 60 and 72 mo of age having the highest number of lambs weaned per ewe lambing. Breed of ewe significantly affected number of lambs weaned at 12, 24, 60 ($P \leq .005$), and 36 mo ($P \leq .05$) of age, with the Suffolk x Targhee ewes weaning more lambs per ewe lambing. Matthews et al. (1977) reported similar results. However, Bradley et al. (1972) observed the reverse.

The high postweaning nutrition level ewes weaned more lambs per ewe lambing at 12 mo of age ($P \leq .05$). Fahmy and Bernard (1973) stated that nutrition affects prolificacy. Age of first breeding affected number of lambs weaned per ewe lambing at 24 mo of age ($P \leq .05$). Ewes that conceived at 7 mo and ewes not exposed until 19 mo weaned more

TABLE 11. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR NUMBER OF LAMBS WEANED PER EWE LAMBING[a]

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	.93 (227)[c]	.96 (462)	1.14 (410)	1.07 (360)	1.20 (303)	1.14 (162)
Ewe type of birth						
Single	.87 (79)	.96 (170)	1.18 (146)	1.03 (142)	1.13 (118)	1.17 (66)
Multiple	.97 (148)	.96 (292)	1.10 (264)	1.10 (218)	1.27 (185)	1.10 (96)
Ewe breed[b]	***	***	*		***	
T	.82 (93)	.91 (230)	1.08 (205)	1.05 (181)	1.15 (149)	1.13 (74)
S x T	1.02 (134)	1.00 (232)	1.20 (205)	1.08 (179)	1.24 (154)	1.13 (88)
Postweaning nutrition	*					
High	1.03 (122)	.98 (234)	1.14 (215)	1.08 (180)	1.21 (156)	1.19 (84)
Moderate	.81 (105)	.94 (228)	1.14 (195)	1.06 (180)	1.19 (147)	1.08 (78)
Age of first breeding		*				
7 mo	--	1.03 (172)	1.08 (158)	1.12 (148)	1.15 (123)	1.10 (63)
19 mo	--	1.00 (168)	1.10 (142)	1.07 (129)	1.27 (111)	1.14 (68)
7 mo, open	--	.84 (122)	1.24 (110)	1.00 (83)	1.17 (69)	1.17 (31)
Year of production		***	***	***		
1972	.72 (42)					
1973	.99 (50)	1.03 (63)				
1974	.87 (62)	.88 (117)	1.16 (63)			
1975	.76 (52)	.49 (105)	.96 (105)	.85 (70)		
1976	1.26 (21)	1.15 (92)	1.31 (100)	1.16 (89)	1.23 (67)	
1977		1.24 (85)	.97 (76)	1.28 (87)	1.26 (67)	1.15 (49)
1978			1.30 (66)	.74 (57)	1.15 (76)	1.12 (55)
1979				1.30 (57)	.99 (44)	1.14 (58)
1980					1.36 (49)	
Lamb type of birth	***	***	***	***	***	***
Single	.74 (164)	.75 (292)	.87 (208)	.71 (134)	.85 (87)	.73 (48)
Multiple	1.09 (63)	1.16 (170)	1.41 (202)	1.42 (226)	1.56 (216)	1.54 (114)
Standard deviation	.51	.52	.54	.56	.58	.61

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Values within parentheses represent number of observations.
*$P \leq .05$.
***$P \leq .005$.

lambs than the 7-mo open ewes. At 24, 36, and 48 mo of age, year of production significantly ($P \leq .005$) affected number of lambs weaned per ewe lambing. This agrees with research conducted by Sidwell et al. (1962). Lamb type of birth affected ($P \leq .005$) number of lambs weaned at all ages of the ewe, with multiple births having more lambs weaned per ewe lambing. Gould and Whiteman (1974) reported similar results, while Thrift and Dutt (1976) found no significant difference.

Number of lambs weaned per ewe exposed (table 12) is a measure of fertility (conception rate), prolificacy, and livability and ranged from .51 at 12 mo to 1.28 lambs weaned at 60 mo of age. Suffolk x Targhee ewes weaned more lambs at 12, 24, 60 ($P \leq .005$), and 36 mo ($P \leq .05$) than Targhee ewes. Dickerson and Laster (1975) and Matthews et al. (1977) documented similar results for these two breeds. However, Bradley et al. (1972) reported the reverse. The high postweaning nutrition group weaned more lambs per ewe exposed at 12 ($P \leq .005$) and 72 mo ($P \leq .05$). Age of first breeding affected number of lambs weaned at 24 and 36 mo ($P \leq .05$). The 7-mo open group was lower at 12 mo and higher at 24 mo than the 7-mo pregnant and 19-mo group. Briggs (1936) reported similar results for 7-mo open and 7-mo pregnant at 12 mo and stated that this trend continued through 24 mo. Year of production was significant at 12, 24, 36, and 48 mo at the $P \leq .005$ level and 60 mo at the $P \leq .05$ level. Many investigators (Sidwell et al., 1962; Wright et al., 1975; Vesely and Peters, 1981) found year of production to affect number of lambs weaned per ewe exposed.

TABLE 12. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR NUMBER OF LAMB WEANED PER EWE EXPOSED[a]

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	.51 (388)[c]	.83 (519)	1.04 (454)	1.11 (382)	1.28 (319)	1.25 (168)
Ewe type of birth						
Single	.50 (142)	.82 (201)	1.05 (173)	1.07 (151)	1.18 (125)	1.31 (69)
Multiple	.52 (246)	.83 (318)	1.03 (281)	1.14 (231)	1.38 (194)	1.19 (99)
Ewe breed[b]	***	***	*		***	
T	.35 (197)	.76 (264)	.93 (230)	1.04 (193)	1.17 (158)	1.23 (75)
S x T	.66 (191)	.89 (255)	1.14 (224)	1.18 (189)	1.39 (161)	1.27 (93)
Postweaning nutrition	***					*
High	.60 (197)	.82 (267)	1.06 (232)	1.12 (193)	1.34 (161)	1.29 (85)
Moderate	.42 (191)	.84 (252)	1.01 (222)	1.10 (189)	1.22 (158)	1.21 (83)
Age of first breeding		*	*			
7 mo	--	.88 (196)	.98 (181)	1.16 (159)	1.28 (131)	1.19 (65)
19 mo	--	.89 (180)	.98 (159)	1.16 (133)	1.37 (114)	1.19 (72)
7 mo, open	--	.71 (143)	1.15 (114)	1.00 (90)	1.19 (74)	1.38 (31)
Year of production	***	***	***	***	*	
1972	.43 (68)					
1973	.59 (87)	.53 (100)				
1974	.64 (83)	.87 (124)	.76 (87)			
1975	.52 (88)	.46 (112)	.92 (112)	.69 (77)		
1976	.36 (62)	1.10 (95)	1.24 (106)	1.23 (95)	1.31 (70)	
1977		1.17 (88)	.82 (83)	1.37 (95)	1.12 (80)	1.11 (55)
1978			1.44 (66)	.76 (57)	1.30 (76)	1.20 (55)
1979				1.49 (58)	1.10 (44)	1.43 (58)
1980					1.57 (49)	
Standard deviation	.60	.57	.62	.69	.71	.00

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Values within parentheses represent number of observations.
*$P \leq .05$.
***$P \leq .005$.

Kilograms of lamb weaned per ewe exposed (table 13) is a more concise measurement of lamb production than number of lambs weaned, since single lambs tend to weigh more at weaning. Kilograms of lamb weaned ranged from 10.22 at 12 mo to 29.01 at 60 mo. Suffolk x Targhee ewes weaned more kilograms of lamb at 12 and 36 mo ($P \leq .005$) and weaned more lambs. However, at 24 and 60 mo, Suffolk x Targhee ewes only weaned more lambs and not more kilograms. Therefore, the assumption is made that Targhee ewes weaned heavier lambs at 24 and 60 mo of age. Matthews et al. (1977) indicated that Suffolk x Targhee ewes weaned more kilograms of lamb, while Sidwell and Miller (1971c) reported Targhee ewes weaned more kilograms of lamb. In both cases, it was due to a higher number of lambs weaned and not higher weaning weight. This supports Sidwell and Miller's (1971c) statement that weight of lamb weaned is highly dependent on number of lambs weaned.

The high postweaning nutrition group also weaned more kilograms of lamb at 12 mo. This may suggest that the high group produced more milk, since they did not give birth to more lambs but weaned more lambs and more kilograms of lamb. Year of production affected kilograms of lamb weaned for 12 and 48 mo at the $P \leq .005$ level and 24 and 36 mo at the $P \leq .05$ level. Number of lambs weaned was similar in significance, therefore indicating no large change in weaning weights. Lamb type of birth was highly ($P \leq .005$) significant at all ages. This also supports that number of lambs weaned is a major factor in kilograms of lamb weaned.

TABLE 13. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR KILOGRAMS OF LAMB WEANED PER EWE EXPOSED

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	10.22 (388)[b]	21.22 (520)	27.02 (464)	27.18 (396)	29.01 (340)	27.48 (184)
Ewe type of birth						
Single	10.25 (142)	20.98 (201)	29.15 (180)	26.75 (157)	27.93 (130)	27.22 (73)
Multiple	10.18 (246)	21.43 (319)	24.90 (284)	27.63 (239)	30.07 (210)	27.77 (111)
Ewe breed[a]	***		***			
T	8.00 (197)	19.66 (264)	23.61 (236)	25.73 (201)	26.41 (169)	28.44 (88)
S x T	12.43 (191)	22.74 (256)	30.44 (228)	28.65 (195)	31.58 (171)	26.55 (96)
Postweaning nutrition	***					
High	11.41 (197)	21.71 (268)	26.72 (238)	26.50 (201)	27.98 (171)	28.46 (91)
Moderate	9.02 (191)	20.69 (252)	27.33 (226)	27.88 (195)	30.05 (169)	26.53 (93)
Age of first breeding						
7 mo	--	22.48 (197)	25.14 (182)	28.90 (162)	29.47 (137)	25.94 (70)
19 mo	--	22.44 (180)	26.89 (161)	28.40 (140)	31.36 (125)	29.03 (75)
7 mo, open	--	18.68 (143)	29.04 (121)	24.27 (94)	26.16 (78)	27.52 (39)
Year of production	***	*	*	***		
1972	6.04 (68)^{c}					
1973	10.44 (87)^{d}	17.82 (100)^{cd}				
1974	9.21 (83)^{d}	22.48 (124)^{ce}	24.02 (87)^{cd}			
1975	11.12 (88)^{d}	13.84 (113)^{d}	19.74 (112)^{c}	21.69 (77)^{c}		
1976	14.26 (62)^{e}	26.14 (95)^{e}	32.93 (106)^{e}	30.36 (95)^{d}	31.98 (70)	
1977		25.72 (88)^{e}	26.96 (83)^{cde}	31.11 (95)^{d}	33.19 (80)	28.87 (55)
1978			31.47 (76)^{de}	15.68 (64)^{c}	29.35 (87)	24.59 (63)
1979				37.13 (65)^{d}	23.46 (51)	31.03 (66)
1980					27.01 (52)	
Lamb type of birth	***	***	***	***	***	***
None	.00 (161)^{c}	.00 (58)^{c}	.00 (53)^{c}	.00 (36)^{c}	.00 (37)^{c}	.00 (20)^{c}
Single	14.16 (164)^{d}	27.23 (292)^{d}	31.48 (209)^{d}	29.49 (134)^{d}	34.01 (87)^{d}	30.43 (49)^{d}
Multiple	16.61 (63)^{e}	35.93 (170)^{e}	47.66 (202)^{e}	51.88 (226)^{e}	54.88 (216)^{e}	54.03 (115)^{e}
Standard deviation	6.80	17.63	18.11	20.39	20.91	23.09

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

[b] Values within parentheses represent number of observations.

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

*$P \leq .05$.

***$P \leq .005$.

Kilograms of lamb weaned per ewe lambing is a measure of lamb growth and survival (table 14). Kilograms of lamb weaned per ewe lambing ranged from 15.71 kg at 12 mo to 44.50 kg of lamb weaned at 60 mo. This trend is similar to number of lambs weaned per ewe lambing, therefore suggesting that age of ewe did not drastically affect lamb growth. Suffolk x Targhee ewes weaned more kilograms of lamb at 12 and 36 mo at the $P \leq .005$ level and 24 and 48 mo at $P \leq .05$ level. This is partially explained by Suffolk x Targhee ewes weaning more lambs at these ages as shown in table 11. These results agreed with results of Matthews et al. (1977) and disagreed with those reported by Sidwell and Miller (1971c).

Year of production significantly ($P \leq .005$) affected kilograms of lamb weaned per ewe lambing. Other researchers also reported year of production as a significant factor (Sidwell and Grandstaff, 1949; Thrift and Dutt, 1976). Lamb type of birth significantly ($P \leq .005$) affected kilograms of lamb weaned per ewe lambing at all ages except 12 mo. Number of lambs weaned per ewe lambing was also affected by lamb type of birth at all ages. In both analysis, multiple births accounted for more kilograms weaned. Thus, this indicates that multiple-born lambs born to 12-mo-old ewes had a slower growth rate to weaning than single-born lambs. Dickerson and Laster (1975) and Pajl (1978) also found lamb type of birth to affect weight of lamb weaned per ewe.

Another method of measuring lamb production is by per ewe weaning a lamb(s). Kilograms of lamb weaned per ewe weaning a lamb(s) ranged from 19.75 kg at 12 mo to 52.26 kg at 72 mo (table 15). Targhee

TABLE 14. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR KILOGRAMS OF LAMB WEANED PER EWE LAMBING

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	15.71 (227)[b]	31.51 (462)	39.73 (411)	40.83 (360)	44.50 (303)	43.01 (164)
Ewe type of birth						
Single	15.32 (79)	31.54 (170)	40.60 (147)	39.64 (142)	41.89 (118)	43.82 (66)
Multiple	15.86 (148)	31.46 (292)	38.84 (264)	42.00 (218)	47.16 (185)	42.11 (98)
Ewe breed[a]	***	*	***	*		
T	12.65 (93)	28.92 (230)	35.61 (206)	38.07 (181)	41.27 (149)	41.31 (76)
S x T	18.53 (134)	34.08 (232)	43.83 (205)	43.58 (179)	47.78 (154)	44.62 (88)
Postweaning nutrition						
High	17.16 (122)	31.94 (234)	39.95 (215)	40.67 (180)	43.95 (156)	44.80 (84)
Moderate	14.02 (105)	31.06 (228)	39.49 (196)	40.98 (180)	45.09 (147)	41.13 (80)
Age of first breeding						
7 mo	--	32.28 (172)	36.79 (158)	43.34 (148)	43.15 (123)	41.57 (64)
19 mo	--	33.42 (168)	39.39 (142)	41.55 (129)	47.98 (111)	43.82 (68)
7 mo, open	--	28.25 (122)	42.98 (111)	37.57 (83)	42.44 (69)	43.52 (32)
Year of production	***	***	***	***		
1972	9.58 (42)[c]					
1973	15.59 (50)[d]	26.45 (63)[cd]				
1974	13.50 (62)[cd]	32.10 (117)[ce]	36.22 (63)[c]			
1975	15.43 (52)[d]	19.92 (105)[d]	31.32 (105)[c]	33.23 (70)[c]		
1976	23.85 (21)[f]	40.63 (92)[f]	48.93 (100)[d]	45.01 (89)[d]	47.50 (67)	
1977		38.40 (85)[ef]	33.71 (76)[c]	45.72 (87)[d]	51.67 (67)	40.60 (49)
1978			48.41 (67)[d]	26.27 (57)[c]	44.23 (76)	43.16 (55)
1979				53.90 (57)[d]	42.43 (44)	45.14 (60)
1980					36.78 (49)	
Lamb type of birth		***	***	***	***	***
Single	14.27 (164)	27.17 (292)	31.72 (209)	29.63 (134)	34.08 (87)	29.26 (49)
Multiple	16.91 (63)	35.83 (170)	47.72 (202)	52.02 (226)	54.97 (216)	56.67 (115)
Standard deviation	8.90	18.59	18.94	21.03	21.91	23.98

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
***$P \leq .005$.

TABLE 15. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR KILOGRAMS OF LAMB WEANED PER EWE WEANING A LAMB(S)

	Age, mo					
Parameter	12	24	36	48	60	72
Overall mean	19.75 (176)[b]	40.73 (353)	44.49 (347)	50.29 (302)	51.49 (272)	52.26 (139)
Ewe type of birth						
Single	19.74 (62)	40.67 (133)	44.06 (129)	50.29 (116)	50.08 (106)	54.26 (57)
Multiple	19.76 (114)	40.83 (220)	44.95 (218)	50.28 (186)	52.91 (166)	50.38 (82)
Ewe breed[a]	***	*	***	***	***	
T	16.42 (71)	39.00 (167)	40.67 (174)	45.82 (153)	46.71 (133)	48.93 (64)
S x T	23.08 (105)	42.49 (186)	48.34 (173)	54.76 (149)	56.29 (139)	55.71 (75)
Postweaning nutrition						
High	19.70 (104)	40.13 (183)	44.29 (184)	49.87 (152)	51.32 (140)	51.71 (76)
Moderate	19.81 (72)	41.37 (170)	44.72 (163)	50.71 (150)	51.68 (132)	52.93 (63)
Age of first breeding						
7 mo	--	42.81 (127)	44.62 (130)	47.48 (131)	50.32 (108)	48.25 (57)
19 mo	--	41.26 (131)	43.60 (123)	52.13 (104)	51.83 (101)	51.91 (56)
7 mo, open	--	38.18 (95)	45.28 (94)	51.25 (67)	52.34 (63)	56.80 (26)
Year of production	***	*	***	*	***	
1972	15.28 (28)[c]					
1973	20.10 (38)[de]	36.58 (49)[c]				
1974	17.25 (50)[cd]	41.24 (91)[cd]	39.28 (52)[c]			
1975	21.27 (42)[ef]	41.00 (50)[cd]	37.79 (83)[c]	46.51 (47)[c]		
1976	24.48 (18)[f]	45.46 (81)[d]	50.16 (93)[d]	52.24 (79)[cd]	51.40 (61)[de]	
1977		39.47 (82)[c]	40.70 (58)[c]	49.78 (83)[cd]	58.04 (59)[e]	45.63 (42)
1978			54.05 (61)[d]	46.20 (40)[c]	49.83 (68)[d]	55.19 (43)
1979				56.70 (53)[d]	59.52 (37)[e]	56.16 (54)
1980					38.70 (47)[c]	
Lamb type of birth		***	***	***	***	***
Single	18.80 (122)	37.00 (211)	36.90 (168)	42.50 (97)	41.12 (74)	42.71 (36)
Multiple	20.71 (54)	44.49 (142)	52.10 (179)	58.08 (205)	61.88 (198)	61.93 (103)
Standard deviation	4.81	11.15	12.30	14.37	14.53	17.69

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
***$P \leq .005$.

ewes weaned less kilograms of lambs at all ages except 72 mo, with 12, 36, and 48 mo at the $P \leq .005$ level and 24 mo at the $P \leq .05$ level. Most of this can be accounted for by the higher number of lambs weaned by the Suffolk x Targhee ewes. Year of production was a significant factor in kilograms of lamb weaned per ewe weaning a lamb(s) at the $P \leq .005$ or $P \leq .05$ level from 12 to 60 mo of age. Kilograms of lamb weaned was significantly affected ($P \leq .005$) by lamb type of birth after 12 mo of age. This trend is also seen in kilograms of lamb weaned per ewe lambing. Therefore, table 15 also shows that the growth rate of multiple-born lambs born to 12-mo-old ewes is slower than the single-born lambs born to the same aged ewes.

Average lamb weaning weight per ewe weaning a lamb(s) allows the producer to evaluate the performance of a ewe's lamb production by removing the multiple birth advantage (table 16). The average values ranged from 16.37 kg at 12 mo to 37.95 kg at 72 mo. Suffolk x Targhee ewes weaned significantly heavier lambs after 24 mo of age. This information and number of lambs weaned per ewe explained why Suffolk x Targhee ewes weaned more kilograms of lamb than Targhee ewes. Year of production and number of lambs weaned significantly affected lamb weaning weight at all ewe ages. Twin weaned lambs weaned at a lower weight. This strongly agreed with data reported by Sidwell (1956), Dickerson and Laster (1975) and Pajl (1978). Sex of lamb only affected ($P \leq .05$) average lamb weaning weight for 12-mo-old ewes. Male lambs have been reported to be heavier at weaning time than ewe lambs (Levine and Hohenboken, 1978; Rastogi et al., 1982). This factor may

TABLE 16. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR AVERAGE LAMB WEANING WEIGHT (KG) PER EWE WEANING A LAMB(S)

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	16.37 (176)[b]	34.10 (353)	34.36 (347)	37.94 (301)	37.25 (271)	37.95 (139)
Ewe type of birth						
Single	17.08 (62)	33.79 (133)	33.93 (129)	37.79 (116)	37.05 (106)	38.34 (57)
Multiple	15.66 (114)	34.43 (220)	34.78 (218)	38.09 (185)	37.48 (165)	37.68 (82)
Ewe breed[a]			***	***	*	***
T	14.67 (71)	33.75 (167)	32.78 (174)	35.49 (154)	36.21 (133)	36.33 (64)
S x T	18.06 (105)	34.47 (186)	35.93 (173)	40.38 (147)	38.32 (138)	39.69 (75)
Postweaning nutrition						
High	16.38 (104)	33.94 (183)	34.34 (185)	37.37 (150)	36.81 (139)	37.42 (76)
Moderate	16.36 (72)	34.27 (170)	34.38 (162)	38.51 (151)	37.72 (132)	38.59 (63)
Age of first breeding						
7 mo	--	33.79 (127)	33.76 (131)	38.15 (131)	37.32 (108)	37.42 (57)
19 mo	--	33.67 (131)	34.64 (123)	38.27 (105)	37.79 (101)	38.80 (56)
7 mo, open	--	34.87 (95)	34.67 (93)	37.40 (65)	36.68 (62)	37.80 (26)
Year of production	*	***	***	***	***	***
1972	12.93 (28)[c]					
1973	15.97 (38)[d]	27.45 (49)[c]				
1974	15.65 (50)[d]	35.30 (91)[d]	30.68 (50)[c]			
1975	18.30 (42)[e]	39.79 (50)[e]	31.95 (83)[c]	39.14 (47)[c]		
1976	19.40 (18)[e]	36.78 (81)[d]	37.00 (93)[d]	39.63 (77)[c]	38.09 (61)[c]	
1977		31.26 (82)[f]	34.33 (60)[e]	35.41 (83)[d]	41.53 (58)[d]	34.31 (42)[c]
1978			37.81 (61)[d]	33.94 (40)[d]	37.37 (68)[c]	39.94 (43)[d]
1979				41.59 (54)[c]	41.43 (37)[d]	39.77 (54)[d]
1980					27.89 (47)[e]	
Number of lambs weaned	*	***	***	***	***	*
One	18.75 (147)	36.01 (291)	35.93 (238)	40.63 (172)	38.54 (128)	39.46 (76)
Two	13.99 (29)	32.20 (62)	32.79 (109)	35.24 (129)	35.98 (143)	36.55 (63)
Sex of lamb	*					
Female	15.30 (89)	34.04 (176)	33.86 (179)	37.71 (153)	36.81 (135)	38.08 (63)
Male	17.45 (87)	34.17 (177)	34.85 (168)	38.17 (148)	37.72 (136)	37.93 (76)
Standard deviation	3.57	5.20	4.68	5.26	4.92	5.24

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P<.05$.
***$P \leq .005$.

be significant at more ages than 12 mo. However, for this analysis, average weaning weight was used for twin weaned lambs. If the twin lambs were male and female, then they received equal weaning weights.

Accumulative Lamb Production. Accumulative lamb production is a means of determining lifetime net worth. Accumulative production was analyzed on a per ewe entering basis and per ewe present basis. Accumulative lambs born per ewe entering were 5.12 lambs including 12-mo production (table 17) and 4.71 lambs excluding 12-mo production (table 18). Suffolk x Targhee ewes significantly ($P \leq .005$) gave birth to more lambs than Targhee ewes at 12 mo and this difference persisted to 72 mo of age. When 12-mo production was excluded, Suffolk x Targhee ewes still were superior in number of lambs born at 24 to 72 mo but at a somewhat lower level of significance. When reviewing number of lambs born per ewe exposed and per ewe lambing (tables 9 and 10), one realizes that the crossbred's main advantage came at 12 to 36 mo of age and this was large enough to still be significant at 72 mo of age for accumulative number of lambs born per ewe entering. This general concept of crossbred ewes being more prolific than straightbred ewes has been reported also by Botkin and Paules (1965), Parker (1971b), Sidwell and Miller (1971a), Scott (1977), and Vesely and Peters (1981).

Age of first breeding affected ($P \leq .005$) accumulative number of lambs born per ewe entering at all ages. Seven-mo pregnant ewes were the most prolific. This is easily explained by the fact that only the 7-mo pregnant ewes lambed at 12 mo. However, excluding 12-mo data, the only difference between groups in age of first breeding was at 72 mo of

TABLE 17. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE ENTERING THE STUDY

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	.48 (586)[b]	1.51 (586)	2.55 (586)	3.57 (586)	4.46 (586)	5.12 (386)
Ewe type of birth						
Single	.47 (214)	1.52 (214)	2.54 (214)	3.60 (214)	4.52 (214)	5.26 (148)
Multiple	.50 (372)	1.51 (372)	2.56 (372)	3.54 (372)	4.39 (372)	4.98 (238)
Ewe breed[a]	***	***	***	**	*	**
T	.35 (297)	1.38 (297)	2.36 (297)	3.34 (297)	4.17 (297)	4.66 (195)
S x T	.62 (289)	1.64 (289)	2.74 (289)	3.80 (289)	4.74 (289)	5.58 (191)
Postweaning nutrition						
High	.53 (293)	1.52 (293)	2.60 (293)	3.68 (293)	4.57 (293)	5.22 (192)
Moderate	.44 (293)	1.50 (293)	2.50 (293)	3.46 (293)	4.34 (293)	5.02 (194)
Age of first breeding		***	***	***	***	***
7 mo	--	2.33 (232)[c]	3.36 (232)[c]	4.41 (232)[c]	5.34 (232)[c]	5.92 (159)[c]
19 mo	--	1.19 (198)[d]	2.24 (198)[d]	3.31 (198)[d]	4.26 (198)[d]	5.31 (138)[c]
7 mo, open	--	1.03 (156)[d]	2.06 (156)[d]	2.99 (156)[d]	3.77 (156)[d]	4.13 (89)[d]
Year of production		***	***	***	***	***
1972	.45 (110)					
1973	.53 (137)	.98 (110)[c]				
1974	.55 (139)	1.73 (137)[d]	1.76 (110)[c]			
1975	.55 (110)	1.33 (139)[e]	2.96 (137)[d]	2.59 (110)[c]		
1976	.35 (90)	1.67 (110)[d]	2.44 (139)[e]	4.10 (137)[d]	3.67 (110)[c]	
1977		1.85 (90)[d]	2.50 (110)[e]	3.57 (139)[de]	4.99 (137)[d]	4.42 (110)[c]
1978			3.10 (90)[f]	3.29 (110)[ce]	4.55 (139)[cd]	5.61 (137)[d]
1979				4.29 (90)[d]	3.84 (110)[c]	5.33 (139)[cd]
1980					5.23 (90)[d]	
Standard deviation	.68	.79	1.30	1.90	2.53	3.10

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

[b] Values within parentheses represent number of observations.

[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \le .05$).

*$P < .05$.

**$P \le .01$.

***$P \le .005$.

TABLE 18. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

Parameter	Age, mo				
	24	36	48	60	72
Overall mean	1.11 (586)[b]	2.15 (586)	3.16 (586)	4.05 (586)	4.71 (386)
Ewe type of birth					
Single	1.13 (214)	2.15 (214)	3.21 (214)	4.13 (214)	4.86 (148)
Multiple	1.09 (372)	2.14 (372)	3.12 (372)	3.97 (372)	4.57 (238)
Ewe breed[a]	***	**	*	*	*
T	1.01 (297)	1.99 (297)	2.96 (297)	3.80 (297)	4.28 (195)
S x T	1.20 (289)	2.30 (289)	3.36 (289)	4.30 (289)	5.15 (191)
Postweaning nutrition					
High	1.10 (293)	2.18 (293)	3.25 (293)	4.15 (293)	4.82 (192)
Moderate	1.12 (293)	2.11 (293)	3.07 (293)	3.94 (293)	4.61 (194)
Age of first breeding					*
7 mo	1.12 (232)	2.15 (232)	3.20 (232)	4.13 (232)	4.69 (159)[c]
19 mo	1.17 (198)	2.23 (198)	3.30 (198)	4.25 (198)	5.31 (138)[c]
7 mo, open	1.03 (156)	2.06 (156)	2.99 (156)	3.77 (156)	4.14 (89)[d]
Year of production	***	***	***	***	*
1973	.62 (110)[c]				
1974	1.29 (137)[d]	1.39 (110)[c]			
1975	.94 (139)[e]	2.53 (137)[de]	2.23 (110)[c]		
1976	1.29 (110)[d]	2.05 (139)[f]	3.66 (137)[d]	3.30 (110)[c]	
1977	1.40 (90)[d]	2.11 (110)[df]	3.18 (139)[de]	4.55 (137)[d]	4.05 (110)[c]
1978		2.65 (90)[e]	2.91 (110)[ce]	4.16 (139)[cd]	5.16 (137)[d]
1979			3.84 (90)[d]	3.46 (110)[c]	4.93 (139)[d]
1980				4.78 (90)[d]	
Standard deviation	.70	1.24	1.84	2.48	3.07

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

age when the 7-mo open group gave birth to less accumulative lambs than their contemporaries. Spencer et al. (1942), Hulet et al. (1969), Burfening et al. (1972), Hohenboken et al. (1977), Scott (1977), and Ponzoni et al. (1979) also found lamb-bred ewes had a higher lifetime production. Year of production was highly significant ($P \leq .005$) for prolificacy at 24 to 72 mo of age, including and excluding 12-mo production. This agrees with the results reported by many researchers (Karam, 1957; Sidwell et al., 1962; Vesely et al., 1965; Vakil et al., 1968; Wright et al., 1975; Thrift and Dutt, 1976).

Accumulative number of lambs born per ewe present was 7.53 lambs (table 19) including 12-mo production and 7.12 lambs excluding 12-mo production (table 20). The crossbred ewes were more prolific ($P \leq .005$) throughout their lifetime in this investigation, inclusive and exclusive of 12-mo data. This was in agreement with accumulative prolificacy per ewe entering. Once again, age of first breeding was significant ($P \leq .005$) when including 12-mo production, with 7-mo pregnant ewes more prolific. When excluding 12-mo production, no difference was found. Year of production followed the same pattern of significance ($P \leq .005$) for accumulative prolificacy per ewe present as for accumulative prolificacy per ewe entering.

Accumulative number of lambs weaned per ewe entering was 3.53 lambs including 12-mo production (table 21) and 3.26 lambs excluding 12-mo production (table 22). The crossbred ewes weaned a significantly higher number of lambs beginning at 12 and 24 mo of age including and excluding 12-mo production. Matthews et al. (1977) also compared

TABLE 19. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE PRESENT

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	.50 (572)	1.65 (521)	2.98 (465)	4.52 (398)	6.14 (333)	7.53 (179)
Ewe type of birth						
Single	.47 (212)	1.61 (202)	2.89 (180)	4.39 (158)	5.98 (128)	7.44 (69)
Multiple	.52 (360)	1.69 (319)	3.09 (285)	4.65 (240)	6.29 (205)	7.60 (110)
Ewe breed[a]	***	***	***	***	***	***
T	.36 (290)	1.52 (266)	2.78 (238)	4.24 (200)	5.75 (165)	7.05 (87)
S x T	.63 (282)	1.78 (255)	3.20 (227)	4.80 (198)	6.53 (168)	7.99 (92)
Postweaning nutrition						
High	.55 (286)	1.64 (264)	2.98 (236)	4.54 (203)	6.11 (167)	7.50 (89)
Moderate	.44 (286)	1.66 (257)	2.99 (229)	4.50 (195)	6.17 (166)	7.55 (90)
Age of first breeding		***	***	***	***	***
7 mo	--	2.50 (199)[c]	3.89 (180)[c]	5.46 (155)[c]	7.25 (128)[c]	8.42 (67)[c]
19 mo	--	1.28 (182)[d]	2.59 (163)[d]	4.15 (141)[d]	5.60 (123)[d]	7.25 (74)[d]
7 mo, open	--	1.16 (140)[d]	2.48 (122)[d]	3.94 (102)[d]	5.57 (82)[d]	6.89 (38)[d]
Year of production		***	***	***	***	***
1972	.47 (106)					
1973	.54 (134)	1.08 (100)[c]				
1974	.57 (132)	1.89 (123)[d]	2.07 (88)[c]			
1975	.55 (110)	1.53 (114)[e]	3.38 (113)[d]	3.26 (77)[c]		
1976	.34 (90)	1.85 (96)[d]	3.00 (105)[d]	4.94 (97)[d]	5.02 (70)[c]	
1977		1.89 (88)[d]	3.02 (83)[d]	4.68 (95)[d]	6.48 (79)[d]	6.51 (54)[c]
1978			3.46 (76)[d]	4.54 (63)[d]	6.29 (87)[d]	7.98 (59)[d]
1979				5.17 (66)[d]	5.98 (47)[d]	8.07 (66)[d]
1980					6.92 (50)[d]	
Standard deviation	.68	.69	1.00	1.32	1.62	1.80

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
***$P \leq .005$.

TABLE 20. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

	Age, mo				
Parameter	24	36	48	60	72
Overall mean	1.24 (521)	2.58 (465)	4.11 (398)	5.72 (333)	7.12 (179)
Ewe type of birth					
Single	1.23 (202)	2.50 (180)	4.01 (158)	5.61 (128)	7.06 (69)
Multiple	1.26 (319)	2.66 (285)	4.21 (240)	5.85 (205)	7.18 (110)
Ewe breed[a]	***	***	***	***	**
T	1.14 (266)	2.40 (238)	3.86 (200)	5.37 (165)	6.68 (87)
S x T	1.34 (255)	2.75 (227)	4.36 (198)	6.09 (168)	7.56 (92)
Postweaning nutrition					
High	1.22 (264)	2.56 (236)	4.11 (203)	5.69 (167)	7.11 (89)
Moderate	1.27 (257)	2.60 (229)	4.11 (195)	5.76 (166)	7.13 (90)
Age of first breeding					
7 mo	1.29 (199)	2.66 (180)	4.23 (155)	5.99 (128)	7.19 (67)
19 mo	1.27 (182)	2.59 (163)	4.15 (141)	5.61 (123)	7.25 (74)
7 mo, open	1.16 (140)	2.48 (122)	3.95 (102)	5.59 (82)	6.91 (38)
Year of production	***	***	***	***	***
1973	.70 (100)[c]				
1974	1.44 (123)[d]	1.71 (88)[c]			
1975	1.16 (114)[e]	2.93 (113)[d]	2.90 (77)[c]		
1976	1.48 (96)[d]	2.62 (105)[d]	4.49 (97)[d]	4.65 (70)[c]	
1977	1.45 (88)[d]	2.64 (83)[d]	4.30 (95)[d]	6.04 (79)[d]	6.14 (54)[c]
1978		2.99 (76)[d]	4.16 (63)[d]	5.91 (87)[d]	7.53 (59)[d]
1979			4.69 (66)[d]	5.59 (47)[d]	7.69 (66)[d]
1980				6.46 (50)[d]	
Standard deviation	.60	.93	1.25	1.57	1.79

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
**$P \leq .01$.
***$P \leq .005$.

TABLE 21. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE ENTERING THE STUDY

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	.35 (586)^{b}	1.02 (586)	1.78 (586)	2.49 (586)	3.15 (586)	3.53 (386)
Ewe type of birth						
Single	.34 (214)	1.04 (214)	1.81 (214)	2.52 (214)	3.19 (214)	3.62 (148)
Multiple	.34 (372)	.99 (372)	1.75 (372)	2.45 (372)	3.12 (372)	3.44 (238)
Ewe breed^{a}	***	**	**	*	**	***
T	.24 (297)	.92 (297)	1.63 (297)	2.30 (297)	2.90 (297)	3.10 (195)
S x T	.44 (289)	1.11 (289)	1.93 (289)	2.67 (289)	3.40 (289)	3.95 (191)
Postweaning nutrition	**					
High	.41 (293)	1.06 (293)	1.87 (293)	2.61 (293)	3.31 (293)	3.74 (192)
Moderate	.28 (293)	.97 (293)	1.69 (293)	2.36 (293)	2.99 (293)	3.32 (194)
Age of first breeding		***	***	***	***	*
7 mo	--	1.57 (232)^{c}	2.30 (232)^{c}	3.04 (232)^{c}	3.69 (232)^{c}	3.98 (159)^{c}
19 mo	--	.82 (198)^{d}	1.58 (198)^{d}	2.29 (198)^{d}	3.01 (198)^{d}	3.61 (138)^{cd}
7 mo, open	--	.65 (156)^{d}	1.46 (156)^{d}	2.12 (156)^{d}	2.75 (156)^{d}	2.99 (89)^{d}
Year of production		***	***	***	***	
1972	.27 (110)					
1973	.38 (137)	.67 (110)^{c}				
1974	.38 (139)	1.10 (137)^{d}	1.26 (110)^{c}			
1975	.40 (110)	.64 (139)^{c}	1.84 (137)^{d}	1.71 (110)^{c}		
1976	.27 (90)	1.21 (110)^{de}	1.56 (139)^{cd}	2.69 (137)^{d}	2.52 (110)^{c}	
1977		1.45 (90)^{e}	1.83 (110)^{d}	2.49 (139)^{d}	3.35 (137)^{de}	3.07 (110)
1978			2.41 (90)^{e}	2.22 (110)^{cd}	3.19 (139)^{cd}	3.75 (137)
1979				3.32 (90)^{e}	2.60 (110)^{cd}	3.76 (139)
1980					4.10 (90)^{e}	
Standard deviation	.56	.73	1.13	1.60	2.09	2.51

^{a} T = Targhee, S x T = Suffolk x Targhee.
^{b} Values within parentheses represent number of observations.
^{c,d,e} Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 22. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

Parameter	Age, mo				
	24	36	48	60	72
Overall mean	.74 (586)[b]	1.50 (586)	2.21 (586)	2.87 (586)	3.26 (386)
Ewe type of birth					
Single	.76 (214)	1.54 (214)	2.25 (214)	2.92 (214)	3.35 (148)
Multiple	.71 (372)	1.46 (372)	2.17 (372)	2.82 (372)	3.17 (238)
Ewe breed[a]	*	*	*	*	**
T	.67 (297)	1.38 (297)	2.05 (297)	2.65 (297)	2.86 (195)
S x T	.80 (289)	1.62 (289)	2.36 (289)	3.09 (289)	3.66 (191)
Postweaning nutrition					
High	.74 (293)	1.55 (293)	2.29 (293)	2.99 (293)	3.44 (192)
Moderate	.73 (293)	1.45 (293)	2.12 (293)	2.75 (293)	3.08 (194)
Age of first breeding					
7 mo	.73 (232)	1.46 (232)	2.21 (232)	2.85 (232)	3.17 (159)
19 mo	.82 (198)	1.57 (198)	2.28 (198)	3.01 (198)	3.62 (138)
7 mo, open	.65 (156)	1.47 (156)	2.13 (156)	2.75 (156)	3.00 (89)
Year of production	***	***	***	***	
1973	.46 (110)[c]				
1974	.79 (137)[d]	1.05 (110)[c]			
1975	.39 (139)[c]	1.53 (137)[d]	1.50 (110)[c]		
1976	.94 (110)[de]	1.30 (139)[cd]	2.38 (137)[d]	2.31 (110)[c]	
1977	1.11 (90)[e]	1.55 (110)[d]	2.22 (139)[d]	3.04 (137)[cd]	2.85 (110)
1978		2.07 (90)[e]	1.95 (110)[cd]	2.92 (139)[c]	3.44 (137)
1979			2.99 (90)[e]	2.32 (110)[c]	3.49 (139)
1980				3.76 (90)[d]	
Standard deviation	.61	1.02	1.51	2.06	2.41

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .001$.
***$P \leq .005$.

Suffolk x Targhee and Targhee ewes and found similar results. Sidwell et al. (1962) and Sidwell and Miller (1971a) reported similar results. The high postweaning nutrition group weaned more lambs at 12 mo ($P \leq .001$). This advantage was not evident at 24 mo. This suggests that the high postweaning nutrition ewes were in better physical condition at 12 mo to care for their lambs and therefore had a better lamb survival rate.

Age of first breeding had a significant effect on accumulative number of lambs weaned when including 12-mo production. This was expected since the 7-mo pregnant ewes were the only ewes that weaned any lambs at 12 mo of age. Year of production significantly ($P \leq .005$) affected accumulative number of lambs weaned with 12-mo production being inclusive or exclusive but only at 24 to 60 mo of age. Sidwell et al. (1962), Wright et al. (1975), and Vesely and Peters (1981) also found year of production as a significant factor.

Accumulative number of lambs weaned per ewe present was 5.30 lambs with 12-mo production (table 23) and 5.00 lambs without 12-mo production (table 24). Once again, Suffolk x Targhee ewes weaned more lambs than Targhee ewes with or without 12-mo production. The high postweaning nutrition ewes weaned more lambs at 12 mo of age per ewe present. This was identical to per ewe entering. Age of first breeding per ewe present was also identical to per ewe entering. Year of production was significant for all ages but 12 mo whether including or excluding 12-mo production.

TABLE 23. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE PRESENT

Parameter	Age, mo					
	12	24	36	48	60	72
Overall mean	.35 (572)	1.11 (521)	2.10 (465)	3.20 (398)	4.42 (333)	5.30 (179)
Ewe type of birth						
Single	.34 (212)	1.10 (202)	2.05 (180)	3.09 (158)	4.24 (128)	5.29 (69)
Multiple	.35 (360)	1.12 (319)	2.14 (285)	3.31 (240)	4.59 (205)	5.31 (110)
Ewe breed[a]	***	***	***	***	***	**
T	.25 (290)	1.01 (266)	1.92 (238)	2.98 (200)	4.09 (165)	4.88 (87)
S x T	.45 (282)	1.21 (255)	2.27 (227)	3.42 (198)	4.75 (168)	5.72 (92)
Postweaning nutrition	**					
High	.41 (286)	1.14 (264)	2.17 (236)	3.27 (203)	4.51 (167)	5.37 (89)
Moderate	.28 (286)	1.07 (257)	2.02 (229)	3.13 (195)	4.32 (166)	5.23 (90)
Age of first breeding		***	***	***	***	***
7 mo	--	1.72 (199)[c]	2.67 (180)[c]	3.95 (155)[c]	5.27 (128)[c]	6.06 (67)[c]
19 mo	--	.88 (182)[d]	1.84 (163)[d]	2.90 (141)[d]	4.02 (123)[d]	4.97 (74)[d]
7 mo, open	--	.73 (140)[d]	1.77 (122)[d]	2.74 (102)[d]	3.96 (82)[d]	4.87 (38)[d]
Year of production		***	***	***	***	*
1972	.28 (106)					
1973	.38 (134)	.76 (100)[c]				
1974	.40 (132)	1.22 (123)[d]	1.53 (88)[c]			
1975	.40 (110)	.74 (114)[c]	2.15 (113)[d]	2.26 (77)[c]		
1976	.27 (90)	1.35 (96)[d]	1.93 (105)[cd]	3.29 (97)[d]	3.61 (70)[c]	
1977		1.47 (88)[d]	2.18 (83)[d]	3.28 (95)[d]	4.38 (79)[d]	4.67 (54)[c]
1978			2.69 (76)[e]	2.96 (63)[d]	4.43 (87)[d]	5.54 (59)[cd]
1979				4.21 (66)[e]	3.94 (47)[cd]	5.69 (66)[d]
1980					5.73 (50)[e]	
Standard deviation	.56	.68	.99	1.30	1.60	1.72

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 24. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

Parameter	Age, mo 24	36	48	60	72
Overall mean	.81 (521)	1.80 (465)	2.90 (398)	4.11 (333)	5.00 (179)
Ewe type of birth					
Single	.81 (202)	1.77 (180)	2.80 (158)	3.96 (128)	5.00 (69)
Multiple	.82 (319)	1.83 (285)	3.00 (240)	4.27 (205)	4.99 (110)
Ewe breed[a]	*	***	**	***	**
T	.75 (266)	1.66 (238)	2.70 (200)	3.81 (165)	4.60 (87)
S x T	.88 (255)	1.94 (227)	3.09 (198)	4.42 (168)	5.39 (92)
Postweaning nutrition					
High	.81 (264)	1.83 (236)	2.93 (203)	4.17 (167)	5.07 (89)
Moderate	.82 (257)	1.77 (229)	2.86 (195)	4.05 (166)	4.93 (90)
Age of first breeding					
7 mo	.84 (199)	1.79 (180)	3.04 (155)	4.34 (128)	5.11 (67)
19 mo	.88 (182)	1.84 (163)	2.90 (141)	4.02 (123)	4.98 (74)
7 mo, open	.73 (140)	1.77 (122)	2.75 (102)	3.97 (82)	4.90 (38)
Year of production	***	***	***	***	*
1973	.52 (100)[c]				
1974	.88 (123)[d]	1.28 (88)[c]			
1975	.47 (114)[c]	1.80 (113)[d]	2.00 (77)[c]		
1976	1.07 (96)[de]	1.66 (105)[d]	2.94 (97)[d]	3.33 (70)[c]	
1977	1.14 (88)[e]	1.90 (83)[d]	3.03 (95)[d]	4.05 (79)[cd]	4.43 (54)[c]
1978		2.35 (76)[e]	2.70 (63)[d]	4.19 (87)[d]	5.15 (59)[cd]
1979			3.82 (66)[e]	3.64 (47)[cd]	5.42 (66)[d]
1980				5.35 (50)[e]	
Standard deviation	.59	.89	1.22	1.52	1.70

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \le .05$).
*$P \le .05$.
**$P \le .01$.
***$P \le .005$.

Accumulative kilograms of lamb weaned is the most accurate measurement of a ewe's lifetime lamb production, even though it is highly influenced by number of lambs weaned. Accumulative kilograms of lamb weaned per ewe entering was 123.49 kg when including 12-mo production (table 25) and 119.17 kg when excluding 12-mo production (table 26). Crossbred ewes weaned more accumulative kilograms of lamb than Targhee ewes with and without 12-mo production. Matthews et al. (1977) observed the same results between the same breeds. The high postweaning nutrition ewes weaned more kilograms of lamb only at 12 mo ($P \leq .001$). This is easily explained by the higher number of lambs weaned by the high postweaning nutrition group. Age of first breeding was significant for 24, 36, and 48 mo when including 12-mo production. This was due to the 7-mo pregnant ewes being the only ewes weaning lambs at 12 mo of age. Year of production was found to be a significant factor at 24 to 60 mo of age when including and excluding 12-mo production. Sidwell and Grandstaff (1949), Sidwell and Miller (1971c), and Thrift and Dutt (1976) reported similar results.

Accumulative kilograms of lamb weaned per ewe present were 191.22 kg when including 12-mo production (table 27) and 185.92 kg when excluding 12-mo production (table 28). Ewe breed, postweaning nutrition, age of first breeding, and year of production followed the same significance pattern as per ewe entering.

Wool Production. Wool production is another valuable commodity produced by the ewe. Annual fleece weight ranged from 3.22 kg at 12 mo to 4.73 kg at 60 mo of age (table 29). Single-born ewes produced more

TABLE 25. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE ENTERING THE STUDY

	Age, mo					
Parameter	12	24	36	48	60	72
Overall mean	6.12 (586)[b]	30.74 (586)	57.92 (586)	84.58 (586)	108.84 (586)	123.49 (386)
Ewe type of birth						
Single	6.27 (214)	31.49 (214)	59.00 (214)	85.91 (214)	110.04 (214)	125.96 (148)
Multiple	5.92 (372)	29.98 (372)	56.84 (372)	83.25 (372)	107.64 (372)	121.11 (238)
Ewe breed[a]	***	***	***	***	***	***
T	3.97 (297)	27.17 (297)	51.33 (297)	75.30 (297)	95.76 (297)	104.69 (195)
S x T	8.22 (289)	34.30 (289)	64.51 (289)	93.85 (289)	121.92 (289)	142.37 (191)
Postweaning nutrition	**					
High	7.21 (293)	31.78 (293)	60.64 (293)	88.32 (293)	113.48 (293)	130.43 (192)
Moderate	4.98 (293)	29.69 (293)	55.19 (293)	80.84 (293)	104.20 (293)	116.63 (194)
Age of first breeding		***	**	*		
7 mo	--	40.03 (232)^{c}	65.44 (232)^{c}	94.20 (232)^{c}	117.54 (232)	130.13 (159)
19 mo	--	29.14 (198)^{d}	56.82 (198)^{cd}	83.56 (198)^{cd}	110.61 (198)	133.56 (138)
7 mo, open	--	23.03 (156)^{d}	51.49 (156)^{d}	75.97 (156)^{d}	98.37 (156)	106.90 (89)
Year of production		***	***	***	***	*
1972	3.88 (110)					
1973	6.05 (137)	16.42 (110)^{c}				
1974	6.50 (139)	33.55 (137)^{d}	35.01 (110)^{c}			
1975	7.95 (110)	19.88 (139)^{c}	58.07 (137)^{d}	52.99 (110)^{c}		
1976	6.10 (90)	39.01 (110)^{de}	53.84 (139)^{d}	90.78 (137)^{d}	83.50 (110)^{c}	
1977		44.82 (90)^{e}	61.21 (110)^{d}	86.08 (139)^{d}	117.68 (137)^{de}	102.02 (110)^{c}
1978			81.46 (90)^{e}	75.40 (110)^{d}	112.45 (139)^{de}	133.57 (137)^{cd}
1979				117.62 (90)^{c}	91.84 (110)^{cd}	135.01 (139)^{d}
1980					138.74 (90)^{e}	
Standard deviation	9.98	22.64	37.24	55.53	74.57	91.82

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 26. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

	Age, mo				
Parameter	24	36	48	60	72
Overall mean	25.45 (586)[b]	52.63 (586)	79.29 (586)	103.55 (586)	119.17 (386)
Ewe type of birth					
Single	25.99 (214)	53.49 (214)	80.40 (214)	104.54 (214)	121.39 (148)
Multiple	24.91 (372)	51.76 (372)	78.17 (372)	102.56 (372)	117.02 (238)
Ewe breed[a]	**	***	***	***	***
T	22.74 (297)	46.90 (297)	70.87 (297)	91.33 (297)	101.07 (195)
S x T	28.16 (289)	58.36 (289)	87.70 (289)	115.78 (289)	137.34 (191)
Postweaning nutrition					
High	25.69 (293)	54.54 (293)	82.22 (293)	107.38 (293)	125.66 (192)
Moderate	25.21 (293)	50.72 (293)	76.36 (293)	99.72 (293)	112.75 (194)
Age of first breeding					
7 mo	24.61 (232)	50.02 (232)	78.78 (232)	102.12 (232)	116.99 (159)
19 mo	28.82 (198)	56.50 (198)	83.24 (198)	110.29 (198)	133.58 (138)
7 mo, open	22.91 (156)	51.37 (156)	75.84 (156)	98.25 (156)	107.03 (89)
Year of production	***	***	***	***	
1973	13.43 (110)^{c}				
1974	28.64 (137)^{d}	32.02 (110)^{c}			
1975	15.13 (139)^{c}	53.16 (137)^{d}	50.00 (110)^{c}		
1976	33.30 (110)^{d}	49.09 (139)^{d}	85.88 (137)^{d}	80.51 (110)^{c}	
1977	36.74 (90)^{d}	55.50 (110)^{d}	81.33 (139)^{d}	112.77 (137)^{de}	98.89 (110)
1978		73.38 (90)^{e}	69.69 (110)^{cd}	107.70 (139)^{cde}	128.55 (137)
1979			109.54 (90)^{e}	86.12 (110)^{cd}	130.17 (139)
1980				103.66 (90)^{e}	
Standard deviation	21.20	35.77	54.26	73.30	90.03

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
**$P \leq .01$.
***$P \leq .005$.

TABLE 27. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE PRESENT

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	6.29 (572)[b]	33.95 (521)	69.36 (465)	110.50 (398)	155.52 (333)	191.22 (179)
Ewe type of birth						
Single	6.40 (212)	33.71 (202)	67.97 (180)	107.19 (158)	150.03 (128)	191.40 (69)
Multiple	6.15 (360)	34.16 (319)	70.69 (285)	113.76 (240)	160.99 (205)	191.04 (110)
Ewe breed[a]	***	***	***	***	***	***
T	4.15 (290)	30.18 (266)	61.00 (238)	98.28 (200)	137.22 (165)	169.52 (87)
S x T	8.41 (282)	37.69 (255)	77.66 (227)	122.66 (198)	173.81 (168)	212.92 (92)
Postweaning nutrition	**					
High	7.47 (286)	34.59 (264)	71.37 (236)	112.01 (203)	157.46 (167)	191.47 (89)
Moderate	5.08 (286)	33.29 (257)	67.29 (229)	108.93 (195)	153.57 (166)	190.97 (90)
Age of first breeding		***	***	***	***	
7 mo	--	44.72 (199)^{c}	78.34 (180)^{c}	125.70 (155)^{c}	172.91 (128)^{c}	207.41 (67)
19 mo	--	31.32 (182)^{d}	67.18 (163)^{d}	106.63 (141)^{d}	149.05 (123)^{d}	185.88 (74)
7 mo, open	--	25.77 (140)^{d}	62.48 (122)^{d}	99.09 (102)^{d}	144.59 (82)^{d}	180.36 (38)
Year of production		***	***	***	***	***
1972	4.18 (106)					
1973	6.22 (134)	18.83 (100)^{c}				
1974	6.94 (132)	37.35 (123)^{d}	43.43 (88)^{c}			
1975	7.94 (110)	23.85 (114)^{c}	67.81 (113)^{d}	71.41 (77)^{c}		
1976	6.09 (90)	43.96 (96)^{d}	67.74 (105)^{d}	112.69 (97)^{d}	121.31 (70)^{c}	
1977		45.69 (88)^{d}	74.25 (83)^{d}	115.57 (95)^{d}	158.71 (79)^{d}	159.67 (54)^{c}
1978			93.41 (76)^{e}	103.15 (63)^{d}	158.65 (87)^{d}	203.31 (59)^{d}
1979				149.54 (66)^{e}	144.49 (47)^{cd}	210.68 (66)^{d}
1980					194.41 (50)^{e}	
Standard deviation	10.11	21.33	31.58	43.95	54.79	64.00

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
**$P \leq .01$.
***$P \leq .005$.

TABLE 28. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

Parameter	Age, mo				
	24	36	48	60	72
Overall mean	28.41 (521)	63.74 (465)	104.88 (398)	149.87 (333)	185.92 (179)
Ewe type of birth					
Single	28.04 (202)	62.27 (180)	101.30 (158)	144.24 (128)	185.81 (69)
Multiple	28.79 (319)	65.18 (285)	108.43 (240)	155.51 (205)	186.02 (110)
Ewe breed[a]	***	***	***	***	***
T	26.50 (266)	56.37 (238)	93.48 (200)	132.51 (165)	164.98 (87)
S x T	31.23 (255)	71.08 (227)	116.25 (198)	167.24 (168)	206.85 (92)
Postweaning nutrition					
High	28.20 (264)	64.98 (236)	105.80 (203)	151.22 (167)	185.97 (89)
Moderate	28.63 (257)	62.47 (229)	103.93 (195)	148.52 (166)	185.87 (90)
Age of first breeding					
7 mo	28.62 (199)	61.93 (180)	109.30 (155)	155.83 (128)	191.39 (67)
19 mo	31.00 (182)	66.96 (163)	106.44 (141)	149.01 (123)	185.91 (74)
7 mo, open	25.63 (140)	62.28 (122)	98.86 (102)	144.77 (82)	180.46 (38)
Year of production	***	***	***	***	***
1973	15.40 (100)^{c}				
1974	31.85 (123)^{d}	39.91 (88)^{c}			
1975	19.03 (114)^{c}	62.22 (113)^{d}	67.50 (77)^{c}		
1976	38.01 (96)^{d}	62.96 (105)^{d}	106.95 (97)^{d}	117.05 (70)^{c}	
1977	37.78 (88)^{d}	68.31 (83)^{d}	110.78 (95)^{d}	153.30 (79)^{d}	156.16 (54)^{c}
1978		85.23 (76)^{e}	97.22 (63)^{d}	154.17 (87)^{d}	196.41 (59)^{d}
1979			141.88 (66)^{e}	137.95 (47)^{cd}	205.19 (66)^{d}
1980				186.89 (50)^{e}	
Standard deviation	20.34	30.43	42.64	53.64	63.47

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
***$P \leq .005$.

TABLE 29. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ANNUAL FLEECE WEIGHT (KG)

	Age, mo					
Parameter	12	24	36	48	60	72
Overall mean	3.22 (559)[b]	4.59 (504)	4.33 (414)	4.33 (384)	4.73 (329)	4.69 (182)
Ewe type of birth	***		*			
Single	3.31 (210)	4.63 (196)	4.41 (151)	4.37 (152)	4.76 (125)	4.78 (72)
Multiple	3.12 (349)	4.53 (308)	4.24 (263)	4.28 (232)	4.72 (204)	4.59 (110)
Ewe breed[a]	***	***	***	***	***	***
T	3.36 (285)	4.88 (257)	4.65 (210)	4.65 (194)	5.11 (162)	5.06 (87)
S x T	3.06 (274)	4.28 (247)	4.00 (204)	4.00 (190)	4.37 (167)	4.31 (95)
Postweaning nutrition	***		**	**		
High	3.33 (283)	4.63 (259)	4.43 (216)	4.44 (195)	4.79 (164)	4.65 (89)
Moderate	3.10 (276)	4.54 (245)	4.22 (198)	4.21 (189)	4.68 (165)	4.72 (93)
Age of first breeding	***	***				
7 mo	3.05 (224)^{c}	4.43 (185)^{c}	4.28 (162)	4.26 (157)	4.72 (136)	4.65 (68)
19 mo	3.49 (190)^{d}	4.54 (178)^{c}	4.31 (142)	4.40 (134)	4.74 (123)	4.66 (75)
7 mo, open	3.10 (145)^{c}	4.78 (141)^{d}	4.39 (110)	4.32 (93)	4.75 (70)	4.74 (39)
Year of production	***	***	***	***	***	***
1972	3.60 (105)^{c}					
1973	3.10 (129)^{d}	4.03 (97)^{c}				
1974	3.33 (127)^{e}	4.90 (123)^{d}	3.95 (39)^{c}			
1975	3.15 (109)^{de}	4.48 (105)^{e}	4.62 (112)^{d}	4.24 (75)^{cd}		
1976	2.89 (89)^{f}	4.70 (92)^{de}	3.94 (104)^{c}	4.36 (90)^{cd}	3.97 (69)^{c}	
1977		4.80 (87)^{d}	3.98 (83)^{c}	4.58 (93)^{c}	5.17 (77)^{d}	4.53 (55)^{c}
1978			5.12 (76)^{e}	4.01 (62)^{d}	4.86 (87)^{d}	5.42 (61)^{d}
1979				4.44 (64)^{c}	4.05 (50)^{c}	4.10 (66)^{e}
1980					5.64 (46)^{e}	
Standard deviation	.53	.66	.65	.76	.72	.76

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

wool at 12 ($P \leq .005$) and 36 mo ($P \leq .05$). Brown et al. (1966) found multiple-born ewes to have a lower number of wool fibers and therefore produced less kilograms of wool annually. Targhee ewes produced more wool at all ages ($P \leq .005$). The high postweaning nutrition ewes produced more wool at 12 ($P \leq .005$), 36, and 48 mo of age ($P \leq .01$). This was in agreement with results reported by Bradford et al. (1961) and Burfening et al. (1971). Age of first breeding groups displayed some difference ($P \leq .005$) at 12 and 24 mo of age, with little consistency between these two ages. Briggs (1936), Ensminger (1970), and Burfening et al. (1972) reported no effect of age of first breeding on fleece weight. Year of production was a significant source of variation ($P \leq .005$) on annual fleece weight. Terrill et al. (1947) suggested that weather differences between years caused the largest variation in wool production of any one factor analyzed.

Annual fleece weight for ewes lambing eliminates the nutrition advantage a barren ewe may have on annual fleece production. Fleece weight for ewes lambing ranged from 3.05 kg at 12 mo to 4.79 kg at 60 mo of age (table 30). These average values were quite similar to the averages of all ewes except at 12 mo when only a third of the ewes lambed. Single-born ewes that lambed produced more wool ($P \leq .05$) at 36 mo of age than twin-born ewes that lambed. Ewe breed demonstrated the same significant effect on fleece weight for ewes lambing as fleece weight for all ewes. Postweaning nutrition and age of first breeding also exhibited similar results for ewes lambing as for all ewes with

TABLE 30. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR FLEECE WEIGHT (KG) FOR THOSE EWES LAMBING

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	3.05 (224)[b]	4.60 (456)	4.34 (376)	4.31 (349)	4.79 (293)	4.67 (162)
Ewe type of birth			*			
Single	3.11 (79)	4.65 (170)	4.42 (127)	4.32 (137)	4.83 (114)	4.78 (65)
Moderate	2.98 (149)	4.55 (286)	4.25 (249)	4.30 (212)	4.75 (179)	4.56 (97)
Ewe breed[a]	***	***	***	***	***	***
T	3.25 (92)	4.92 (226)	4.68 (188)	4.63 (175)	5.14 (143)	5.04 (75)
S x T	2.84 (132)	4.28 (230)	4.00 (188)	4.00 (174)	4.43 (150)	4.30 (87)
Postweaning nutrition			*	*		
High	3.11 (122)	4.65 (230)	4.42 (196)	4.42 (174)	4.82 (149)	4.63 (82)
Moderate	2.98 (102)	4.54 (226)	4.26 (180)	4.21 (175)	4.75 (144)	4.71 (80)
Age of first breeding		***				
7 mo	--	4.46 (168)^{c}	4.30 (144)	4.25 (143)	4.79 (122)	4.60 (62)
19 mo	--	4.56 (167)^{cd}	4.31 (131)	4.39 (124)	4.84 (109)	4.65 (68)
7 mo, open	--	4.77 (121)^{d}	4.41 (101)	4.30 (82)	4.73 (62)	4.75 (32)
Year of production	***	***	***	*	***	***
1972	3.67 (42)^{c}					
1973	2.41 (50)^{d}	4.14 (60)^{c}				
1974	3.24 (59)^{e}	4.89 (116)^{d}	3.93 (30)^{c}			
1975	3.06 (52)^{ef}	4.44 (105)^{e}	4.64 (105)^{d}	4.24 (68)^{cd}		
1976	2.85 (21)^{f}	4.71 (90)^{d}	3.95 (98)^{c}	4.34 (85)^{cd}	3.99 (66)^{c}	
1977		4.81 (85)^{d}	4.04 (76)^{c}	4.53 (85)^{d}	5.15 (65)^{d}	4.51 (49)^{c}
1978			5.13 (67)^{e}	4.00 (55)^{c}	4.88 (76)^{d}	5.48 (53)^{d}
1979				4.47 (56)^{d}	4.14 (43)^{c}	4.01 (60)^{e}
1980					5.79 (43)^{e}	
Lamb type of birth						
Single	3.06 (161)	4.63 (290)	4.34 (182)	4.31 (130)	4.86 (84)	4.56 (47)
Multiple	3.04 (63)	4.57 (166)	4.34 (194)	4.32 (219)	4.71 (209)	4.78 (115)
Standard deviation	.44	.62	.66	.75	.72	.73

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
***$P \leq .005$.

the exception of 12-mo production. Year of production had a significant effect on fleece weight of ewes lambing at all ages.

Accumulative fleece weight per ewe entering (table 31) averaged 17.36 kg by 72 mo of age. Single-born ewes produced more wool at 12 mo and this difference persisted to 60 mo of age at a significant level. Targhee ewes produced a higher accumulative fleece weight up to 60 mo of age. The lack of a difference at 72 mo for accumulative wool weight per ewe entering the study was unexpected since Targhee ewes produced a heavier clip ($P \leq .005$) than Suffolk x Targhee ewes at all ages as portrayed in table 29. The high postweaning nutrition ewes produced more wool as yearlings and maintained this advantage to 60 mo of age. Evans et al. (1975) found a similar but larger difference.

Ewes not exposed to a ram until 14 mo of age produced more wool at 12 mo of age than their contemporaries; but this higher production was only maintained over the 7-mo pregnant group and only until 36 mo of age. The added nutrient strain on the 7-mo pregnant ewes of raising lambs may account for this difference. Year of production was a significant factor at all ages.

Attrition

About 45% of the original ewes were still alive at 72 mo of age (table 32). Attrition averaged 10.0% from 12 to 60 mo of age, but at 0 to 12 mo of age the death loss was 12.36% of the entire population and 60 to 72 mo of age death loss was 2.63%. Single-born ewes had a slower attrition rate from 12 to 36 mo and at 72 mo of age. Unknown causes were the disposal reason that accounted for the majority of this

TABLE 31. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR ACCUMULATIVE FLEECE WEIGHT (KG) PER EWE ENTERING THE STUDY

Parameter	Age, mo 12	24	36	48	60	72
Overall mean	3.09 (586)[b]	7.10 (586)	10.12 (586)	12.94 (586)	15.44 (586)	17.36 (386)
Ewe type of birth	***	***	**	**	*	
Single	3.23 (214)	7.41 (214)	10.57 (214)	13.58 (214)	16.15 (214)	18.18 (148)
Multiple	2.95 (372)	6.78 (372)	9.67 (372)	12.28 (372)	14.72 (372)	16.54 (238)
Ewe breed[a]	***	***	***	***	***	
T	3.25 (297)	7.54 (297)	10.84 (297)	13.84 (297)	16.60 (297)	18.19 (195)
S x T	2.93 (289)	6.65 (289)	9.40 (289)	12.02 (289)	14.28 (289)	16.53 (191)
Postweaning nutrition	***	*	**	*	*	
High	3.24 (293)	7.32 (293)	10.54 (293)	13.51 (293)	16.08 (293)	17.91 (192)
Moderate	2.94 (293)	6.87 (293)	9.70 (293)	12.36 (293)	14.79 (293)	16.81 (194)
Age of first breeding	***	***	*			
7 mo	3.00 (232)[c]	6.65 (232)[c]	9.54 (232)[c]	12.27 (232)	14.75 (232)	16.65 (159)
19 mo	3.37 (198)[d]	7.52 (198)[d]	10.58 (198)[d]	13.57 (198)	16.36 (198)	18.98 (138)
7 mo, open	2.90 (156)[c]	7.12 (156)[cd]	10.23 (156)[cd]	12.95 (156)	15.20 (156)	16.44 (89)
Year of production	***	***	***	***	***	*
1972	3.41 (110)[c]					
1973	2.96 (137)[d]	6.96 (110)[cd]				
1974	2.96 (139)[d]	7.36 (137)[c]	8.34 (110)[c]			
1975	3.13 (110)[cd]	6.32 (139)[d]	11.18 (137)[de]	11.18 (110)[c]		
1976	3.00 (90)[d]	7.18 (110)[c]	9.16 (139)[cf]	14.25 (137)[d]	13.62 (110)[c]	
1977		7.66 (90)[c]	10.15 (110)[df]	12.18 (139)[c]	17.07 (137)[d]	15.86 (110)[c]
1978			11.77 (90)[e]	12.25 (110)[c]	15.21 (139)[cd]	19.18 (137)[d]
1979				14.80 (90)[d]	13.75 (110)[c]	17.03 (139)[cd]
1980					17.54 (90)[d]	
Standard deviation	.88	2.11	3.50	5.04	6.83	8.76

[a] T = Targhee, S x T = Suffolk x Targhee.
[b] Values within parentheses represent number of observations.
[c,d,e,f] Means with different superscripts in the same column and main effect differ ($P \leq .05$).
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 32. PERCENTAGE OF EWES REMAINING IN THE STUDY[a]

Parameter	Age, mo 12	24	36	48	60	72
Overall	87.64	78.58	66.89	57.17	47.61	44.98
Ewe type of birth	***	*	**			***
Single	91.86	83.71	72.85	60.63	50.68	49.77
Multiple	85.23	75.65	63.47	55.18	45.85	42.23
Ewe breed[b]						
T	87.10	78.71	66.45	55.48	47.74	44.52
S x T	88.22	78.45	67.34	58.92	47.47	45.45
Postweaning nutrition						
High	87.06	78.32	66.99	56.63	46.60	44.34
Moderate	88.26	78.86	66.78	57.72	48.66	45.64
Age of first breeding						
7 mo	89.22	79.74	67.67	57.76	46.98	44.40
19 mo	92.93	84.34	73.23	64.65	54.55	52.53
7 mo, open	90.38	80.13	66.67	54.49	46.15	42.31
Year of birth	***				***	
1971	90.35	83.33	68.42	61.40	47.37	43.86
1972	89.93	82.73	71.22	58.99	46.76	41.73
1973	83.10	73.94	67.61	61.97	47.18	43.66
1974	83.05	71.19	56.78	44.92	44.07	--
1975	93.62	82.98	70.21	57.45	54.26	--

[a] Differences between main effects were tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
*P≤.05.
**P≤.01.
***P≤.005.

variation. One can assume that, since the multiple-born ewes were smaller in size, they may have been more susceptible to disease and coyote kill at young ages. Year of production significantly affected 12- and 60-mo-old ewes. Norman and Hohenboken (1979) also found year of production a significant factor and attributed it to the variation in environmental elements. Table 33 presents all ewe deaths and disposal reasons. The largest disposal reason was unknown causes. Unknown causes mainly consisted of missing ewes. Poor udders, vaginal prolapse, bloat, rectal prolapse, and poor teeth accounted for the majority of the remaining ewe losses. Matthews et al. (1977) and Pajl (1978) reported that missing ewes, poor udders, and poor teeth were the major causes of attrition.

Table 34 presents only the significant disposal reasons. Unknown causes were significant at 12, 48, and 72 mo for ewe type of birth with no consistent pattern. Unknown causes also significantly affected attrition for ewe breed over the entire study, for age of first breeding at 48 mo, and year of birth at 12, 36, 48, and 60 mo of age and over the entire study. Vaginal prolapse accounted for a higher ($P \leq .05$) attrition for 7-mo exposed ewes than 19-mo exposed ewes at 12 mo of age. Bloat was more prevalent in the crossbred ewes over the entire study and was significant for year of birth over the entire study. Udder problems were more common for the moderate postweaning nutrition level ewes at 60 months.

TABLE 33. EWE DEATH AND DISPOSAL REASONS

Reason	Number of ewes
Unknown causes	222 (66.5)[a]
Poor udder	32 (9.6)
Vaginal prolapse	19 (5.7)
Bloat	13 (3.9)
Rectal prolapse	11 (3.3)
Poor teeth	9 (2.7)
Died on back	6 (1.8)
Dystocia	5 (1.5)
Blood poisoning	2 (.6)
Pneumonia	2 (.6)
Renal failure	2 (.6)
Sun stroke	2 (.6)
Abdominal rupture	1 (.3)
Acidosis	1 (.3)
Entertoxemia	1 (.3)
Internal parasites	1 (.3)
Killed by car	1 (.3)
Storm loss	1 (.3)
Strangulation	1 (.3)
Stuck in bog	1 (.3)
Trampled in truck	1 (.3)
Total	334 (100)

[a] Values in parentheses represent percentage of total ewe loss.

TABLE 34. SIGNIFICANT EWE DISPOSAL REASONS AS PERCENTAGES OF EWES PRESENT[a]

	Age, mo							
Parameter	12	24	36	48	60	72	Total	
Ewe type of birth	*			*		*		
Single	1.9[c]			15.2[c]		1.5[c]		
Multiple	5.6			8.8		10.9		
Ewe breed[b]							*	*
T							.7[e]	41.8[c]
S x T							3.8	33.9
Postweaning nutrition					*			
High					1.4[f]			
Moderate					5.7			
Age of first breeding	*			*				
7 mo	3.6[d]			9.7[c]				
19 mo	.1			9.2				
7 mo, open	4.2			16.7				
Year of birth	**		**	***	***		**	***
1971	1.0[c]		18.2[c]	10.4[c]	17.1[c]		2.7[e]	48.2[c]
1972	3.2		6.2	14.4	11.4		.0	38.0
1973	9.7		6.7	1.1	12.6		2.9	34.5
1974	7.4		16.9	22.2	2.1		.0	42.7
1975	1.1		10.5	12.1	.0		6.7	24.4

[a] Differences between main effects tested by Chi-square procedures.
[b] T = Targhee, S x T = Suffolk x Targhee.
[c] Unknown causes.
[d] Vaginal prolapse.
[e] Bloat.
[f] Udder.
*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

SUMMARY

Single-born ewes grew faster to a 3-kg heavier mature weight and produced .78 kg more wool per ewe present and 1.48 kg more wool to 60 mo of age per ewe entering. Fifty percent of the single ewes were still alive at 72 mo of age, while only 42% of the multiple-born ewes were still alive. However, the multiple-born ewes had a 4.4% higher conception rate.

Crossbred ewes had a 3.3 kg heavier mature weight and a .7 cm shorter mature size. They also had a 22% higher conception rate at 7 mo of age and a 5.85% higher overall conception rate. Furthermore, these ewes gave birth to .92 more lambs and weaned .85 more lambs that averaged 2.94 kg more at weaning time. Nevertheless, the Targhee ewes produced 3.69 kg more wool in their lifetime per ewe present, had 3.1% less bloat problems, but 7.9% more deaths attributed to unknown causes.

The high postweaning nutrition ewes grew faster to 12 mo of age, weaned .22 more lambs per ewe lambing at 12 mo of age, and produced .80 kg more wool per ewe present in their lifetime than the moderate postweaning nutrition ewes.

Seven-mo pregnant ewes were 2.6 kg lighter at 12 mo of age and produced .05 and 1.1 kg lighter fleece at 12 and 24 mo of age, respectively, than their contemporaries. If 12-mo production was included, 7-mo pregnant ewes gave birth to 1.17 and 1.53 more lambs than 19-mo ewes and 7-mo open ewes, respectively, and weaned 1.09 and 1.19 more lambs than 19-mo ewes and 7-mo open ewes, respectively, on a per ewe present basis. Furthermore, 7-mo pregnant ewes weaned 23.86

and 28.36 kg more lamb than 19-mo ewes and 7-mo open ewes, respectively, on a per ewe present basis. These three measurements of lamb production on a per ewe entering the study basis followed the same trend as per ewe present but with smaller differences.

Year of production was a very significant factor in growth, mature size, percent conception, number of lambs born and weaned, kilograms of lamb weaned, and fleece weight. Thus, if the producer could identify optimum environmental conditions and economically control them or minimize adverse environmental conditions, he will have gained an excellent management tool.

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APPENDIX

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

Source	Birth date[a]		Birth wt (kg)		Weaning wt (kg)		7-mo wt (kg)		7-mo wither height (cm)		Wt:height ratio (kg:cm)	
	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.322	1	76.379***	1	3044.168***	1	2927.191***	1	428.715***	1	.422***
Ewe breed (Breed)	1	67.275	1	22.256***	1	662.713***	1	2790.109***	1	1.273	1	.758***
Postweaning nutrition (Postwn)	1	.022	1	3.132**	1	.808	1	3404.580***	1	211.125*	1	.579***
Age at first breeding (Age)	2	107.722	2	1.199	2	66.881	2	182.536	2	93.379	2	.026
Year of birth (Year)	4	4199.037***	4	9.479***	4	6309.329***	4	6345.582***	4	3090.663***	4	1.150***
Type x breed	1	21.136	1	.520	1	7.676	1	10.537	1	4.510	1	.000
Type x postwn	1	1.677	1	1.325	1	8.475	1	27.202	1	1.041	1	.017
Type x age	2	34.339	2	.520	2	1.166	2	192.886	2	289.693*	2	.023
Type x year	4	272.505	4	.925	4	424.183***	4	299.292	4	249.741	4	.050
Breed x postwn	1	2.691	1	.382	1	.332	1	.681	1	11.625	1	.001
Breed x age	2	196.628	2	2.121	2	24.649	2	331.491*	2	154.865	2	.024
Breed x year	4	465.684*	4	1.225	4	232.280***	4	806.924***	4	285.935	4	.064*
Postwn x age	2	54.380	2	.046	2	12.573	2	156.582	2	93.973	2	.007
Postwn x year	4	59.817	4	.970	4	94.904	4	1111.733***	4	60.251	4	.323***
Age x year	8	213.163	8	2.926	8	91.588	8	445.932	8	142.439	8	.089
Error	545	47.686	547	.413	546	14.680	547	48.776	547	38.985	542	.007

[a] Days after January 1.

*P≤.05.

**P≤.001.

***P≤.005.

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

Source	Age, mo: 12 df	12 MS	24 df	24 MS	36 df	36 MS	48 df	48 MS	60 df	60 MS	72 df	72 MS
Ewe type of birth (Type)	1	1377.164***	1	621.526***	1	800.102***	1	81.601	1	326.448*	1	261.186*
Ewe breed (Breed)	1	2749.878***	1	607.782***	1	1203.105***	1	1220.762***	1	195.601	1	258.773*
Postweaning nutrition (Postwn)	1	501.087***	1	24.515	1	5.424	1	22.508	1	58.779	1	57.719
Age of first breeding (Age)	2	1068.021***	2	3.848	2	.914	2	8.505	2	13.855	2	1.598
Year of production (Year)	4	11269.114***	4	3914.978***	4	4267.847***	4	8618.456***	4	1950.127***	2	254.094
Type x breed	1	.073	1	1.161	1	81.231	1	14.168	1	168.639	1	4.173
Type x postwn	1	40.782	1	146.195	1	51.138	1	77.680	1	138.237	1	26.169
Type x age	2	21.584	2	8.938	2	95.281	2	103.430	2	137.323	2	259.168
Type x year	4	223.276	4	64.929	4	122.788	4	192.110	4	18.559	2	94.600
Breed x postwn	1	2.350	1	17.636	1	17.605	1	.127	1	.978	1	66.512
Breed x age	2	300.967*	2	16.015	2	70.390	2	23.954	2	17.783	2	48.520
Breed x year	4	335.826*	4	209.863	4	48.667	4	108.415	4	75.494	2	85.624
Postwn x age	2	61.523	2	9.896	2	1.804	2	65.551	2	41.774	2	274.065
Postwn x year	4	63.468	4	37.658	4	87.988	4	195.619	4	264.547	2	45.532
Age x year	8	2022.887***	8	722.143*	8	354.385	8	664.411	8	1168.873**	4	899.754**
Error	514	33.267	430	40.690	383	42.183	314	45.099	248	54.727	131	63.396

*$P \leq .05$.
**$P \leq .001$.
***$P \leq .005$.

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

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	339.673***	1	493.511***	1	467.214**	1	79.577	1	146.516	1	209.965
Ewe breed (Breed	1	497.591***	1	320.343***	1	650.466***	1	1087.887***	1	278.867*	1	104.904
Postweaning nutrition (Postwn)	1	54.494	1	79.003	1	6.812	1	5.380	1	15.538	1	17.516
Age of first breeding (Age)	-	--	2	17.307	2	16.143	2	42.433	2	15.385	2	2.554
Year of production (Year)	4	4395.475***	4	2861.188***	4	2934.829***	4	6047.700***	4	1230.454***	2	166.907
Type x breed	1	3.026	1	27.019	1	40.432	1	1.816	1	119.173	1	52.614
Type x postwn	-	--	1	129.537	1	21.520	1	185.009*	1	129.626	1	.027
Type x age	-	--	2	6.947	2	79.938	2	34.522	2	81.132	2	218.168
Type x year	4	75.873	4	48.967	4	84.718	4	143.107	4	39.631	2	76.204
Breed x postwn	1	69.649	1	.002	1	11.557	1	21.496	1	26.075	1	58.176
Breed x age	-	--	2	6.311	2	57.997	2	52.850	2	8.550	2	39.068
Breed x year	4	195.822	4	122.850	4	35.749	4	14.739	4	130.234	2	125.711
Postwn x age	-	--	2	.014	2	21.419	2	27.320	2	63.271	2	438.757*
Postwn x year	4	27.354	4	34.243	4	238.968	4	361.460*	4	165.384	2	18.314
Age x year	-	--	8	619.143*	8	176.674	8	632.759*	8	1011.329**	4	944.295***
Error	152	26.112	286	35.188	295	40.165	242	35.107	215	47.802	111	57.891

*P≤.05.
**P≤.001.
***P≤.005.

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

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	76.258***	1	35.336*	1	11.541	1	9.723	1	4.147	1	51.416**
Ewe breed (Breed)	1	48.665***	1	157.970***	1	47.648*	1	16.865	1	47.417***	1	12.459
Postweaning nutrition (Postwn)	1	32.662*	1	.030	1	2.101	1	.178	1	.598	1	18.134
Age of first breeding (Age)	2	34.343	2	.008	2	2.894	2	34.962	2	9.802	2	1.965
Year of production (Year)	4	2108.637***	4	771.407***	4	245.369***	4	466.744***	4	509.003***	2	52.818*
Type x breed	1	2.985	1	13.243	1	.039	1	5.343	1	.001	1	3.200
Type x postwn	1	.026	1	1.112	1	72.250***	1	14.058	1	18.015	1	4.718
Type x age	2	8.497	2	12.633	2	16.173	2	21.315	2	13.048	2	7.407
Type x year	4	55.045	4	17.871	4	12.339	4	7.473	4	45.826	2	17.081
Breed x postwn	1	.356	1	1.889	1	.709	1	2.190	1	4.327	1	5.600
Breed x age	2	.200	2	2.544	2	26.402	2	2.383	2	4.770	2	1.241
Breed x year	4	40.519	4	232.662***	4	66.175	4	48.598	4	12.947	2	11.860
Postwn x age	2	22.883	2	8.764	2	3.093	2	.128	2	4.463	2	42.359*
Postwn x year	4	23.980	4	16.547	4	27.583	4	4.538	4	66.976*	2	1.629
Age x year	8	124.758**	8	78.148	8	101.510	8	56.483	8	128.781**	4	56.535
Error	513	5.841	430	6.682	383	8.279	308	6.501	248	5.796	131	6.746

*P≤.05.
**P≤.001.
***P≤.005.

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

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	20.541	1	10.623	1	3.635	1	6.345	1	3.524	1	43.716**
Ewe breed (Breed)	1	4.198	1	113.833***	1	31.764	1	9.959	1	38.957**	1	18.270
Postweaning nutrition (Postwn)	1	.450	1	3.827	1	.017	1	.122	1	1.782	1	9.324
Age of first breeding (Age)	-	--	2	8.311	2	2.001	2	35.083	2	6.918	2	.936
Year of production (Year)	4	754.352***	4	409.669***	4	190.130***	4	424.066***	4	460.234***	2	28.299
Type x breed	1	2.983	1	33.231*	1	2.552	1	.293	1	.003	1	2.574
Type x postwn	1	6.600	1	5.434	1	56.108**	1	28.314*	1	17.163	1	6.727
Type x age	-	--	2	8.851	2	6.327	2	10.045	2	12.570	2	3.131
Type x year	4	95.368***	4	11.385	4	27.658	4	2.461	4	40.508	2	35.577
Breed x postwn	1	.209	1	2.000	1	.132	1	7.292	1	.000	1	3.497
Breed x age	-	--	2	2.282	2	7.220	2	9.480	2	5.254	2	.022
Breed x year	4	18.908	4	134.950***	4	58.809	4	54.830	4	11.041	2	19.116
Postwn x age	-	--	2	14.325	2	6.705	2	.968	2	5.915	2	51.839*
Postwn x year	4	23.587	4	17.029	4	7.565	4	3.231	4	76.430*	2	5.017
Age x year	-	--	8	79.686	8	94.798	8	45.538	8	120.072**	4	51.540
Error	152	6.043	286	6.311	295	8.328	240	6.474	215	5.633	111	6.183

*$P \leq .05$.
**$P \leq .001$.
***$P \leq .005$.

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

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	44.501	1	150.988	1	6.755	1	1962.216*	1	256.568	1	16.014
Ewe breed (Breed)	1	186.700	1	49.913	1	1223.813***	1	596.992	1	39.939	1	16.464
Postweaning nutrition (Postwn)	1	162.331	1	45.813	1	38.448	1	282.014	1	420.360*	1	94.793
Age of first breeding (Age)	-	---	2	170.467	2	37.236	2	3129.742*	2	195.960	2	62.190
Year of production (Year)	4	4617.494***	4	224871.276***	4	66066.548***	4	160847.155***	4	27871.763***	2	6225.884***
Lamb type of birth (Lamb)	1	15.013	1	395.304*	1	830.073***	1	379.025	1	56.906	1	6.151
Type x breed	1	157.997	1	13.346	1	.994	1	2032.707*	1	15.421	1	9.268
Type x postwn	1	87.169	1	363.919*	1	10.907	1	951.782	1	1.972	1	262.649
Type x age	-	---	2	.519	2	39.331	2	4434.801**	2	8.563	2	172.596
Type x year	4	170.432	4	369.548	4	66.947	4	6042.508**	4	95.985	2	16.054
Breed x postwn	1	50.112	1	2.351	1	274.842	1	30.424	1	64.529	1	137.401
Breed x age	-	---	2	203.591	2	139.869	2	2086.654	2	176.980	2	237.679
Breed x year	4	541.964	4	967.219*	4	317.011	4	5641.826*	4	347.856	2	262.687
Postwn x age	-	---	2	133.914	2	310.487	2	707.993	2	59.224	2	122.697
Postwn x year	4	371.689	4	877.306*	4	1063.789*	4	1572.308	4	120.915	2	564.574
Age x year	-	---	8	514.040	8	489.404	8	6355.237	8	532.708	4	157.801
Lamb x type	1	264.834	1	209.591	1	7.923	1	601.602	1	130.232	1	502.677*
Lamb x breed	1	.317	1	106.055	1	119.172	1	9.766	1	25.373	1	67.760
Lamb x postwn	1	1.310	1	.346	1	43.043	1	287.462	1	31.728	1	5.060
Lamb x age	-	---	2	162.811	2	208.519	2	1672.329	2	30.756	2	79.618
Lamb x year	4	28.970	4	267.314	4	1082.157*	4	329.052	4	601.059	2	54.026
Error	196	80.739	413	82.871	362	88.828	311	446.787	254	69.266	129	119.192

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 7. CHI-SQUARE ANALYSIS FOR NUMBER OF EWES CONCEIVING AT 7 MO OF AGE OF THOSE EXPOSED

	Parameter			
Item	Ewe type of birth	Ewe breed	Postweaning nutrition	Year of production
χ^2 value	.88	22.22***	3.75	22.87***
df	1	1	1	4

***P≤.05, χ^2 value = 7.88 and 14.90 for one and four degrees of freedom, respectively.

TABLE 8. CHI-SQUARE ANALYSIS FOR PERCENT EWES LAMBING OF THOSE EXPOSED

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	.88	22.22***	3.75	--	22.87***
24	6.58*	1.97	1.08	5.79	86.33***
36	11.87***	.85	1.56	1.48	32.01***
48	.03	.37	1.76	1.56	1.20
60	.09	.07	.98	.35	7.13
72	.00	.26	3.00	1.09	2.53
Overall	8.15***	15.18***	1.92	3.41[a]	34.94***
df	1	1	1	2	4

[a] Excluding 12-mo lambing.

*P≤.05, χ^2 value = 3.84 for one degree of freedom.

***P≤.005, χ^2 value = 7.88 and 14.90 for one and four degrees of freedom, respectively.

TABLE 9. CHI-SQUARE ANALYSIS FOR NUMBER OF LAMBS BORN PER EWE EXPOSED

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	3.62	34.84***	3.35	--	27.31***
24	7.38*	14.94***	1.10	12.09*	116.02***
36	13.00***	5.80	1.56	6.97	88.99***
48	1.34	1.39	3.49	2.10	33.31***
60	.39	3.41	1.02	2.23	10.30
72	1.29	.27	3.08	4.45	2.43
df	2	2	2	4	8

*P≤.05, χ^2 value = 5.99 and 9.49 for two and four degrees of freedom, respectively.

***P≤.005, χ^2 value = 10.60 and 22.00 for two and eight degrees of freedom, respectively.

TABLE 10. CHI-SQUARE ANALYSIS FOR NUMBER OF LAMBS BORN PER EWE LAMBING

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	2.10	14.87***	.00	--	4.41
24	.85	12.88***	.04	6.41*	32.09***
36	1.17	4.93*	.00	5.50	57.12***
48	1.29	1.01	1.71	.54	32.07***
60	.30	3.34	.04	1.88	3.19
72	1.32	.01	.09	4.28	3.06
df	1	1	1	2	4

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

***P≤.005, χ^2 value = 7.88 and 14.90 for one and four degrees of freedom, respectively.

TABLE 11. CHI-SQUARE ANALYSIS FOR NUMBER OF LAMBS WEANED PER EWE LAMBING

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	3.30	19.73***	8.84*	--	13.34
24	.79	14.42***	.67	13.49**	84.80***
36	4.61	8.57*	.45	7.67	60.61***
48	2.05	5.05	1.07	5.38	33.12***
60	2.83	19.10***	1.72	1.17	6.08
72	.19	.53	4.48	5.27	6.07
df	2	2	2	4	8

*P≤.05, χ^2 value = 5.99 for two degrees of freedom.
**P≤.01, χ^2 value = 9.49 for four degrees of freedom.
***P≤.005, χ^2 value = 10.60 and 22.00 for two and eight degrees of freedom, respectively.

TABLE 12. CHI-SQUARE ANALYSIS FOR NUMBER OF LAMBS WEANED PER EWE EXPOSED

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	3.70	32.20***	10.64***	--	22.33***
24	.68	15.60***	.17	13.29*	93.21***
36	2.36	8.69*	2.40	10.58*	49.77***
48	5.87	5.01	1.06	4.14	59.50***
60	2.80	19.20***	2.44	2.12	16.40*
72	.16	1.09	6.76*	7.57	5.98
df	2	2	2	4	8

*P≤.05, χ^2 value = 5.99 and 9.49 for two and four degrees of freedom, respectively.
***P≤.005, χ^2 value = 10.60 and 22.00 for two and eight degrees of freedom, respectively.

TABLE 13. LEAST-SQUARES ANALYSIS OF VARIANCE FOR KILOGRAMS OF LAMB WEANED PER EWE EXPOSED

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.199	1	11.873	1	980.424	1	33.873	1	158.363	1	5.115
Ewe breed (Breed)	1	1001.756***	1	529.599	1	2815.351***	1	378.732	1	583.576	1	30.435
Postweaning nutrition (Postwn)	1	369.413***	1	64.182	1	22.809	1	83.694	1	157.265	1	51.558
Age of first breeding (Age)	-	—	2	589.039	2	384.099	2	602.707	2	500.176	2	140.028
Year of production (Year)	4	1341.137***	4	3370.691*	4	4211.913*	4	8651.952***	4	1351.115	2	565.652
Lamb type of birth (Lamb)	2	14980.454***	2	21000.921***	2	54641.778***	2	81352.323***	2	62438.751***	2	37714.897***
Type x breed	1	35.965	1	929.797	1	28.121	1	243.057	1	336.480	1	495.163
Type x postwn	1	5.098	1	684.432	1	343.807	1	6.451	1	70.893	1	132.871
Type x age	-	—	2	340.597	2	1353.239	2	526.673	2	525.120	2	830.197
Type x year	4	154.007	4	191.293	4	1649.024	4	761.463	4	997.387	2	210.870
Breed x postwn	1	1.567	1	138.678	1	447.909	1	8.331	1	188.078	1	4017.639**
Breed x age	-	—	2	142.218	2	314.048	2	254.730	2	158.183	2	306.922
Breed x year	4	283.547	4	2196.780	4	2281.200	4	1128.935	4	1127.236	2	249.852
Postwn x age	-	—	2	1655.638	2	2143.653*	2	677.454	2	1290.875	2	1267.137
Postwn x year	4	556.419*	4	226.154	4	678.297	4	2011.173	4	618.562	2	167.340
Age x year	-	—	8	1537.456	8	2851.995	8	2942.179	8	8558.992*	4	4082.166
Lamb x type	2	364.851*	2	460.638	2	390.183	2	212.023	2	605.366	2	3689.301*
Lamb x breed	2	611.360***	2	1187.904	2	113.029	2	1937.507	2	1321.281	2	1825.644
Lamb x postwn	2	322.925*	2	5.548	2	120.815	2	354.663	2	992.179	2	201.581
Lamb x age	-	—	4	527.117	4	2505.503	4	625.584	4	292.438	4	2558.548
Lamb x year	8	977.417**	8	7374.933***	8	6996.505**	8	4403.989	8	3533.350	4	1297.926
Error	349	46.256	461	310.988	405	327.933	337	415.682	281	437.313	141	533.153

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 14. LEAST-SQUARES ANALYSIS OF VARIANCE FOR KILOGRAMS OF LAMB WEANED PER EWE LAMBING

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	6.818	1	.488	1	234.153	1	344.901	1	1084.804	1	60.767
Ewe breed (Breed)	1	758.607***	1	2093.151*	1	4859.245***	1	1830.411*	1	1662.126	1	215.107
Postweaning nutrition (Postwn)	1	273.411	1	68.189	1	17.392	1	6.378	1	55.553	1	268.597
Age of first breeding (Age)	-	---	2	1417.297	2	1695.763	2	1057.828	2	1090.635	2	118.159
Year of production (Year)	4	1509.398***	4	15618.341***	4	16682.889***	4	16594.282***	4	4386.507	2	255.138
Lamb type of birth (Lamb)	1	141.365	1	4977.435***	1	17383.043***	1	29857.176***	1	20782.424***	1	15409.435***
Type x breed	1	33.468	1	1114.682	1	18.240	1	297.013	1	475.891	1	514.716
Type x postwn	1	2.842	1	732.108	1	272.448	1	61.379	1	34.960	1	28.440
Type x age	-	—	2	456.119	2	1424.490	2	435.878	2	347.183	2	986.682
Type x year	4	219.890	4	246.066	4	1767.732	4	525.191	4	931.760	2	286.496
Breed x postwn	1	4.309	1	191.059	1	397.986	1	21.087	1	253.384	1	3962.741**
Breed x age	-	—	2	248.388	2	473.990	2	293.913	2	184.997	2	391.637
Breed x year	4	453.399	4	2281.381	4	2352.616	4	1435.145	4	1374.829	2	526.454
Postwn x age	-	—	2	1721.751	2	2905.463*	2	834.150	2	1468.894	2	1554.161
Postwn x year	4	894.743*	4	264.454	4	623.684	4	1959.710	4	710.953	2	89.330
Age x year	-	—	8	1740.606	8	3250.905	8	3280.818	8	9285.983*	4	4900.523
Lamb x type	1	398.340*	1	507.215	1	30.159	1	79.051	1	159.931	1	3643.915*
Lamb x breed	1	331.264*	1	1027.354	1	.988	1	1360.555	1	1032.450	1	1224.888
Lamb x postwn	1	22.058	1	6.911	1	27.656	1	248.604	1	771.943	1	231.141
Lamb x age	-	—	2	471.714	2	2464.843*	2	555.499	2	81.825	2	2519.164
Lamb x year	4	567.050	4	6153.093***	4	4185.335*	4	2655.220	4	1693.574	2	1048.347
Error	196	79.200	413	345.527	362	358.785	311	442.243	254	479.981	129	575.219

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 15. LEAST-SQUARES ANALYSIS OF VARIANCE FOR KILOGRAMS OF LAMB WEANED PER EWE WEANING A LAMB(S)

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.005	1	1.467	1	50.423	1	.003	1	245.340	1	227.413
Ewe breed (Breed)	1	720.827***	1	699.036*	1	3737.446***	1	3517.945***	1	2554.432***	1	678.196
Postweaning nutrition (Postwn)	1	.219	1	100.068	1	12.812	1	33.207	1	4.520	1	17.949
Age of first breeding (Age)	-	--	2	741.570	2	126.654	2	815.107	2	102.597	2	561.671
Year of production (Year)	4	679.524***	4	1588.264*	4	10265.479***	4	2071.367*	4	7101.679***	2	1229.415
Lamb type of birth (Lamb)	1	55.411	1	2750.684***	1	13681.817***	1	10368.679***	1	13980.980***	1	5285.128***
Type x breed	1	54.624	1	505.177*	1	.000	1	1042.878*	1	.008	1	.419
Type x postwn	1	8.840	1	6.471	1	455.161	1	70.320	1	451.114	1	154.977
Type x age	-	--	2	193.569	2	322.678	2	240.274	2	62.280	2	279.902
Type x year	4	111.644	4	99.180	4	988.653	4	396.382	4	349.315	2	435.622
Breed x postwn	1	8.117	1	9.969	1	49.099	1	75.773	1	5.859	1	643.720
Breed x age	-	--	2	94.995	2	29.852	2	214.252	2	98.955	2	87.575
Breed x year	4	164.878	4	391.490	4	2176.719**	4	435.407	4	1062.038	2	89.436
Postwn x age	-	--	2	220.484	2	1279.833*	2	330.647	2	10.738	2	259.700
Postwn x year	4	91.419	4	1405.905*	4	1034.434	4	580.567	4	262.849	2	1241.317
Age x year	-	--	8	493.051	8	1046.563	8	1240.671	8	2761.044	4	883.746
Lamb x type	1	155.631*	1	5.017	1	8.482	1	496.794	1	11.834	1	71.841
Lamb x breed	1	253.325***	1	391.119	1	85.681	1	664.678	1	978.203*	1	46.157
Lamb x postwn	1	.986	1	73.967	1	10.177	1	.372	1	254.444	1	2.712
Lamb x age	-	--	2	1339.715***	2	1509.460**	2	177.643	2	158.357	2	324.162
Lamb x year	4	192.896	4	1202.925*	4	1724.785*	4	2797.002*	4	319.443	2	194.881
Error	145	23.144	304	124.429	298	151.216	253	206.385	223	211.060	104	312.825

*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 16. LEAST-SQUARES ANALYSIS OF VARIANCE FOR AVERAGE WEANING WEIGHT (KG) PER EWE WEANING A LAMB(S)

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	16.472	1	12.560	1	34.758	1	3.762	1	5.913	1	8.171
Ewe breed (Breed)	1	25.942	1	14.023	1	517.908***	1	1003.597***	1	141.058*	1	240.854***
Postweaning nutrition (Postwn)	1	.004	1	3.811	1	.075	1	57.774	1	34.721	1	29.621
Age of first breeding (Age)	-	--	2	22.345	2	35.242	2	16.461	2	25.207	2	20.734
Year of production (Year)	4	170.622*	4	1430.202***	4	1420.958***	4	1202.894***	4	3237.190***	2	534.518***
Number of lambs weaned (Wean)	1	51.233*	1	246.216***	1	348.111***	1	979.159***	1	242.833***	1	180.535*
Sex of lamb (Sex)	1	54.735*	1	.494	1	44.669	1	10.094	1	30.471	1	.448
Type x breed	1	19.427	1	70.603	1	.832	1	169.362*	1	23.023	1	10.931
Type x postwn	1	.714	1	.055	1	.273	1	1.150	1	12.450	1	84.741
Type x age	-	--	2	.086	2	15.632	2	.796	2	25.885	2	18.970
Type x year	4	38.709	4	34.572	4	95.662	4	226.498	4	89.147	2	37.167
Breed x postwn	1	.128	1	14.368	1	4.380	1	3.109	1	49.545	1	85.904
Breed x age	-	--	2	33.486	2	.087	2	74.523	2	39.458	2	38.913
Breed x year	4	81.451	4	52.614	4	273.031*	4	217.498	4	78.756	2	11.735
Postwn x age	-	--	2	80.335	2	64.622	2	81.198	2	64.093	2	29.876
Postwn x year	4	19.640	4	194.799	4	101.550	4	122.006	4	153.459	2	180.201*
Age x year	-	--	8	92.560	8	538.543***	8	216.301	8	278.639	4	153.911
Wean x type	1	4.290	1	19.970	1	17.593	1	61.072	1	51.838	1	.223
Wean x breed	1	.054	1	17.502	1	23.336	1	55.967	1	.877	1	7.094
Wean x postwn	1	.475	1	2.008	1	2.495	1	4.075	1	20.842	1	130.515*
Wean x age	-	--	2	193.000*	2	111.248	2	49.401	2	234.984**	2	22.988
Wean x year	4	16.078	4	118.659	4	81.336	4	86.761	4	164.679	2	90.772
Sex x type	1	25.436	1	1.248	1	.749	1	4.377	1	18.263	1	2.618
Sex x breed	1	13.708	1	.174	1	12.989	1	21.057	1	1.499	1	19.550
Sex x postwn	1	13.587	1	9.275	1	.390	1	138.558*	1	6.658	1	20.274
Sex x age	-	--	2	85.968	2	353.370***	2	58.388	2	47.940	2	8.163
Sex x year	4	38.509	4	51.543	4	118.019	4	198.766	4	147.600	2	12.291
Sex x wean	1	24.652	1	5.552	1	97.348*	1	3.022	1	.111	1	34.007
Error	136	12.713	293	27.051	287	21.906	241	27.682	211	24.160	95	27.423

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 17. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE ENTERING THE STUDY

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.169	1	.022	1	.066	1	.487	1	1.907	1	5.649
Ewe breed (Breed)	1	9.511***	1	7.810***	1	16.794***	1	25.606**	1	37.132*	1	65.088***
Postweaning nutrition (Postwn)	1	1.304	1	.054	1	1.290	1	5.837	1	7.099	1	3.380
Age of first breeding (Age)	-	--	2	160.090***	2	157.416***	2	171.014***	2	194.508***	2	151.705***
Year of production (Year)	4	2.844	4	48.888***	4	112.072***	4	182.035***	4	178.761***	2	82.469*
Type x breed	1	.346	1	.449	1	1.387	1	2.900	1	4.897	1	3.699
Type x postwn	1	.079	1	.093	1	.001	1	1.021	1	1.855	1	2.295
Type x age	-	--	2	.158	2	1.194	2	.496	2	.497	2	8.453
Type x year	4	1.342	4	2.023	4	6.857	4	12.119	4	21.341	2	6.849
Breed x postwn	1	1.105	1	.019	1	.013	1	.115	1	2.050	1	3.824
Breed x age	-	--	2	.953	2	2.967	2	4.127	2	7.768	2	9.788
Breed x year	4	.710	4	5.865	4	4.140	4	13.421	4	28.049	2	12.605
Postwn x age	-	--	2	.285	2	3.685	2	11.371	2	27.023	2	82.327*
Postwn x year	4	3.238	4	2.620	4	2.892	4	14.366	4	15.724	2	7.246
Age x year	-	--	8	4.568	8	12.400	8	29.062	8	58.689	4	46.333
Error	563	.456	547	.620	547	1.670	547	3.592	547	6.398	359	9.620

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 18. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

	Age mo									
	24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.239	1	.007	1	1.081	1	2.968	1	6.278
Ewe breed (Breed)	1	4.283***	1	11.377**	1	18.794*	1	28.821*	1	58.022*
Postweaning nutrition (Postwn)	1	.025	1	.555	1	4.101	1	5.168	1	3.927
Age of first breeding (Age)	2	1.521	2	2.144	2	6.754	2	16.817	2	67.044*
Year of production (Year)	4	40.568***	4	97.568***	4	163.017***	4	159.946***	2	73.208*
Type x breed	1	.224	1	.962	1	2.269	1	4.065	1	3.344
Type x postwn	1	.211	1	.015	1	.733	1	1.458	1	1.520
Type x age	2	.114	2	1.022	2	.498	2	.620	2	8.395
Type x year	4	.480	4	3.740	4	7.270	4	14.875	2	3.500
Breed x postwn	1	.003	1	.039	1	.065	1	1.816	1	4.820
Breed x age	2	.777	2	.708	1	1.318	1	6.011	2	9.043
Breed x year	4	3.627	4	3.252	4	13.823	4	29.158	2	9.925
Postwn x age	2	.498	2	4.284	2	12.558	2	28.758	2	86.391*
Postwn x year	4	1.286	4	1.565	4	10.464	4	12.025	2	6.703
Age x year	8	2.661	8	10.150	8	25.873	8	54.717	4	39.679
Error	547	.489	547	1.532	547	3.403	547	6.168	359	9.408

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 19. LEAST-SQUARES ANALSYIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE PRESENT

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.313	1	.762	1	3.528	1	5.069	1	5.622	1	.823
Ewe breed (Breed)	1	9.568***	1	7.426***	1	16.633***	1	24.069***	1	36.553***	1	28.272***
Postweaning nutrition (Postwn)	1	1.363	1	.018	1	.009	1	.140	1	.198	1	.092
Age of first breeding (Age)	-	--	2	156.970***	2	150.691***	2	135.999***	2	153.129***	2	59.066***
Year of production (Year)	4	3.094	4	44.838***	4	95.820***	4	144.768***	4	110.885***	2	70.448***
Type x breed	1	.523	1	.374	1	.664	1	.453	1	.765	1	.062
Type x postwn	1	.095	1	.000	1	.081	1	.068	1	.693	1	3.563
Type x age	-	--	2	3.027*	2	7.985*	2	3.929	2	4.865	2	4.800
Type x year	4	1.412	4	1.074	4	3.505	4	4.257	4	11.490	2	3.524
Breed x postwn	1	.876	1	.215	1	.047	1	.124	1	.000	1	.484
Breed x age	-	--	2	.275	2	1.171	2	.034	2	1.210	2	4.921
Breed x year	4	.639	4	3.847	4	2.480	4	5.664	4	12.656	2	19.481
Postwn x age	-	--	2	.028	2	1.242	2	.676	2	.063	2	4.189
Postwn x year	4	3.211	4	1.824	4	.528	4	2.169	4	3.827	2	13.206
Age x year	-	--	8	4.990	8	9.371	8	23.676	8	32.796	4	16.729
Error	549	.460	482	.474	426	1.008	359	1.740	294	2.639	152	3.255

*$P \le .05$.
**$P \le .01$.
***$P \le .005$.

TABLE 20. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS BORN PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

	Age, mo									
	24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.141	1	2.174	1	3.276	1	3.386	1	.527
Ewe breed (Breed)	1	4.132***	1	11.374***	1	19.304***	1	30.823***	1	24.973**
Postweaning nutrition (Postwn)	1	.353	1	.201	1	.005	1	.341	1	.006
Age of first breeding (Age)	2	1.145	2	1.659	2	3.332	2	8.634	2	2.259
Year of production (Year)	4	39.439***	4	83.968***	4	129.048***	4	101.350***	2	64.835***
Type x breed	1	.080	1	.417	1	.222	1	.222	1	.205
Type x postwn	1	.000	1	.112	1	.032	1	.517	1	3.576
Type x age	2	2.487*	2	6.776*	2	2.969	2	3.264	2	4.171
Type x year	4	.377	4	2.797	4	2.522	4	8.299	2	3.447
Breed x postwn	1	.108	1	.009	1	.188	1	.000	1	.520
Breed x age	2	1.840	2	2.214	2	1.301	2	4.628	2	7.506
Breed x year	4	1.628	4	1.586	4	4.818	4	10.174	2	18.774
Postwn x age	2	.027	2	1.051	2	.950	2	.090	2	5.830
Postwn x year	4	1.084	4	1.377	4	3.217	4	4.216	2	9.767
Age x year	8	3.448	8	7.939	8	20.544	8	29.445	4	12.869
Error	482	.362	426	.868	359	1.558	294	2.453	152	3.198

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 21. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE ENTERING THE STUDY

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.007	1	.246	1	.569	1	.655	1	.879	1	2.272
Ewe breed (Breed)	1	4.904***	1	3.925**	1	10.010**	1	16.203*	1	30.182**	1	55.466***
Postweaning nutrition (Postwn)	1	2.226**	1	.966	1	3.948	1	7.716	1	12.902	1	14.530
Age of first breeding (Age)	-	---	2	74.542***	2	65.151***	2	75.777***	2	73.107***	2	46.905*
Year of production (Year)	4	1.593	4	43.370***	4	64.325***	4	128.669***	4	141.543***	2	31.718
Type x breed	1	.306	1	.701	1	2.063	1	2.857	1	5.168	1	12.735
Type x postwn	1	.092	1	.134	1	2.827	1	6.000	1	6.970	1	17.308
Type x age	-	---	2	.003	2	2.213	2	1.567	2	.127	2	2.506
Type x year	4	.494	4	1.276	4	3.323	4	5.714	4	9.531	2	2.905
Breed x postwn	1	.477	1	.041	1	.002	1	.279	1	2.479	1	4.316
Breed x age	-	---	2	1.622	2	2.382	2	4.285	2	5.730	2	10.240
Breed x year	4	.814	4	5.989*	4	4.323	4	12.602	4	21.962	2	3.342
Postwn x age	-	---	2	.217	2	2.688	2	5.000	2	7.190	2	23.755
Postwn x year	4	2.271	4	.817	4	1.241	4	5.626	4	5.549	2	1.367
Age x year	-	---	8	2.938	8	6.754	8	11.488	8	19.680	4	20.193
Error	563	.314	547	.535	547	1.286	547	2.568	547	4.382	359	6.301

*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 22. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

	Age, mo									
	24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.304	1	.657	1	.750	1	.987	1	2.458
Ewe breed (Breed)	1	1.830*	1	6.428*	1	11.538*	1	23.671*	1	49.572***
Postweaning nutrition (Postwn)	1	.011	1	1.231	1	3.610	1	7.367	1	10.854
Age of first breeding (Age)	2	1.994	2	1.324	2	1.803	2	4.693	2	21.664
Year of production (Year)	4	34.151***	4	51.211***	4	109.410***	4	123.164***	2	25.144
Type x breed	1	.256	1	1.221	1	1.846	1	3.770	1	9.563
Type x postwn	1	.123	1	2.778	1	5.928	2	.117	1	4.750
Type x age	2	.114	2	2.395	2	1.434	1	6.893	2	2.158
Type x year	4	.345	4	1.696	4	3.412	4	6.570	2	1.915
Breed x postwn	1	.075	1	.014	1	.359	1	2.707	1	4.184
Breed x age	2	.838	2	.217	2	.820	2	2.390	2	7.618
Breed x year	4	5.175**	4	3.370	4	11.433	4	21.656	2	1.697
Postwn x age	2	.207	2	.701	2	2.042	2	3.672	2	20.212
Postwn x year	4	.501	4	1.112	4	4.742	4	5.346	2	.338
Age x year	8	1.831	8	3.009	8	7.750	8	15.149	4	14.143
Error	547	.371	547	1.030	547	2.273	547	4.009	359	5.811

*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 23. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE PRESENT

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.030	1	.046	1	.677	1	3.835	1	7.167	1	.006
Ewe breed (Breed)	1	4.958***	1	3.858***	1	11.792***	1	15.442***	1	26.444***	1	22.705**
Postweaning nutrition (Postwn)	1	2.300**	1	.550	1	2.159	1	1.620	1	2.376	1	.707
Age of first breeding (Age)	-	--	2	80.142***	2	62.222***	2	86.919***	2	90.419***	2	44.709***
Year of production (Year)	4	1.627	4	36.821***	4	49.902***	4	113.388***	4	112.767***	2	27.180*
Type x breed	1	.430	1	.679	1	1.392	1	1.191	1	.823	1	.850
Type x postwn	1	.113	1	.453	1	2.972	1	2.820	1	3.100	1	9.749
Type x age	-	--	2	.820	2	3.354	2	2.017	2	2.539	2	3.542
Type x year	4	.514	4	1.365	4	4.198	4	6.109	4	8.853	2	9.870
Breed x postwn	1	.374	1	.235	1	.045	1	.064	1	.725	1	.514
Breed x age	-	--	2	1.173	2	.951	2	1.322	2	.985	2	.339
Breed x year	4	.707	4	5.675*	4	4.081	4	11.207	4	5.554	2	3.055
Postwn x age	-	--	2	.213	2	.114	2	.934	2	2.336	2	4.532
Postwn x year	4	2.319	4	.339	4	1.648	4	6.177	4	6.750	2	4.902
Age x year	-	--	8	3.908	8	7.215	8	12.125	8	29.972	4	20.266
Error	549	.318	482	.464	426	.986	359	1.680	294	2.528	152	2.965

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 24. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE NUMBER OF LAMBS WEANED PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

	Age, mo									
	24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.001	1	.337	1	2.990	1	5.546	1	.003
Ewe breed (Breed)	1	1.661*	1	7.446***	1	11.635**	1	22.573***	1	19.949**
Postweaning nutrition (Postwn)	1	.030	1	.428	1	.480	1	.950	1	.710
Age of first breeding	2	1.478	2	.346	2	3.671	2	6.164	2	1.008
Year of production (Year)	4	29.876***	4	40.859***	4	97.996***	4	103.042***	2	23.113*
Type x breed	1	.235	1	.936	1	.966	1	.315	1	.243
Type x postwn	1	.605	1	2.930	1	3.529	1	2.932	1	8.323
Type x age	2	1.111	2	3.598	2	2.100	2	1.649	2	2.906
Type x year	4	.374	4	2.565	4	4.716	4	8.592	2	10.690
Breed x postwn	1	.198	1	.088	1	.072	1	.973	1	.295
Breed x age	2	.844	2	1.212	2	.515	2	.670	2	.336
Breed x year	4	3.989*	4	2.816	4	8.024	4	4.134	2	2.325
Postwn x age	2	1.293	2	.315	2	1.632	2	3.626	2	3.961
Postwn x year	4	.823	4	2.409	4	6.233	4	6.857	2	2.366
Age x year	8	2.747	8	4.001	8	9.933	8	25.409	4	16.302
Error	482	.346	426	.792	359	1.486	294	2.299	152	2.899

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 25. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE ENTERING THE STUDY

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	15.724	1	266.309	1	546.112	1	828.856	1	679.753	1	1752.848
Ewe breed (Breed)	1	2417.687***	1	5999.786***	1	20461.352***	1	40504.515***	1	80644.686***	1	108831.720***
Postweaning nutrition (Postwn)	1	686.242**	1	554.331	1	3733.227	1	7041.977	1	10834.499	1	15683.157
Age of first breeding (Age)	-	--	2	22181.181***	2	14735.807**	2	24704.531*	2	26257.695	2	35590.122
Year of production (Year)	4	859.189	4	53523.700***	4	100189.916***	4	201465.282***	4	17403.103***	2	69783.742*
Type x breed	1	30.981	1	642.209	1	2388.406	1	2735.849	1	5100.606	1	13142.592
Type x postwn	1	98.931	1	239.466	1	3037.865	1	6922.980	1	9081.103	1	9953.109
Type x age	-	--	2	218.727	2	3520.229	2	1983.074	2	200.946	2	5941.510
Type x year	4	109.832	4	746.699	4	4019.244	4	7890.242	4	17251.893	2	7099.972
Breed x postwn	1	94.788	1	82.851	1	5.854	1	286.991	1	1801.509	1	4360.874
Breed x age	-	--	2	1073.654	2	1767.669	2	2968.773	2	4898.736	2	10861.562
Breed x year	4	441.742	4	4874.701	4	3324.659	4	14094.026	4	21930.891	2	7725.555
Postwn x age	-	--	2	104.971	2	3077.873	2	6983.061	2	13205.844	2	37922.430
Postwn x year	4	939.840	4	913.654	4	2265.041	4	9008.439	4	8261.289	2	890.717
Age x year	-	--	8	2521.599	8	3878.430	8	10553.230	8	19897.076	4	24323.120
Error	584	99.557	547	512.706	547	1387.063	547	3083.155	547	5561.061	359	8430.482

*$P \leq .05$.
**$P \leq .01$.
***$P \leq .005$.

TABLE 26. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE ENTERING THE STUDY (EXCLUDING 12-MO PRODUCTION)

Source	Age, mo									
	24		36		48		60		72	
	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	136.970	1	351.693	1	584.396	1	460.381	1	1422.018
Ewe breed (Breed)	1	3458.568**	1	15473.988***	1	33345.916***	1	70400.743***	1	100829.948***
Postweaning nutrition (Postwn)	1	28.953	1	1843.556	1	4323.457	1	7383.177	1	13704.424
Age of first breeding (Age)	2	2883.883*	2	4002.310	2	4177.809	2	11647.907	2	36723.799
Year of production (Year)	4	40420.893***	4	79584.444***	4	174406.996***	4	149607.555***	2	62166.977*
Type x breed	1	530.898	1	2168.830	1	2500.471	1	4777.284	1	12920.940
Type x postwen	1	307.088	1	3267.959	1	7268.191	1	9475.866	1	8392.205
Type x age	2	454.286	2	3768.010	2	1639.178	2	68.101	2	5148.902
Type x year	4	413.438	4	3166.236	4	6579.670	4	15389.612	2	6134.829
Breed x postwn	1	88.339	1	7.377	1	297.130	1	1826.779	1	4004.020
Breed x age	2	719.341	2	142.410	2	531.441	2	3051.656	2	8748.891
Breed x year	4	4830.426	4	2787.158	4	13206.052	4	21673.116	2	5793.711
Postwn x age	2	206.258	2	1626.587	2	4680.655	2	10026.767	2	34963.413
Postwn x year	4	644.009	4	1710.689	4	7540.043	4	7280.243	2	450.275
Age x year	8	1523.091	8	3293.856	8	9886.983	8	18273.950	4	21262.448
Error	547	449.495	547	1279.361	547	2944.030	547	5373.486	359	8106.044

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 27. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE PRESENT

Source	Age, mo 12		24		36		48		60		72	
	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	7.310	1	22.256	1	685.652	1	3329.265	1	7104.186	1	4.280
Ewe breed (Breed)	1	2369.298***	1	5965.313***	1	26039.590***	1	45665.216***	1	80455.091***	1	59950.395***
Postweaning nutrition (Postwn)	1	765.941**	1	192.759	1	1666.864	1	804.927	1	1008.060	1	9.211
Age of first breeding (Age)	-	--	2	25652.963***	2	15245.721***	2	35828.175***	2	36621.228***	2	19303.616
Year of production (Year)	4	735.746	4	47611.563***	4	89541.413***	4	182073.255***	4	135116.874***	2	68336.414***
Type x breed	1	49.883	1	623.591	1	1974.939	1	752.976	1	148.529	1	83.711
Type x postwn	1	99.454	1	841.082	1	2823.281	1	4019.770	1	4274.493	1	8100.290
Type x age	-	--	2	932.909	2	4866.921	2	1704.337	2	1459.236	2	4709.562
Type x year	4	114.573	4	776.611	4	5550.536	4	6807.296	4	18074.015	2	19239.801
Breed x postwn	1	77.129	1	283.442	1	35.957	1	5.786	1	50.796	1	2640.311
Breed x age	-	--	2	566.662	2	603.200	2	167.096	2	972.056	2	1549.703
Breed x year	4	403.300	4	3749.679	4	4598.304	4	16848.006	4	11239.783	2	12412.266
Postwn x age	-	--	2	619.831	2	274.775	2	1270.540	2	3720.550	2	8304.635
Postwn x year	4	859.523	4	942.700	4	2364.719	4	10118.347	4	11393.700	2	2482.552
Age x year	-	--	8	3432.727	8	8036.545	8	18284.671	8	40882.495	4	32950.964
Error	561	102.176	482	455.035	426	997.374	359	1914.206	294	3002.250	152	4096.054

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 28. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE KILOGRAMS OF LAMB WEANED PER EWE PRESENT (EXCLUDING 12-MO PRODUCTION)

	Age, mo									
	24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	60.738	1	791.718	1	3914.418	1	7513.531	1	1.491
Ewe breed (Breed)	1	3359.142***	1	20309.464***	1	39838.281***	1	72473.458***	1	55778.947***
Postweaning nutrition (Postwn)	1	21.297	1	635.571	1	293.736	1	483.991	1	.330
Age of first breeding (Age)	2	1880.635	2	2119.905	2	4842.802	2	4469.225	2	2270.811
Year of production (Year)	4	36680.781***	4	73970.470***	4	166312.858***	4	125296.652***	2	61151.267***
Type x breed	1	507.842	1	1864.625	1	775.295	1	87.221	1	51.391
Type x postwn	1	1005.932	1	2892.353	1	4391.387	1	3849.839	1	7764.402
Type x age	2	1740.330	2	5697.993*	2	2435.338	2	1573.548	2	3947.888
Type x year	4	355.832	4	4307.263	4	6085.813	4	17831.851	2	19358.823
Breed x postwn	1	231.543	1	40.447	1	.687	1	82.304	1	2306.227
Breed x age	2	790.332	2	1532.932	2	723.421	2	1959.980	2	1673.941
Breed x year	4	3356.686	4	3704.893	4	15283.663	4	9646.045	2	10402.459
Postwn x age	2	1414.034	2	234.934	2	1611.565	2	4224.986	2	7848.996
Postwn x year	4	1097.415	4	2610.491	4	9771.487	4	10413.664	2	1768.018
Age x year	8	2849.473	8	7449.886	8	18395.376	8	39236.539	4	32528.612
Error	482	413.578	426	926.003	359	1818.270	294	2877.194	152	4028.046

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 29. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ANNUAL FLEECE WEIGHT (KG)

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	4.090***	1	1.144	1	2.057*	1	.678	1	.081	1	1.144
Ewe breed (Breed)	1	10.476***	1	37.803***	1	29.702***	1	29.813***	1	26.737***	1	18.429***
Postweaning nutrition (Postwn)	1	6.167***	1	.878	1	3.309**	1	4.033**	1	.687	1	.169
Age of first breeding (Age)	2	19.432***	2	7.934***	2	.534	2	1.137	2	.025	2	.165
Year of production (Year)	4	25.555***	4	43.614***	4	66.941***	4	8.063**	4	89.997***	2	44.608***
Type x breed	1	.711	1	1.349	1	3.815***	1	4.943***	1	1.151	1	.012
Type x postwn	1	.013	1	.036	1	.129	1	.004	1	.035	1	.409
Type x age	2	.887	2	.586	2	1.535	2	.174	2	2.107	2	2.965
Type x year	4	.527	4	3.560	4	2.044	4	2.183	4	1.439	2	.992
Breed x postwn	1	.109	1	.002	1	.017	1	.574	1	.265	1	.270
Breed x age	2	1.853*	2	1.478	2	.212	2	1.915	2	1.118	2	.448
Breed x year	4	4.929***	4	5.229*	4	9.989***	4	16.835***	4	12.442***	2	.097
Postwn x age	2	.207	2	1.375	2	.437	2	3.499*	2	.290	2	.340
Postwn x year	4	.472	4	1.245	4	3.255	4	2.370	4	4.877	2	.293
Age x year	8	66.661***	8	32.419***	8	3.518	8	4.429	8	4.436	4	6.570*
Error	520	.283	465	.439	375	.425	345	.573	290	.522	155	.578

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 30. LEAST-SQUARES ANALYSIS OF VARIANCE FOR FLEECE WEIGHT (KG) FOR THOSE EWES LAMBING

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	.364	1	.714	1	1.736*	1	.024	1	.230	1	.948
Ewe breed (Breed)	1	3.684***	1	31.415***	1	24.730***	1	23.046***	1	17.125***	1	10.783***
Postweaning nutrition (Postwn)	1	.489	1	1.054	1	1.675*	1	2.659*	1	.203	1	.105
Age of first breeding (Age)	–	—	2	4.434***	2	.524	2	1.009	2	.255	2	.247
Year of production (Year)	4	26.332***	4	15.269***	4	50.989***	4	5.548*	4	68.829***	2	33.535***
Lamb type of birth (Lamb)	1	.008	1	.269	1	.002	1	.000	1	1.024	1	.922
Type x breed	1	.135	1	1.494	1	3.948***	1	3.843**	1	.931	1	.048
Type x postwn	1	.534	1	.110	1	.092	1	.005	1	.506	1	.095
Type x age	–	--	2	.470	2	1.651	2	.583	2	.487	2	3.804*
Type x year	4	.617	4	2.313	4	1.246	4	.893	4	1.643	2	1.418
Breed x postwn	1	.011	1	.315	1	.000	1	.540	1	.366	1	.638
Breed x age	–	--	2	1.328	2	.160	2	2.274	2	1.990	2	.282
Breed x year	4	4.578***	4	4.402*	4	10.362***	4	16.124***	4	10.411***	2	.441
Postwn x age	–	—	2	.578	2	.246	2	2.998	2	.017	2	.492
Postwn x year	4	1.076	4	1.908	4	1.759	4	2.974	4	5.792*	2	.329
Age x year	–	--	8	26.053***	8	3.310	8	3.085	8	3.666	4	7.135*
Lamb x type	1	.300	1	.188	1	.010	1	1.025	1	.448	1	.093
Lamb x breed	1	.183	1	.336	1	.524	1	1.006	1	.040	1	.032
Lamb x postwn	1	.080	1	.362	1	.000	1	.002	1	.095	1	.013
Lamb x age	–	--	2	.059	2	.271	2	1.336	2	.930	2	.521
Lamb x year	4	1.496	4	1.146	4	1.785	4	.405	4	.851	2	.130
Error	193	.195	407	.390	327	.433	300	.565	244	.518	127	.537

*P≤.05.
*P≤.01.
***P≤.005.

TABLE 31. LEAST-SQUARES ANALYSIS OF VARIANCE FOR ACCUMULATIVE FLEECE WEIGHT (KG) PER EWE ENTERING THE STUDY

	Age, mo											
	12		24		36		48		60		72	
Source	df	MS	df	MS	df	MS	df	MS	df	MS	df	MS
Ewe type of birth (Type)	1	8.813***	1	46.010***	1	95.412**	1	199.216**	1	239.716*	1	200.212
Ewe breed (Breed)	1	11.982***	1	92.288***	1	244.547***	1	388.692***	1	633.357***	1	210.492
Postweaning nutrition (Postwn)	1	11.474***	1	25.068*	1	88.862**	1	165.939*	1	208.134*	1	100.617
Age of first breeding (Age)	2	19.070***	2	66.298***	2	97.653*	2	147.558	2	239.969	2	465.922*
Year of production (Year)	4	14.896***	4	88.683***	4	766.972***	4	898.503***	4	1255.657***	2	644.515*
Type x breed	1	.220	1	9.272	1	47.675*	1	104.421*	1	184.651*	1	150.050
Type x postwn	1	.016	1	.015	1	4.778	1	17.603	1	39.333	1	133.353
Type x age	2	.040	2	6.981	2	21.415	2	30.569	2	14.454	2	39.289
Type x year	4	5.392	4	19.850	4	39.448	4	52.559	4	91.673	2	28.751
Breed x postwn	1	.617	1	.007	1	.339	1	1.310	1	10.324	1	34.091
Breed x age	2	2.648	2	1.534	2	6.556	2	6.787	2	3.846	2	53.397
Breed x year	4	3.163	4	28.189	4	44.945	4	140.686	4	283.867	2	116.602
Postwn x age	2	.163	2	7.440	2	19.212	2	56.411	2	186.260	2	493.548*
Postwn x year	4	2.129	4	9.396	4	34.538	4	80.706	4	132.953	2	6.164
Age x year	8	48.420***	8	76.370*	8	191.465*	8	369.499	8	413.459	4	477.284
Error	547	.780	547	4.457	547	12.242	547	25.429	547	46.675	359	76.786

*P≤.05.
**P≤.01.
***P≤.005.

TABLE 32. CHI-SQUARE ANALYSIS FOR PERCENT EWES REMAINING IN THE STUDY

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	14.70***	.09	.35	5.20	15.52***
24	6.56*	.16	.02	1.96	2.18
36	7.45**	.35	.01	1.21	4.04
48	.42	1.37	.36	.95	5.15
60	3.38	1.72	.28	3.76	27.86***
72	9.00***	1.00	.25	.50	.88
df	1	1	1	2	4

*$P \leq .05$, χ^2 value = 3.84 for one degree of freedom.

**$P \leq .01$, χ^2 value = 6.63 for one degree of freedom.

***$P \leq .005$, χ^2 value = 7.88 and 14.90 for one and four degrees of freedom, respectively.

TABLE 33. CHI-SQUARE ANALYSIS FOR SIGNIFICANT EWE DISPOSAL REASONS

	χ^2 value				
Age of ewe, mo	Ewe type of birth	Ewe breed	Post-weaning nutrition	Age of first breeding	Year of production
12	5.14[a] *			4.90[b] *	14.28[a] **
24					
36					13.77[a] **
48	4.92[a] *			5.58[a] *	21.62[a] ***
60			4.04[d] *		100.49[a] ***
72	5.18[a] *				
Overall		3.84[a] *			16.12[a] ***
		6.66[c] *			14.12[c] **
df	1	1	1	2	4

[a] Unknown causes.
[b] Vaginal prolapse.
[c] Bloat.
[d] Udder.
*$P \leq .05$, χ^2 value = 3.84 for one degree of freedom.
**$P \leq .01$, χ^2 value = 13.3 for four degrees of freedom.
***$P \leq .005$, χ^2 value = 14.9 for four degrees of freedom.

TABLE 34. LEAST-SQUARES MEANS AND STANDARD DEVIATIONS FOR SIGNIFICANT TWO-WAY INTERACTIONS

Breed x Year Interaction for Ewe Birth Date
Least-Squares Means (Days after January 1) = 63.8 (584)[a]

Year	Breed: Targhee	Breed: S x T[b]
1971	58.8 (48)	61.3 (62)
1972	64.0 (75)	63.5 (62)
1973	69.9 (72)	67.6 (67)
1974	62.8 (53)	59.6 (57)
1975	65.3 (48)	65.1 (40)

Standard deviation = 6.91

Type of Birth x Year Interaction for Ewe Weaning Weight
Least-Squares Means (kg) = 27.4 (585)

Year	Type of birth: Single	Type of birth: Multiple
1971	24.7 (59)	20.2 (51)
1972	35.2 (55)	27.6 (81)
1973	28.0 (33)	22.7 (106)
1974	34.6 (28)	28.5 (82)
1975	27.4 (38)	25.4 (52)

Standard deviation = 3.83

Breed x Year Interaction for Ewe Weaning Weight
Least-Squares Means (kg) = 27.4 (585)

Year	Breed: Targhee	Breed: S x T
1971	22.4 (48)	22.6 (62)
1972	30.4 (74)	32.5 (62)
1973	23.8 (72)	26.8 (67)
1974	29.3 (53)	33.8 (57)
1975	25.3 (49)	27.4 (41)

Standard deviation = 3.83

TABLE 34 CONTINUED

Breed x Year Interaction for 7-Mo Weight
Least-Squares Means (Kg) = 47.2 (586)

Year	Breed	
	Targhee	S x T
1971	40.3 (48)	41.0 (62)
1972	47.1 (75)	51.3 (62)
1973	47.8 (72)	55.0 (67)
1974	43.7 (53)	51.7 (57)
1975	45.0 (49)	49.3 (41)

Standard deviation = 6.98

Postweaning Nutrition x Year Interaction for 7-Mo Weight
Least-Squares Means (Kg) = 47.2 (586)

Year	Postweaning nutrition	
	High	Low
1971	41.8 (55)	39.5 (55)
1972	53.5 (69)	44.9 (68)
1973	52.3 (68)	50.5 (71)
1974	50.7 (56)	44.6 (54)
1975	50.7 (45)	43.6 (45)

Standard deviation = 6.98

Breed x Age of First Breeding Interaction for 7-Mo Weight
Least-Squares Means (Kg) = 47.2 (586)

Age of first breeding	Breed	
	Targhee	S x T
7 mo	46.4 (93)	49.3 (139)
19 mo	45.0 (101)	49.9 (97)
7 mo, open	42.8 (103)	49.7 (53)

Standard deviation = 6.98

TABLE 34 CONTINUED

Type of Birth x Age of First Breeding Interaction for 7-Mo Wither Height
Least-Squares Means (Cm) = 60.91 (586)

Age of first breeding	Type of birth: Single	Type of birth: Multiple
7 mo	62.8 (80)	60.2 (152)
19 mo	60.6 (74)	60.9 (124)
7 mo, open	62.1 (60)	58.8 (96)

Standard deviation = 6.24

Breed x Year Interaction for 7-Mo Weight:Wither Height Ratio
Least-Squares Means (Kg/cm) = .774 (581)

Year	Breed: Targhee	Breed: S x T
1971	.69 (47)	.73 (61)
1972	.74 (75)	.82 (62)
1973	.82 (70)	.92 (66)
1974	.70 (53)	.80 (57)
1975	.73 (49)	.80 (41)

Standard deviation = .08

Postweaning Nutrition x Year Interaction for 7-Mo Weight:Wither Height Ratio
Least-Squares Means (Kg/cm) = .774 (581)

Year	Postweaning nutrition: High	Postweaning nutrition: Low
1971	.73 (54)	.69 (54)
1972	.84 (69)	.72 (68)
1973	.86 (66)	.87 (70)
1974	.79 (56)	.71 (54)
1975	.82 (45)	.71 (45)

Standard deviation = .08

TABLE 34 CONTINUED

Breed x Year Interaction for 12-Mo Ewe Weight
Least-Squares Means (Kg) = 51.2 (553)

Year	Breed: Targhee	Breed: S x T
1972	41.2 (45)	43.5 (57)
1973	52.7 (72)	57.3 (57)
1974	48.5 (68)	52.9 (62)
1975	47.8 (51)	55.2 (54)
1976	53.3 (46)	59.6 (41)

Standard deviation = 5.77

Breed x Age of First Breeding Interaction for 12-Mo Ewe Weight
Least-Squares Means (Kg) = 51.2 (553)

Age of first breeding	Breed: Targhee	Breed: S x T
7 mo	47.6 (89)	50.6 (129)
19 mo	49.2 (98)	54.2 (94)
7 mo, open	49.3 (95)	56.4 (48)

Standard deviation = 5.77

Age of First Breeding x Year Interaction for 12-Mo Ewe Weight
Least-Squares Means (Kg) = 51.2 (553)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1972	39.6 (41)	43.7 (37)	43.8 (24)
1973	56.5 (47)	51.7 (46)	56.7 (36)
1974	50.4 (60)	50.7 (49)	51.0 (21)
1975	47.1 (50)	53.2 (29)	54.2 (26)
1976	51.6 (20)	59.2 (31)	58.6 (36)

Standard deviation = 5.77

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 24-Mo Ewe Weight
Least-Squares Means (Kg) = 66.6 (469)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1973	60.9 (35)	61.0 (33)	60.9 (22)
1974	70.2 (40)	66.4 (43)	69.7 (30)
1975	68.4 (49)	67.0 (36)	65.0 (19)
1976	64.4 (39)	68.4 (24)	67.5 (22)
1977	69.8 (16)	69.7 (26)	70.2 (35)

Standard deviation = 6.38

Age of First Breeding x Year Interaction for 60-Mo Ewe Weight
Least-Squares Means (Kg) = 72.2 (287)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1976	65.0 (22)	72.6 (22)	70.7 (13)
1977	76.0 (24)	74.9 (24)	75.7 (19)
1978	75.1 (36)	69.9 (31)	70.1 (10)
1979	75.9 (23)	74.2 (12)	78.7 (5)
1980	67.1 (11)	68.9 (15)	67.8 (20)

Standard deviation = 7.40

Age of First Breeding x Year Interaction for 72-Mo Ewe Weight
Least-Squares Means (Kg) = 71.5 (158)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1977	67.0 (18)	74.4 (20)	69.5 (12)
1978	73.9 (20)	70.4 (20)	76.3 (13)
1979	73.2 (24)	69.6 (25)	69.3 (6)

Standard deviation = 7.96

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 24-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 65.6 (325)

	Age of first breeding		
Year	7 mo	19 mo	7 mo, open
1973	56.7 (20)	59.8 (19)	60.6 (9)
1974	68.7 (32)	65.3 (36)	68.6 (20)
1975	67.6 (18)	66.5 (18)	63.1 (9)
1976	63.6 (34)	66.7 (21)	66.8 (18)
1977	69.3 (13)	69.7 (26)	70.3 (32)

Standard deviation = 5.93

Type of Birth x Postweaning Nutrition Interaction for 48-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 70.5 (281)

Postweaning	Type of birth	
nutrition	Single	Multiple
High	70.1 (54)	70.6 (89)
Moderate	72.3 (52)	69.1 (86)

Standard deviation = 5.93

Postweaning Nutrition x Year Interaction for 48-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 70.5 (281)

	Postweaning nutrition	
Year	High	Moderate
1975	67.3 (21)	63.4 (22)
1976	77.3 (35)	78.2 (32)
1977	74.2 (38)	76.4 (40)
1978	59.0 (21)	62.9 (22)
1979	74.1 (28)	72.7 (22)

Standard deviation = 5.93

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 48-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 70.5 (281)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1975	62.9 (20)	64.4 (15)	68.8 (8)
1976	78.3 (25)	76.1 (26)	78.8 (16)
1977	78.0 (34)	76.3 (31)	71.5 (13)
1978	60.6 (26)	60.3 (12)	62.0 (5)
1979	72.7 (13)	72.5 (19)	75.0 (18)

Standard deviation = 5.93

Age of First Breeding x Year Interaction for 60-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 71.6 (254)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1976	64.4 (21)	71.5 (20)	70.8 (13)
1977	74.8 (16)	74.4 (18)	73.1 (14)
1978	74.8 (32)	69.9 (29)	69.7 (10)
1979	75.0 (19)	74.4 (12)	77.5 (4)
1980	66.9 (11)	68.8 (15)	67.9 (20)

Standard deviation = 6.91

Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Weight of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 70.6 (138)

Age of first breeding	Postweaning nutrition: High	Moderate
7 mo	70.3 (35)	70.5 (21)
19 mo	72.7 (26)	68.5 (27)
7 mo, open	67.6 (14)	74.0 (15)

Standard deviation = 7.61

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 72-Mo Weight
of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Kg) = 70.6 (138)

Year	Age of first breeding		
	7 mo	19 mo	7 mo, open
1977	66.1 (15)	73.9 (14)	67.6 (10)
1978	72.0 (17)	68.5 (15)	76.4 (13)
1979	73.2 (24)	69.5 (24)	68.6 (6)

Standard deviation = 7.61

Age of First Breeding x Year Interaction for 12-Mo Month
Ewe Wither Height
Least-Squares Means (Cm) = 66.0 (552)

Year	Age of first breeding		
	7 mo	19 mo	7 mo, open
1972	61.5 (41)	62.5 (37)	62.8 (24)
1973	68.8 (46)	67.1 (46)	68.9 (36)
1974	65.6 (60)	66.0 (49)	66.1 (21)
1975	65.1 (50)	66.4 (29)	66.2 (26)
1976	67.2 (20)	67.5 (31)	67.8 (36)

Standard deviation = 2.42

Breed x Year Interaction for 24-Mo Ewe Wither Height
Least-Squares Means (Cm) = 66.4 (469)

Year	Breed	
	Targhee	S x T
1973	69.6 (41)	67.1 (49)
1974	69.4 (60)	66.1 (53)
1975	65.3 (53)	64.7 (51)
1976	65.6 (41)	64.6 (44)
1977	65.1 (44)	66.1 (33)

Standard deviation = 2.58

TABLE 34 CONTINUED

Type of Birth x Postweaning Nutrition Interaction for 36-Mo Wither Height
Least-Squares Means (Cm) = 67.1 (422)

Postweaning nutrition	Type of birth	
	Single	Multiple
High	66.9 (88)	67.4 (128)
Moderate	67.7 (78)	66.4 (128)

Standard deviation = 2.88

- -

Postweaning Nutrition x Year Interaction for 60-Mo Wither Height
Least-Squares Means (Cm) = 65.2 (287)

Year	Postweaning nutrition	
	High	Moderate
1976	66.4 (29)	66.0 (28)
1977	67.2 (35)	66.8 (32)
1978	64.8 (37)	66.5 (40)
1979	65.5 (20)	64.5 (20)
1980	62.5 (26)	62.0 (20)

Standard deviation = 2.41

- -

Age of First Breeding x Year Interaction for 60-Mo Wither Height
Least-Squares Means (Cm) = 65.2 (287)

Year	Age of first breeding		
	7 mo	19 mo	7 mo, open
1976	64.6 (22)	66.3 (22)	67.7 (13)
1977	67.4 (24)	66.6 (24)	66.8 (19)
1978	66.8 (36)	65.7 (31)	64.4 (10)
1979	65.8 (23)	64.2 (12)	65.1 (5)
1980	62.4 (11)	61.9 (15)	62.5 (20)

Standard deviation = 2.41

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TABLE 34 CONTINUED

Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Ewe Wither Height
Least-Squares Means (Cm) = 67.0 (158)

Age of first breeding	Postweaning nutrition	
	High	Moderate
7 mo	66.7 (37)	67.1 (25)
19 mo	67.2 (29)	66.6 (36)
7 mo, open	66.0 (15)	68.5 (16)

Standard deviation = 2.60

Type of Birth x Year Interaction for 12-Mo Wither Height of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 65.4 (175)

Year	Type of birth	
	Single	Multiple
1972	61.8 (17)	60.9 (11)
1973	69.2 (17)	68.3 (21)
1974	65.1 (11)	65.7 (39)
1975	64.4 (10)	65.5 (32)
1976	66.8 (7)	66.3 (10)

Standard deviation = 2.96

Type of Birth x Breed Interaction for 24-Mo Wither Height of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 66.3 (325)

Breed	Type of Birth	
	Single	Multiple
Targhee	67.5 (69)	66.4 (86)
S x T	65.4 (55)	65.7 (115)

Standard deviation = 2.51

TABLE 34 CONTINUED

Breed x Year Interaction for 24-Mo Wither Height of Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 66.3 (325)

Year	Breed: Targhee	Breed: S x T
1973	69.4 (18)	67.2 (30)
1974	68.8 (43)	65.9 (45)
1975	66.1 (19)	64.4 (26)
1976	65.4 (36)	64.6 (37)
1977	65.0 (39)	65.9 (32)

Standard deviation = 2.51

Type of Birth x Postweaning Nutrition Interaction for 36-Mo Wither Height for Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 67.0 (334)

Postweaning nutrition	Type of birth: Single	Type of birth: Multiple
High	66.6 (72)	67.3 (107)
Moderate	67.5 (55)	66.4 (100)

Standard deviation = 2.89

Type of Birth x Postweaning Nutrition Interaction for 48-Mo Wither Height for Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 67.0 (279)

Postweaning nutrition	Type of birth: Single	Type of birth: Multiple
High	66.9 (53)	67.2 (89)
Moderate	67.6 (51)	66.5 (86)

Standard deviation = 2.54

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 60-Mo Wither Height for Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 65.2 (254)

Year	Postweaning nutrition: High	Moderate
1976	66.4 (28)	65.9 (26)
1977	67.2 (27)	66.7 (21)
1978	64.7 (34)	66.5 (37)
1979	65.8 (17)	64.3 (18)
1980	62.4 (26)	62.0 (20)

Standard deviation = 2.37

Age of First Breeding x Year Interaction for 60-Mo Wither Height for Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 65.2 (254)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1976	64.5 (21)	66.1 (20)	67.8 (13)
1977	67.6 (16)	66.5 (18)	66.8 (14)
1978	66.6 (32)	65.8 (29)	64.3 (10)
1979	65.3 (19)	64.2 (12)	65.6 (4)
1980	62.3 (11)	61.9 (15)	62.5 (20)

Standard deviation = 2.37

Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Wither Height for Those Ewes Weaning a Lamb(s)
Least-Squares Means (Cm) = 66.8 (138)

Age of first breeding	Postweaning nutrition: High	Moderate
7 mo	66.8 (35)	66.8 (21)
19 mo	67.4 (26)	66.4 (27)
7 mo, open	65.4 (14)	68.1 (15)

Standard deviation = 2.49

TABLE 34 CONTINUED

Type of Birth x Postweaning Nutrition Interaction
for 24-Mo Lambing Date
Least-Squares Means (Days after January 1) = 99.6 (462)

Postweaning nutrition	Type of birth	
	Single	Multiple
High	100.3 (86)	99.7 (148)
Moderate	97.6 (84)	100.9 (144)

Standard deviation = 9.10

Breed x Year Interaction for 24-Mo Lambing Date
Least-Squares Means (Days after January 1) = 99.6 (462)

Year	Breed	
	Targhee	S x T
1973	107.1 (25)	112.6 (38)
1974	69.3 (62)	64.3 (55)
1975	125.1 (55)	122.6 (50)
1976	125.4 (43)	123.7 (49)
1977	73.2 (45)	72.9 (40)

Standard deviation = 9.10

Postweaning Nutrition x Year Interaction for 24-Mo Lambing Date
Least-Squares Means (Days after January 1) = 99.6 (462)

Year	Postweaning nutrition	
	High	Moderate
1973	107.6 (30)	112.0 (33)
1974	67.0 (58)	66.6 (59)
1975	124.0 (52)	123.7 (53)
1976	127.3 (48)	121.8 (44)
1977	74.0 (46)	72.1 (39)

Standard deviation = 9.10

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 36-Mo Lambing Date
Least-Squares Means (Days after January 1) = 93.2 (411)

Year	Postweaning nutrition	
	High	Moderate
1974	93.0 (33)	100.6 (30)
1975	78.1 (55)	76.8 (50)
1976	86.0 (51)	84.1 (49)
1977	126.0 (41)	128.0 (35)
1978	81.2 (35)	78.2 (32)

Standard deviation = 9.42

Type of Lamb Birth x Year Interaction for 36-Mo Lambing Date
Least-Squares Means (Days after January 1) = 93.2 (411)

Year	Type of lamb birth	
	Single	Multiple
1974	102.3 (45)	91.2 (18)
1975	77.8 (44)	77.1 (61)
1976	87.2 (37)	82.9 (63)
1977	127.6 (61)	126.4 (15)
1978	79.7 (22)	79.6 (45)

Standard deviation = 9.42

Type of Birth x Breed Interaction for 48-Mo Lambing Date
Least-Squares Means (Days after January 1) = 77.7 (360)

Breed	Type of birth	
	Single	Multiple
Targhee	76.3 (83)	76.1 (98)
S x T	84.8 (59)	73.8 (120)

Standard deviation = 21.14

TABLE 34 CONTINUED

Type of Birth x Year Interaction for 48-Mo Lambing Date
Least-Squares Means (Days after January 1) = 77.7 (360)

Year	Type of birth: Single	Multiple
1975	124.1 (41)	123.3 (29)
1976	61.8 (38)	40.6 (51)
1977	62.6 (23)	56.1 (64)
1978	76.8 (14)	73.3 (43)
1979	77.5 (26)	81.2 (31)

Standard deviation = 21.14

Breed x Year Interaction for 48-Mo Lambing Date
Least-Squares Means (Days after January 1) = 77.7 (360)

Year	Breed: Targhee	S x T
1975	124.6 (30)	122.9 (40)
1976	41.7 (44)	60.7 (45)
1977	60.2 (42)	58.5 (45)
1978	74.9 (28)	75.2 (29)
1979	79.4 (37)	79.3 (20)

Standard deviation = 21.14

Type of Birth x Age of First Breeding Interaction
for 48-Mo Lambing Date
Least-Squares Means (Days after January 1) = 77.7 (360)

Age of first breeding	Type of birth: Single	Multiple
7 mo	72.9 (56)	78.1 (92)
19 mo	76.7 (51)	71.4 (78)
7 mo, open	92.0 (35)	75.2 (48)

Standard deviation = 21.14

TABLE 34 CONTINUED

Type of Birth x Type of Lamb Birth Interaction for 72-Mo Lambing Date
Least-Squares Means (Days after January 1) = 69.6 (164)

Type of lamb birth	Type of birth: Single	Multiple
Single	66.9 (23)	72.6 (26)
Multiple	71.2 (43)	67.3 (72)

Standard deviation = 10.92

Postweaning Nutrition x Year Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 10.22 (388)

Year	Postweaning nutrition: High	Moderate
1972	8.2 (34)	3.9 (34)
1973	12.9 (44)	8.0 (43)
1974	8.6 (40)	9.9 (43)
1975	12.9 (47)	9.3 (41)
1976	14.4 (32)	14.1 (30)

Standard deviation = 6.80

Type of Birth x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 10.22 (388)

Type of lamb birth	Type of birth: Single	Multiple
None	.0 (63)	.0 (98)
Single	15.8 (62)	12.5 (102)
Multiple	15.0 (17)	18.2 (46)

Standard deviation = 6.80

TABLE 34 CONTINUED

Breed x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 10.22 (388)

Type of lamb birth	Breed Targhee	S x T
None	.0 (104)	.0 (57)
Single	12.7 (80)	15.6 (84)
Multiple	11.6 (13)	21.6 (50)

Standard deviation = 6.80

Postweaning Nutrition x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 10.22 (388)

Type of lamb birth	Postweaning nutrition High	Moderate
None	.0 (75)	.0 (86)
Single	15.6 (88)	12.7 (76)
Multiple	19.0 (34)	14.2 (29)

Standard deviation = 6.80

Type of Lamb Birth x Year Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 10.22 (388)

	Type of lamb birth		
Year	None	Single	Multiple
1972	.0 (26)	9.8 (34)	8.8 (8)
1973	.0 (37)	13.1 (31)	18.1 (19)
1974	.0 (21)	14.0 (45)	14.2 (17)
1975	.0 (36)	16.8 (39)	16.3 (13)
1976	.0 (41)	17.1 (15)	25.7 (6)

Standard deviation = 6.80

TABLE 34 CONTINUED

Type of Lamb Birth x Year Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 21.22 (520)

	Type of lamb birth		
Year	None	Single	Multiple
1973	.0 (37)	23.5 (55)	29.7 (8)
1974	.0 (7)	30.7 (58)	33.5 (59)
1975	.0 (8)	19.3 (77)	21.0 (28)
1976	.0 (3)	29.0 (52)	52.2 (40)
1977	.0 (3)	33.7 (50)	43.2 (35)

Standard deviation = 17.63

Type of Lamb Birth x Year Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 27.02 (464)

	Type of lamb birth		
Year	None	Single	Multiple
1974	.0 (24)	24.4 (45)	47.2 (18)
1975	.0 (7)	27.8 (44)	34.5 (61)
1976	.0 (6)	38.4 (37)	58.8 (63)
1977	.0 (7)	29.8 (61)	38.0 (15)
1978	.0 (9)	37.0 (22)	59.8 (45)

Standard deviation = 18.11

Postweaning Nutrition x Age of First Breeding Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 27.02 (464)

	Postweaning nutrition	
Age of first breeding	High	Moderate
7 mo	28.0 (103)	22.3 (79)
19 mo	26.3 (80)	27.5 (81)
7 mo, open	25.9 (55)	32.2 (66)

Standard deviation = 18.11

TABLE 34 CONTINUED

Age of First Breeding x Year Interaaction for 60-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 29.01 (340)

Year	Age of first breeding 7 mo	19 mo	7 mo, open
1976	33.2 (26)	28.4 (28)	34.3 (16)
1977	37.6 (31)	28.1 (30)	33.9 (19)
1978	23.0 (39)	32.2 (33)	32.9 (15)
1979	25.4 (29)	41.9 (15)	3.1 (7)
1980	28.2 (12)	26.2 (19)	26.6 (21)

Standard deviation = 20.91

Breed x Postweaning Nutrition Interaction for 72-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 27.48 (184)

Postweaning nutrition	Breed Targhee	S x T
High	34.8 (41)	22.1 (50)
Moderate	22.1 (47)	31.0 (46)

Standard deviation = 23.09

Type of Birth x Type of Lamb Birth Interaction for 72-Mo Kilograms of Lamb Weaned Per Ewe Exposed
Least-Squares Means (Kg) = 27.48 (184)

Type of lamb birth	Type of birth Single	Multiple
None	.0 (7)	.0 (13)
Single	24.0 (23)	35.2 (26)
Multiple	63.3 (43)	49.6 (72)

Standard deviation = 23.09

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 15.71 (227)

Year	Postweaning nutrition: High	Moderate
1972	12.7 (23)	6.4 (19)
1973	19.6 (26)	11.5 (24)
1974	13.1 (30)	13.9 (32)
1975	18.6 (28)	12.3 (24)
1976	21.8 (15)	25.9 (6)

Standard deviation = 8.90

Type of Birth x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 15.71 (227)

Type of lamb birth	Type of birth: Single	Multiple
Single	16.0 (62)	12.5 (102)
Multiple	14.6 (17)	19.2 (46)

Standard deviation = 8.90

Breed x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 15.71 (227)

Type of lamb birth	Breed: Targhee	S x T
Single	13.0 (80)	15.5 (84)
Multiple	12.3 (13)	21.6 (50)

Standard deviation = 8.90

TABLE 34 CONTINUED

Type of Lamb Birth x Year Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 31.51 (462)

Year	Type of lamb birth: Single	Type of lamb birth: Multiple
1973	23.4 (55)	29.5 (8)
1974	30.7 (58)	33.5 (59)
1975	19.1 (77)	20.7 (28)
1976	29.1 (52)	52.2 (40)
1977	33.6 (50)	43.2 (35)

Standard deviation = 18.59

Type of Lamb Birth x Year Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 39.73 (411)

Year	Type of lamb birth: Single	Type of lamb birth: Multiple
1974	24.5 (45)	47.9 (18)
1975	28.1 (44)	34.6 (61)
1976	39.1 (37)	58.8 (63)
1977	29.7 (61)	37.7 (15)
1978	37.2 (22)	59.6 (45)

Standard deviation = 18.94

Postweaning Nutrition x Age of First Breeding Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 39.73 (411)

Age of first breeding	Postweaning nutrition: High	Postweaning nutrition: Moderate
7 mo	41.0 (92)	32.6 (66)
19 mo	38.8 (72)	40.0 (70)
7 mo, open	40.1 (51)	45.9 (60)

Standard deviation = 18.94

TABLE 34 CONTINUED

Type of Lamb Birth x Age of First Breeding Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 39.73 (411)

Age of first breeding	Type of lamb birth: Single	Multiple
7 mo	27.7 (70)	45.9 (88)
19 mo	35.3 (74)	43.5 (68)
7 mo, open	32.2 (65)	53.7 (46)

Standard deviation = 18.94

Age of First Breeding x Year Interaction for 60-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 44.50 (303)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1976	47.2 (25)	44.7 (26)	50.6 (16)
1977	55.1 (24)	47.0 (29)	52.9 (14)
1978	35.5 (35)	47.8 (29)	49.4 (12)
1979	41.3 (27)	63.7 (10)	22.2 (7)
1980	36.6 (12)	36.7 (17)	37.0 (20)

Standard deviation = 21.91

Breed x Postweaning Nutrition Interaction for 72-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 43.01 (164)

Postweaning nutrition	Breed: Targhee	S x T
High	48.5 (34)	41.1 (50)
Moderate	34.1 (42)	48.2 (38)

Standard deviation = 23.98

TABLE 34 CONTINUED

Type of Birth x Type of Lamb Birth Interaction for 72-Mo Kilograms of Lamb Weaned Per Ewe Lambing
Least-Squares Means (Kg) = 43.01 (164)

Type of lamb birth	Type of birth: Single	Multiple
Single	23.6 (23)	34.9 (26)
Multiple	64.0 (43)	49.3 (72)

Standard deviation = 23.98

Type of Birth x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 19.75 (176)

Type of lamb birth	Type of birth: Single	Multiple
Single	20.2 (48)	17.4 (74)
Multiple	19.3 (14)	22.2 (40)

Standard deviation = 4.81

Breed x Type of Lamb Birth Interaction for 12-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 19.75 (176)

Type of lamb birth	Breed: Targhee	S x T
Single	17.2 (60)	20.4 (62)
Multiple	15.7 (11)	25.8 (43)

Standard deviation = 4.81

Type of Birth x Breed Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 40.73 (353)

Breed	Type of birth: Single	Multiple
Targhee	40.3 (75)	37.7 (92)
S x T	41.0 (58)	44.0 (128)

Standard deviation = 11.15

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 40.73 (353)

Year	Postweaning nutrition: High	Postweaning nutrition: Moderate
1973	37.3 (23)	35.8 (26)
1974	40.7 (46)	41.7 (45)
1975	40.4 (26)	41.6 (24)
1976	41.0 (45)	49.9 (36)
1977	41.1 (43)	37.9 (39)

Standard deviation = 11.15

Type of Lamb Birth x Year Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 40.73 (353)

Year	Type of lamb birth: Single	Type of lamb birth: Multiple
1973	30.8 (43)	42.3 (6)
1974	38.6 (45)	43.9 (46)
1975	41.2 (35)	40.8 (15)
1976	39.3 (41)	51.6 (40)
1977	35.1 (47)	43.9 (35)

Standard deviation = 11.15

Type of Lamb Birth x Age of First Breeding Interaction for 24-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 40.73 (353)

Age of first breeding	Type of lamb birth: Single	Type of lamb birth: Multiple
7 mo	35.9 (70)	49.7 (57)
19 mo	38.5 (77)	44.0 (54)
7 mo, open	36.6 (64)	39.7 (31)

Standard deviation = 11.15

TABLE 34 CONTINUED

Breed x Year Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Year	Breed: Targhee	Breed: S x T
1974	38.6 (23)	41.0 (29)
1975	37.8 (42)	37.8 (41)
1976	43.4 (48)	56.9 (45)
1977	35.8 (25)	45.6 (33)
1978	47.8 (36)	60.3 (25)

Standard deviation = 12.30

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Type of Lamb Birth x Year Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Year	Type of lamb birth: Single	Type of lamb birth: Multiple
1974	30.4 (35)	49.3 (17)
1975	32.9 (35)	42.7 (48)
1976	41.4 (33)	58.9 (60)
1977	36.7 (46)	44.7 (12)
1978	43.2 (19)	64.9 (42)

Standard deviation = 12.30

- -

Postweaning Nutrition x Age of First Breeding Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Age of first breeding	Postweaning nutrition: High	Postweaning nutrition: Moderate
7 mo	47.1 (77)	42.2 (53)
19 mo	43.5 (63)	43.7 (60)
7 mo, open	42.3 (44)	48.3 (50)

Standard deviation = 12.30

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TABLE 34 CONTINUED

Type of Lamb Birth x Age of First Breeding Interaction for 36-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Age of first breeding	Type of lamb birth	
	Single	Multiple
7 mo	34.8 (54)	54.5 (76)
19 mo	39.2 (63)	48.0 (60)
7 mo, open	36.7 (51)	53.8 (43)

Standard deviation = 12.30

Type of Birth x Breed Interaction for 48-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Breed	Type of birth	
	Single	Multiple
Targhee	43.7 (69)	48.0 (84)
S x T	56.9 (47)	52.6 (102)

Standard deviation = 12.30

Type of Lamb Birth x Year for 48-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 44.49 (347)

Year	Type of lamb birth	
	Single	Multiple
1975	41.6 (29)	51.4 (18)
1976	42.0 (23)	62.5 (56)
1977	41.1 (20)	58.4 (63)
1978	45.2 (11)	47.2 (29)
1979	42.5 (14)	70.9 (39)

Standard deviation = 12.30

TABLE 34 CONTINUED

Breed x Type of Lamb Birth Interaction for 60-Mo Kilograms of Lamb Weaned Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 51.49 (272)

Type of lamb birth	Breed: Targhee	Breed: S x T
Single	39.1 (43)	43.2 (31)
Multiple	54.3 (90)	69.4 (108)

Standard deviation = 14.53

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Number of Lambs Weaned x Age of First Breeding Interaction for 24-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 34.10 (353)

Age of first breeding	Number of lambs weaned: One	Number of lambs weaned: Two
7 mo	35.4 (95)	32.2 (32)
19 mo	37.2 (109)	30.1 (22)
7 mo, open	35.5 (87)	34.3 (8)

Standard deviation = 5.20

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Breed x Year Interaction for 36-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 34.36 (347)

Year	Breed: Targhee	Breed: S x T
1974	30.1 (22)	31.3 (28)
1975	31.9 (42)	32.0 (41)
1976	34.5 (48)	39.5 (45)
1977	31.9 (26)	36.8 (34)
1978	35.5 (36)	40.1 (25)

Standard deviation = 4.68

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TABLE 34 CONTINUED

Number of Lambs Weaned x Sex of Lamb Interaction for 36-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 34.36 (347)

Sex of lamb	Number of lambs weaned: One	Two
Female	34.7 (116)	33.0 (63)
Male	37.2 (122)	32.6 (46)

Standard deviation = 4.68

Postweaning Nutrition x Age of First Breeding Interaction for 36-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 34.36 (347)

Age of first breeding	Postweaning nutrition: High	Moderate
7 mo	34.3 (77)	33.2 (54)
19 mo	34.7 (64)	34.6 (59)
7 mo, open	34.0 (44)	35.4 (49)

Standard deviation = 4.68

Sex of Lamb x Age of First Breeding Interaction for 36-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 34.36 (347)

Age of first breeding	Sex of lamb: Female	Male
7 mo	34.4 (68)	33.1 (63)
19 mo	32.8 (65)	36.5 (58)
7 mo, open	34.4 (46)	34.9 (47)

Standard deviation = 4.68

TABLE 34 CONTINUED

Type of Birth x Breed Interaction for 48-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 37.94 (301)

Breed	Type of birth: Single	Type of birth: Multiple
Targhee	34.4 (70)	36.6 (84)
S x T	41.1 (46)	39.6 (101)

Standard deviation = 5.26

Postweaning Nutrition x Sex of Lamb for 48-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 37.94 (301)

Sex of lamb	Postweaning nutrition: Single	Postweaning nutrition: Multiple
Female	37.9 (82)	37.5 (71)
Male	36.9 (68)	39.5 (80)

Standard deviation = 5.26

Number of Lambs Weaned x Age of First Breeding Interaction for 60-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 37.25 (271)

Age of first breeding	Number of lambs weaned: One	Number of lambs weaned: Two
7 mo	40.2 (50)	34.4 (58)
19 mo	38.7 (50)	36.9 (51)
7 mo, open	36.7 (28)	36.6 (34)

Standard deviation = 4.82

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 72-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 37.95 (139)

Year	Postweaning nutrition	
	High	Moderate
1977	34.1 (24)	34.5 (18)
1978	37.4 (24)	42.4 (19)
1979	40.7 (28)	38.8 (26)

Standard deviation = 5.24

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Postweaning Nutrition x Number of Lambs Weaned Interaction for 72-Mo Average Lamb Weaning Weight Per Ewe Weaning a Lamb(s)
Least-Squares Means (Kg) = 37.95 (139)

Number of lambs weaned	Postweaning nutrition	
	High	Moderate
One	37.7 (45)	41.3 (31)
Two	37.2 (31)	35.9 (32)

Standard deviation = 5.24

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Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Accumulative Number of Lambs Born Per Ewe Entering the Study
Least-Squares Means = 5.12 (386)

Age of first breeding	Postweaning nutrition	
	High	Moderate
7 mo	6.4 (83)	5.4 (76)
19 mo	4.8 (69)	5.8 (69)
7 mo, open	4.5 (40)	3.8 (49)

Standard deviation = 3.10

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TABLE 34 CONTINUED

Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Accumulative Number of Lambs Born Per Ewe Entering the Study (Excluding 12-Mo Production)
Least-Squares Means = 4.71 (386)

Age of first breeding	Postweaning nutrition	
	High	Moderate
7 mo	5.2 (83)	4.2 (76)
19 mo	4.8 (69)	5.8 (69)
7 mo, open	4.5 (40)	3.8 (49)

Standard deviation = 3.07

Type of Birth x Age of First Breeding Interaction for 24-Mo Accumulative Number of Lambs Born Per Ewe Present
Least-Squares Means = 1.65 (521)

Age of first breeding	Type of birth	
	Single	Multiple
7 mo	2.4 (76)	2.6 (123)
19 mo	1.3 (67)	1.2 (115)
7 mo, open	1.1 (59)	1.2 (81)

Standard deviation = .69

Type of Birth x Age of First Breeding Interaction for 36-Mo Accumulative Number of Lambs Born Per Ewe Present
Least-Squares Means = 2.98 (465)

Age of first breeding	Type of birth	
	Single	Multiple
7 mo	3.6 (68)	4.2 (112)
19 mo	2.6 (62)	2.6 (101)
7 mo, open	2.5 (50)	2.5 (72)

Standard deviation = 1.00

TABLE 34 CONTINUED

Type of Birth x Age of First Breeding Interaction for 36-Mo Accumulative Number of Lambs Born Per Ewe Present (Excluding 12-Mo Production)
Least-Squares Means = 2.58 (465)

Age of first breeding	Type of birth	
	Single	Multiple
7 mo	2.4 (68)	2.9 (112)
19 mo	2.6 (62)	2.6 (101)
7 mo, open	2.5 (50)	2.5 (72)

Standard deviation = .93

Breed x Year Interaction for 24-Mo Accumulative Number of Lambs Weaned Per Ewe Entering the Study
Least-Squares Means = 1.02 (586)

Year	Breed	
	Targhee	S x T
1973	.6 (48)	.7 (62)
1974	.9 (75)	1.3 (62)
1975	.6 (72)	.7 (67)
1976	1.3 (53)	1.1 (57)
1977	1.2 (49)	1.7 (41)

Standard deviation = .73

Breed x Year Interaction for 24-Mo Accumulative Number of Lambs Weaned Per Ewe Entering the Study (Excluding 12-Mo Production)
Least-Squares Means = .74 (586)

Year	Breed	
	Targhee	S x T
1973	.4 (48)	.5 (62)
1974	.6 (75)	.9 (62)
1975	.3 (72)	.4 (67)
1976	1.0 (53)	.8 (57)
1977	.9 (49)	1.3 (41)

Standard deviation = .61

TABLE 34 CONTINUED

Breed x Year Interaction for 24-Mo Accumulative Number of Lambs Weaned Per Ewe Present
Least-Squares Means = 1.11 (521)

	Breed	
Year	Targhee	S x T
1973	.7 (46)	.8 (54)
1974	1.0 (68)	1.4 (55)
1975	.6 (58)	.8 (56)
1976	1.5 (47)	1.2 (49)
1977	1.3 (47)	1.7 (41)

Standard deviation = .68

Breed x Year Interaction for 24-Mo Accumulative Number of Lambs Weaned Per Ewe Present (Excluding 12-Mo Production)
Least-Squares Means = .81 (521)

	Breed	
Year	Targhee	S x T
1973	.5 (46)	.6 (54)
1974	.7 (68)	1.0 (55)
1975	.4 (58)	.5 (56)
1976	1.2 (47)	1.0 (49)
1977	1.0 (47)	1.3 (41)

Standard deviation = .59

Type of Birth x Age of First Breeding for 36-Mo Accumulative Kilograms of Lamb Weaned Per Ewe Present (Excluding 12-Mo Production)
Least-Squares Means (Kg) = 63.74 (465)

Age of first breeding	Type of birth	
	Single	Multiple
7 mo	55.3 (68)	68.6 (112)
19 mo	65.9 (62)	68.0 (101)
7 mo, open	65.6 (50)	59.0 (72)

Standard deviation = 30.43

TABLE 34 CONTINUED

Breed x Year Interaction for 12-Mo Fleece Weight
Least-Squares Means (Kg) = 3.22 (559)

Year	Breed: Targhee	Breed: S x T
1972	3.8 (46)	3.4 (59)
1973	3.1 (73)	3.1 (56)
1974	3.6 (65)	3.0 (62)
1975	3.3 (53)	3.0 (56)
1976	3.0 (48)	2.8 (41)

Standard deviation = .53

Breed x Age of First Breeding Interaction for 12-Mo Fleece Weight
Least-Squares Means (Kg) = 3.22 (559)

Age of first breeding	Breed: Targhee	Breed: S x T
7 mo	3.3 (91)	2.8 (133)
19 mo	3.6 (98)	3.4 (92)
7 mo, open	3.2 (96)	3.0 (49)

Standard deviation = .53

Age of First Breeding x Year Interaction for 12-Mo Fleece Weight
Least-Squares Means (Kg) = 3.22 (559)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1972	3.5 (42)	3.7 (37)	3.6 (26)
1973	2.4 (50)	4.3 (43)	2.6 (36)
1974	3.3 (59)	3.5 (49)	3.2 (19)
1975	3.1 (52)	3.2 (30)	3.2 (27)
1976	2.9 (21)	2.8 (31)	2.9 (37)

Standard deviation = .53

TABLE 34 CONTINUED

Breed x Year Interaction for 24-Mo Fleece Weight
Least-Squares Means (Kg) = 4.59 (405)

Year	Breed: Targhee	Breed: S x T
1973	4.3 (44)	3.8 (53)
1974	5.2 (67)	4.6 (56)
1975	4.9 (55)	4.0 (50)
1976	5.1 (44)	4.3 (48)
1977	4.9 (47)	4.7 (40)

Standard deviation = .66

Age of First Breeding x Year Interaction for 24-Mo Fleece Weight
Least-Squares Means (Kg) = 4.59 (504)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1973	3.7 (37)	4.3 (35)	4.1 (25)
1974	5.1 (41)	4.3 (46)	5.3 (36)
1975	4.5 (47)	4.5 (39)	4.4 (19)
1976	4.4 (42)	4.8 (27)	5.0 (23)
1977	4.4 (18)	4.9 (31)	5.1 (38)

Standard deviation = .66

Type of Birth x Breed Interaction for 36-Mo Fleece Weight
Least-Squares Means (Kg) = 4.33 (414)

Breed	Type of birth: Single	Multiple
Targhee	4.8 (91)	4.5 (119)
S x T	4.0 (60)	4.0 (144)

Standard deviation = .65

TABLE 34 CONTINUED

Breed x Year Interaction for 36-Mo Fleece Weight
Least-Squares Means (Kg) = 4.33 (414)

Year	Breed: Targhee	Breed: S x T
1974	4.0 (15)	3.9 (24)
1975	5.2 (58)	4.1 (54)
1976	4.4 (52)	3.4 (52)
1977	4.3 (40)	3.6 (43)
1978	5.3 (45)	5.0 (31)

Standard deviation = .65

Type of Birth x Breed Interaction for 48-Mo Fleece Weight
Least-Squares Means (Kg) = 4.33 (384)

Breed	Type of birth: Single	Type of birth: Multiple
Targhee	4.8 (89)	4.5 (105)
S x T	3.9 (63)	4.1 (127)

Standard deviation = .76

Breed x Year Interaction for 48-Mo Fleece Weight
Least-Squares Means (Kg) = 4.33 (384)

Year	Breed: Targhee	Breed: S x T
1975	4.3 (31)	4.2 (44)
1976	4.8 (45)	3.9 (45)
1977	5.1 (45)	4.1 (48)
1978	4.6 (32)	3.4 (30)
1979	4.4 (41)	4.5 (23)

Standard deviation = .76

TABLE 34 CONTINUED

Postweaning Nutrition x Age of First Breeding Interaction for 48-Mo Fleece Weight
Least-Squares Means (Kg) = 4.33 (384)

Age of first breeding	Postweaning nutrition: High	Moderate
7 mo	4.3 (93)	4.2 (64)
19 mo	4.4 (64)	4.4 (70)
7 mo, open	4.6 (38)	4.1 (55)

Standard deviation = .76

Breed x Year Interaction for 60-Mo Fleece Weight
Least-Squares Means (Kg) = 4.73 (329)

Year	Breed: Targhee	S x T
1976	4.1 (28)	3.8 (41)
1977	5.6 (36)	4.7 (41)
1978	5.5 (41)	4.2 (46)
1979	4.6 (25)	3.5 (25)
1980	5.7 (32)	5.6 (14)

Standard deviation = .72

Age of First Breeding x Year Interaction for 72-Mo Fleece Weight
Least-Squares Means (Kg) = 4.69 (182)

Year	Age of first breeding: 7 mo	19 mo	7 mo, open
1977	4.6 (20)	4.8 (22)	4.2 (13)
1978	5.2 (20)	5.2 (25)	5.9 (16)
1979	4.1 (28)	4.0 (28)	4.2 (10)

Standard deviation = .76

TABLE 34 CONTINUED

Breed x Year Interaction for 12-Mo Fleece Weight
for Those Ewes Lambing
Least-Squares Means (Kg) = 3.05 (224)

Year	Breed: Targhee	S x T
1972	4.1 (14)	3.3 (28)
1973	2.4 (22)	2.4 (28)
1974	3.6 (28)	2.9 (31)
1975	3.3 (19)	2.8 (33)
1976	2.9 (9)	2.8 (12)

Standard deviation = .44

Breed x Year Interaction for 24-Mo Fleece Weight
for Those Ewes Lambing
Least-Squares Means (Kg) = 4.60 (456)

Year	Breed: Targhee	S x T
1973	4.5 (23)	3.8 (37)
1974	5.2 (61)	4.6 (55)
1975	4.9 (55)	4.0 (50)
1976	5.1 (42)	4.3 (48)
1977	4.9 (45)	4.7 (40)

Standard deviation = .62

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 24-Mo Fleece Weight
for Those Ewes Lambing
Least-Squares Means (Kg) = 4.60 (456)

	Age of first breeding		
Year	7 mo	19 mo	7 mo, open
1973	3.9 (21)	4.0 (26)	4.2 (13)
1974	5.1 (41)	4.3 (45)	5.3 (30)
1975	4.5 (47)	4.4 (39)	4.4 (19)
1976	4.4 (41)	4.8 (26)	4.9 (23)
1977	4.4 (18)	4.9 (31)	5.1 (36)

Standard deviation = .62

Type of Birth x Breed Interaction for 36-Mo Fleece Weight
for Those Ewes Lambing
Least-Squares Means (Kg) = 4.34 (376)

	Type of birth	
Breed	Single	Multiple
Targhee	4.9 (78)	4.5 (110)
S x T	4.0 (49)	4.0 (139)

Standard deviation = .66

Postweaning Nutrition x Year Interaction for 36-Mo Fleece Weight
for Those Ewes Lambing
Least-Squares Means (Kg) = 4.34 (376)

	Postweaning nutrition	
Year	High	Moderate
1974	4.1 (16)	3.8 (14)
1975	4.6 (55)	4.7 (50)
1976	4.0 (49)	3.9 (49)
1977	4.2 (41)	3.9 (35)
1978	5.3 (35)	5.0 (32)

Standard deviation = .66

TABLE 34 CONTINUED

Type of Birth x Breed Interaction for 48-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.31 (349)

Breed	Type of birth: Single	Type of birth: Multiple
Targhee	4.8 (80)	4.5 (95)
S x T	3.9 (57)	4.1 (117)

Standard deviation = .75

Breed x Year Interaction for 48-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.31 (349)

Year	Breed: Targhee	Breed: S x T
1975	4.2 (28)	4.2 (40)
1976	4.9 (42)	3.8 (43)
1977	5.0 (41)	4.0 (44)
1978	4.5 (28)	3.5 (27)
1979	4.5 (36)	4.5 (20)

Standard deviation = .75

Breed x Year Interaction for 60-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.79 (293)

Year	Breed: Targhee	Breed: S x T
1976	4.2 (27)	3.8 (39)
1977	5.6 (29)	4.7 (36)
1978	5.5 (36)	4.3 (40)
1979	4.7 (21)	3.6 (22)
1980	5.8 (30)	5.8 (13)

Standard deviation = .72

TABLE 34 CONTINUED

Postweaning Nutrition x Year Interaction for 60-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.79 (293)

Year	Postweaning nutrition High	Postweaning nutrition Moderate
1976	4.0 (33)	3.9 (33)
1977	5.0 (35)	5.3 (30)
1978	4.9 (38)	4.9 (38)
1979	4.0 (20)	4.2 (23)
1980	6.2 (23)	5.4 (20)

Standard deviation = .72

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Type of Birth x Age of First Breeding Interaction for 72-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.67 (162)

Age of first breeding	Type of birth Single	Type of birth Multiple
7 mo	4.5 (26)	4.8 (36)
19 mo	4.7 (27)	4.6 (41)
7 mo, open	5.1 (12)	4.4 (20)

Standard deviation = .73

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Age of First Breeding x Year Interaction for 72-Mo Fleece Weight for Those Ewes Lambing
Least-Squares Means (Kg) = 4.67 (162)

Year	Age of first breeding 7 mo	19 mo	7 mo, open
1977	4.7 (18)	4.8 (18)	4.1 (13)
1978	5.2 (19)	5.2 (23)	6.1 (11)
1979	4.0 (25)	4.0 (27)	4.1 (8)

Standard deviation = .73

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TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 12-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 3.09 (586)

	Age of first breeding		
Year	7 mo	19 mo	7 mo, open
1972	3.3 (45)	3.5 (37)	3.4 (26)
1973	2.4 (52)	3.8 (49)	2.6 (36)
1974	3.2 (62)	3.4 (50)	2.3 (27)
1975	3.1 (52)	3.2 (30)	3.1 (28)
1976	3.0 (21)	3.0 (30)	3.0 (39)

Standard deviation = .88

Age of First Breeding x Year Interaction for 24-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 7.10 (586)

	Age of first breeding		
Year	7 mo	19 mo	7 mo, open
1973	6.4 (45)	7.4 (39)	7.1 (26)
1974	6.4 (52)	7.8 (49)	7.8 (36)
1975	6.7 (62)	6.9 (50)	5.4 (27)
1976	6.8 (52)	7.5 (30)	7.2 (28)
1977	7.0 (21)	8.0 (30)	8.0 (39)

Standard deviation = 2.11

Type of Birth x Breed Interaction for 36-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) 10.12 (586)

	Type of birth	
Breed	Single	Multiple
Targhee	11.6 (124)	10.1 (173)
S x T	9.5 (90)	9.3 (199)

Standard deviation = 3.50

TABLE 34 CONTINUED

Age of First Breeding x Year Interaction for 36-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 10.12 (586)

Year	Age of first breeding 7 mo	19 mo	7 mo, open
1974	7.6 (45)	8.9 (39)	8.6 (26)
1975	10.1 (52)	11.6 (49)	11.9 (36)
1976	9.8 (62)	9.9 (50)	7.8 (27)
1977	9.6 (52)	10.8 (30)	10.1 (28)
1978	10.6 (21)	11.8 (30)	12.8 (39)

Standard deviation = 3.50

Type of Birth x Breed Interaction for 48-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 12.94 (586)

Breed	Type of birth Single	Multiple
Targhee	15.0 (124)	12.7 (173)
S x T	12.2 (90)	11.8 (199)

Standard deviation = 5.04

Type of Birth x Breed Interaction for 60-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 15.44 (586)

Breed	Type of birth Single	Multiple
Targhee	17.9 (124)	15.2 (173)
S x T	14.4 (90)	14.2 (199)

Standard deviation = 6.83

TABLE 34 CONTINUED

Postweaning Nutrition x Age of First Breeding Interaction for 72-Mo Accumulative Fleece Weight Per Ewe Entering the Study
Least-Squares Means (Kg) = 17.36 (386)

Age of first breeding	Postweaning nutrition	
	High	Moderate
7 mo	17.6 (83)	15.7 (76)
19 mo	17.9 (69)	20.0 (69)
7 mo, open	18.2 (40)	14.7 (49)

Standard deviation = 8.76

[a] Number in parenthesis = number of observations.
[b] S x T = Suffolf x Targhee.